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Foreword

Informatics and Cybernetics (communication and control) are having an increasing impact on societies and in the globalization process that is integrating them. Societies are trying to regulate this impact, and adapt it to their respective cultural infra-structures. Societies and cultures are in reciprocal co-adaptations with Information and Communication Technologies. Synergic relationships might emerge in this co-adaptation process by means of positive and negative feedback loops, as well as feedforward ones. This would make the whole larger than the sum of its parts, generating emergent properties in the parts involved as well as in the whole coming forth. The academic, private, and public sectors are integrating their activities; multi-disciplinary groups and inter-disciplinary teams are being formed, and collaborative research and development projects are being organized in order to facilitate and adequately orient the design and implementation of the feedback and the feedforward loops, so the synergic relationships are socially positive and personally human.

One of the main purposes of The International Conference on Society and Information Technologies (ICSIT 2010) and The International Conference on Education, Training and Informatics (ICETI 2010) is to bring together academics, professionals, and managers from the private and the public sectors, so they can share ideas, results of research, and innovative services or products, in a multi-disciplinary and multi-sector forum.

Educational technologies, socio-economic organizations, and socio-political processes are essential domains among those involved in the evolving co-adaptation and co-transformation between societies and cultures on the one hand, and between informatics and cybernetics (communication and control) on the other hand.

ICSIT 2010 and ICETI 2010 are related to each other and, as a whole, are producing or might produce synergic relationships with Information and Communication Technologies. This is why the Organizing Committees of both of them have the purpose of combining their efforts in a way that would lead to the organization of an adequate joint event, where academics, researchers, consultants, professionals, innovators, and practitioners from the three areas might relate and interact with each other in the same event. These types of interaction might generate possibilities of cross-fertilization and analogical thinking, as well as possibilities of new working hypothesis, ideas, and reflections on the impact, significance, and usefulness of Informatics and Cybernetics in important dimensions of educational, socio-political, and socio-economical processes, services, and products.

On behalf of the Organizing Committees, I extend our heartfelt thanks to:

1. the 85 members of the Program Committees (66 members of the ICETI 2010's PC and 19 members of ICSIT 2010's PC) from 20 countries;

2. the 284 additional reviewers, from 65 countries, for their **double-blind peer reviews**;
3. the 304 reviewers, from 56 countries, for their efforts in making the **non-blind peer reviews**. (Some reviewers supported both: non-blind and double-blind reviewing for different submissions)

A total of 1395 reviews made by 507 reviewers (who made at least one review) contributed to the quality achieved in ICSIT 2010 and ICETI 2010. This means an average of 6.20 reviews per submission (225 submissions were received). Each registered author had access, via the conference web site, to the reviews that recommended the acceptance of their respective submissions. Each registered author could get information about: 1) the average of the reviewers evaluations according to 8 criteria, and the average of a global evaluation of his/her submission; and 2) the comments and the constructive feedback made by the reviewers, who recommended the acceptance of his/her submission, so the author would be able to improve the final version of the paper.

In the organizational process of ICSIT 2010 and ICETI 2010, about 225 papers/abstracts were submitted. These conference proceedings include about 94 papers that were accepted for presentation. The submissions were reviewed as carefully as time permitted; it is expected that most of them will appear in a more polished and complete form in scientific journals.

This information about ICSIT 2010 (including ICETI 2010) is summarized in the following table, along with the other collocated conferences:

Conference	# of submissions received	# of reviewers that made at least one review	# of reviews made	Average of reviews per reviewer	Average of reviews per submission	# of papers included in the proceedings	% of submissions included in the proceedings
IMCIC 2010	426	1161	2286	1.97	5.37	171	**40.14%**
ICEME 2010	236	494	1139	2.31	4.83	49	**20.76%**
ICSIT 2010	225	507	1395	2.75	6.20	94	**41.78%**
TOTAL	**887**	**2162**	**4820**	**2.23**	**5.43**	**314**	**35.40%**

We extend our gratitude to the co-editors of these proceedings, for the hard work, energy and eagerness they shown preparing their respective sessions. We express our intense gratitude to Professor William Lesso for his wise and opportune tutoring, for his eternal energy, integrity, and continuous support and advice, as the Program Committee Chair of past conferences, organized by the International Institute of Informatics and Systemics, and as Honorary President of ICSIT/ICETI 2010, as well as for being a very caring old friend and intellectual father to many of us. We also extend our gratitude to Professor Belkis Sánchez, who brilliantly managed the organizing process.

We also extend our gratefulness to Professor Friedrich Welsch for chairing the Program Committees of ICSIT/ICETI 2010; to Professor Jorge Baralt for his General Co-Chairmanship; to Professors José Ferrer and Belkis Sánchez for co-charing ICETI 2010's Organization Committee; and to Professor Angel Oropeza and José Vicente Carrasquero

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Professor Federico Welsh
ICSIT/ICETI 2010 Program Committee Co-Chair

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ICSIT/ICETI 2010 General Co-Chairs

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Developing A Pilot Multimedia Tool For Transportation Engineering Education

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ABSTRACT

In this paper, the development of a pilot project that utilizes new Multimedia technologies in teaching engineering concepts for undergraduate students is presented. A transportation engineering courseware is being developed over four years. It aims to enhance the students learning capabilities using state-of-the-art technologies. A model is developed in a way that permits the students to use the course material through a university local network and later on through the Internet. Course materials are presented using different media types such as: text, still pictures, graphs, animations, sound, and video clips. They are integrated to provide a new way of delivering course material. The system uses different navigation tools to increase the level of student interaction. Preliminary testing and evaluation were performed. They showed positive impact on teaching the course.

The project was funded by the UNESCO through a regional program to upgrade science and engineering education in southern Mediterranean. An-Najah National University was selected to develop such a courseware. The procedures and templates designed in this model could be used for the preparation of other engineering courses.

Keywords: Transportation, Multimedia, Engineering, Education, Software.

1. INTRODUCTION

Recent advancements in science and engineering university education have revolved around the introduction of computing and networking technologies, as well as the application, modification or production of interactive and multimedia technologies. Adopting such technologies in teaching results in teaching methods which are described as multifaceted (with more than a single modality) and flexible. This is considered of great assistance to facilitate productive learning and to overcome a number of education-related difficulties, such as the mismatch between teaching and students learning styles (*i.e.*, how information is perceived, organized, processed and understood).

Currently, multimedia and computer networking technologies have limited utilization in engineering departments and faculties. However, the training of faculty members and the development of appropriate courseware, associated with the emergence of inexpensive computer and networking technologies and mass storage media, would bridge the gap. There is a great need to upgrade the efficiency and quality of teaching programs using such technologies in order to educate and graduate engineers who, at the one hand, are well trained and highly qualified and capable of utilizing the latest technological computing tools, and, on the other, know exactly their society developmental needs and objectives.

2. SIGNIFICANCE AND OBJECTIVES

The main purpose of the project is focused on the development of a pilot course in engineering design, considering the model of transportation engineering, using advanced computer, multimedia, and networking technologies. It aims to enhance the students learning capabilities using state of the art technologies. To facilitate achieving this aim, the courseware is being designed in a way that permits the students to use the course material through the university local network and later on through the Internet.

The use of interactive and multimedia technologies in teaching facilitates the know-how

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transfer and it will improve the learning process for the students, since it provides for both self and interactive teaching. Such an opportunity enhances the students understanding of the study material especially where there are no enough teaching assistants, as in the case of most local universities. Moreover, for some students, it provides a supplementary learning environment free of the psychological influences associated with the classical in-class teaching.

The specific objectives of the project include:

1. Enhancing students' learning capabilities and training them utilizing state-of-the-art multimedia technology and advanced interactive computing tools with especially tailored engineering design courseware, considering transportation engineering as a model topic.
2. Developing Computer Aided Instructions (CAI) for the courses to be developed which encourage interactions among students and with the instructors or experts in the field.
3. Facilitating authoring of multimedia courseware and facilitating the interaction with existing software through developing proper computing interfaces.
4. Developing a web-based courseware, including both static web contents and dynamic, interactive web contents.
5. Facilitate building custom applications for the already available software and multimedia technologies through proper interfacing and modifications in order to suite local needs, including the introduction of transportation-related data, maps photos, aerial photographs, video clips and other sources of information.
6. Exploiting the capabilities of multimedia and computing technologies in engineering design in general, and the model topics of transportation engineering at specific, to other Universities.

3. METHODOLOGY AND RATIONALE

The methodological approach followed in the development of the multimedia courseware includes a description of the course, trends in engineering design courses, aspects of the developed learning tool, the software utilized, training provided and the plan of investigation. The outcome of the approach led to the arrival at a fully interactive multimedia learning tool that covers a broad range of transportation engineering disciplines.

Description of Course: The main course considered as the target of investigation and improvement is Transportation Engineering, with basic extensions of the approach to two other related subsequent courses: Highway Engineering and Traffic Engineering, Transportation Engineering is a basic and compulsory course for all civil engineering students at the undergraduate level. Most universities follow the same or a similar structure of the series of transportation engineering course.

Current teaching methods in these courses follow mainly the traditional style of in-class lectures and instructions supplemented by practical design and lab sessions and in some cases utilizing the available educational software.

Transportation Engineering courses in the undergraduate programs consist mainly of an introductory course, a highway engineering course, and a traffic engineering course. The introductory course presents a conceptual framework for transportation planning and engineering, and the types and elements of transportation systems. The course also introduces the various transport systems with concentration on their characteristics, general design considerations, design of main elements and main operational characteristics.

The developed course is intended to serve as a basic general introductory course in transportation engineering presenting the above topics. This is mainly done to fit the requirements for almost all undergraduate programs. Other specialized courses are recommended in the field of both highway and traffic engineering. Those courses concatenate on the geometric design of roadways, structural design of roadways, and analysis and design of highway operational analysis.

New Trends in Engineering Design Courses: Although a number of engineering design web-based courses have been developed especially in

American and European universities, a review of literature or authored multimedia did not indicate that a comprehensive transportation engineering course has been developed. Most of the developed courses, which utilize advanced multimedia and networking technologies applications, concentrate on very basic courses such as mechanics of materials, statics, dynamics and engineering drawing.

Aspects of the Learning Tool: The major aspects of the learning tool, which developed for the courseware, include:

- Designing the main and secondary homepages.
- Provision of the syllabus and course calendar.
- Design and provision of static lecture contents, including text, solved sample problems, reference materials, still pictures, motion pictures (animation), sound, and movies.
- Design and provision of computer aided instruction, and dynamic/interactive instructions and assignments.
- Design and provision of interfacing with available educational software in the engineering design and analysis of transportation system.
- Design and provision of necessary help menus.
- Design and provision of mail instructions.

Software: The approach utilized professional software intended for authoring static and interactive web-based courseware. The methodological approach paid attention to the integration of various multimedia aspects into the learning package; such as projected video images, animation, sound, and full motion video.

The professional multimedia authoring software utilized in this course includes:

- A general purpose editor such as Word for Windows for text and equations
- A drawing software , such as Freehand
- A photo editor , such as Photoshop
- A sound editor , such as Sound Forge
- An animation software, such as Flash and Extreme
- A video editor , such as Premier
- A simulation software , such as Director

4. APPLICATION AND COURSEWARE DEVELOPMENT

The application of the methodological approach indicated above towards developing the courseware is presented here. The application is illustrated in terms of activities, application structure, multimedia materials utilized, template design, and implementation plan to develop the courseware.

Activities: The application is developed by combining simple and controlling activities. Simple activities have one start point and one end point, but controlling activities have one starting point and multiple end pointes. An example of simple activities is viewing the contents of one section in one of the chapters. Controlling activities are used in the main menus of chapters and to navigate between various sections and chapters.

Application Structures: Four types of application structures were used in the development: linear presentation, hierarchical menu, hypermedia, and simulation. The learning tool has several examples that utilize these types of structures and hence increase the level of student interaction. Each of these structures is presented briefly below.

- **Linear presentations:** A useful linear presentation needs to have some control points such as the ability to go forward or backward in the presentation, or the option to simply quit the presentation. In the following example shown in Figure 1, the user can explore the contents of the project chapter by chapter, section by section, or page by page. An iconic representation of the forward and backward is chosen from the transportation environment, namely the small cars and traffic signs.

- **Hierarchical menus**: A linear activity displays the menu and then a controlling activity receives the user's selection. The result of the selection could go directly to another presentation activity or it might go to another menu level. In Figure 2 below the

student can go directly from the pull down menu to any of the chapters or sections in the project. Only simplified menus were setup in the project.

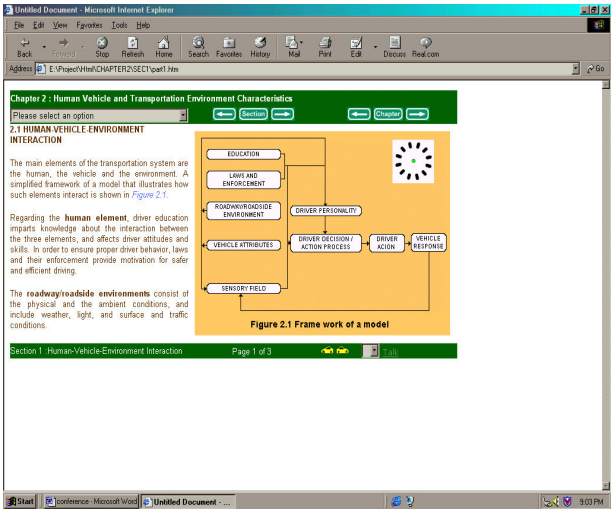

Figure 1: Navigation through the page

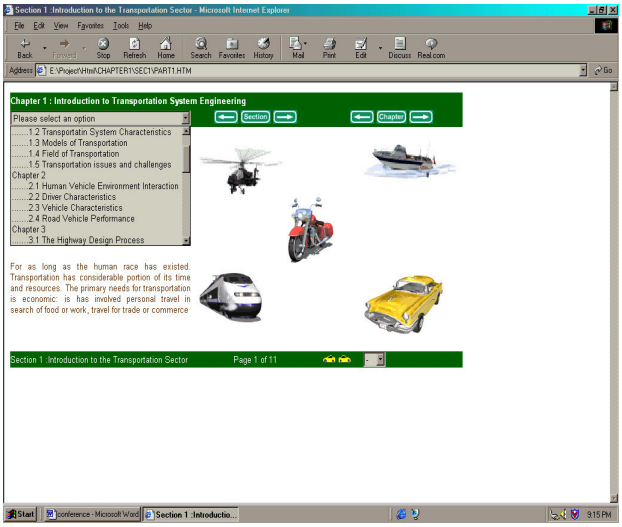

Figure 2: Pull down menu

- **Hypermedia**: The user is allowed to make direct selection to hot words or hot images in the presented information. If the user needs additional information about such a word or image, then he can simply click on it and the information is displayed. In the example shown in Figure 3 the user can seek more information regarding the figure presented elsewhere in the presentation by clicking on the hot word *Figure 3.6*. Upon clicking on this hot word the control of the browser is transferred to the page containing the desired figure as shown below.
- **Simulation**: Real transportation system concepts are simulated throughout the project. They simplify understanding of the concepts by the students using animation. For example, the concept of stopping sight distance which is the minimum sight distance a driver needs to stop the vehicle after seeing an object on the roadway without colliding with it is simulated.

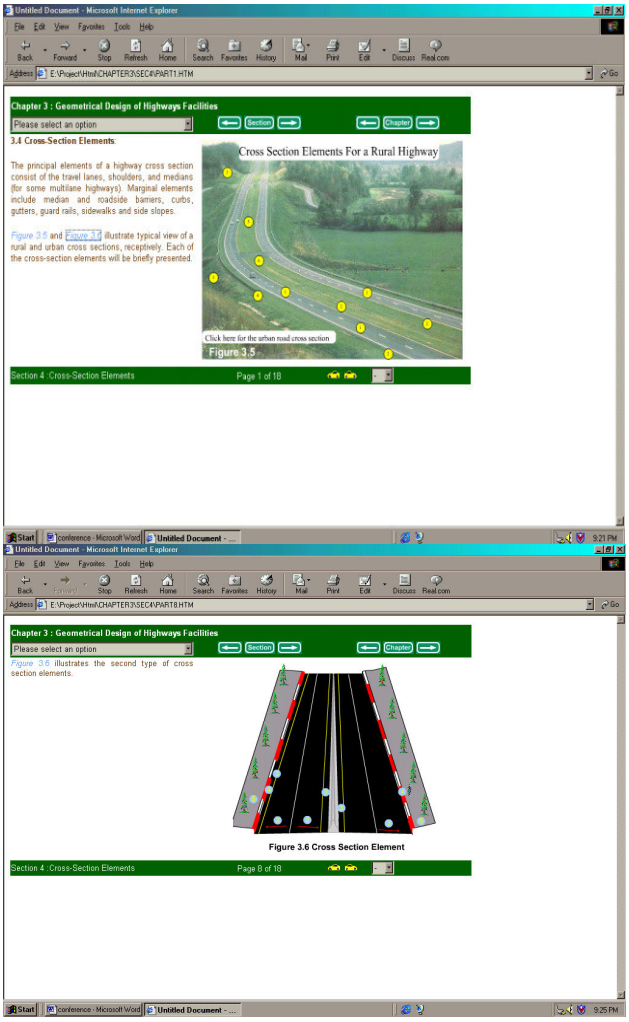

Figure 3: Hot words

The animation shows a driver driving his vehicle and suddenly a deer is about to pass the road in front of his car. He has to break and completely stop before hitting it as shown in Figure 4.

Multimedia Materials: Since the application is going to be used in a one-on-one computer environment, it is very important to get the student attention and keep the focus on the

material presented. This was accomplished by including different media types in the proper cue points of the presentations. The course material is presented using different media types, such as text, still pictures, graphs, animations, sound, and video clips. These media are integrated to provide a new way of delivering course material.

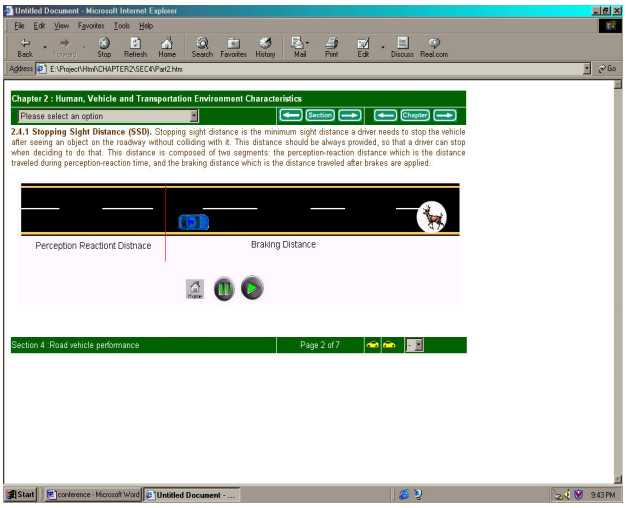

Figure 4: Simulations

Template Design: Screen contents are organized in templates to preserve consistency in the course of project development. The templates are at the chapter level, the section level, and at the page level. For example, the colors are selected in way that will not bother the user and will not get him tired from reading the text. Frames in the page are setup to allow the student view the text and the attached image or graph illustrating it at that stage.

Implementation Plan: The project is implemented as part of the Special Program for Upgrading Science and Engineering Education (USEE) in Universities, administered by UNSECO Regional Office for Science and Technology. The project is intended to assist science and engineering departments and faculties in Universities in upgrading the efficiency and quality of their undergraduate teaching programs through intensive and dynamic use of computer multimedia and networking technologies. The project involves cooperation with Oxford University in the form of limited technical consultancy.

The implementation plan is composed of the following tasks:

Task 1- Preparation of the Courseware and Introduction of Multimedia Technologies:

This initial task involves the general preparation of the courseware and the development of the detailed methodological approach to be followed. In addition, the proper multimedia software tools are specified and purchased. This task also involves the investigation of how various multimedia technologies can be introduced.

Task 2- Developing and Teaching the Course:

This task involves teaching the Transportation Engineering course. The students are taught the theoretical background in two lectures per week for the whole semester. In addition, there is a practical session in which the students are introduced to the learning tool through practical training, demonstrations, and in-class assignments. As a test, and in number of cases, mixed type of presentation is being performed to examine the impact of different teaching styles of students learning abilities. The courseware is this task is prepared in detail in order to satisfy the stated objectives.

Task 3- Evaluation:

Testing the performance of students, and getting their opinions and evaluation of the multimedia courseware is essential. The students who will be asked to evaluate the course material, relevance, teaching and learning through especially designed questionnaires. Specific questions are included in such questionnaires in order to measure the student's responses towards multimedia technologies through a rating system. The effect of multimedia on students attainment expressed in mid-term and final exams for the multimedia section of students compared to another section where students are taught in the traditional teaching style is measured.

Task 4- Modification, Documentation, and Training:

This final task involves the preparation of material in its final status after teaching the course and doing the evaluation. Proper documentation is to be made, finally methodological procedures for training the interested instructors from local Universities are to be prepared and implemented. Through dissemination of information, workshop

meetings and other means, interested instructors will be able to know about the package and its use.

5. CONCLUSIONS

Conclusions include the following:

1. The new approaches in developing engineering education programs and curricula concentrate on using computer, multimedia and networking technologies.
2. There is a good potential to develop engineering education basic courses using multimedia technologies as such courses inherently posses capabilities to express real life concepts using various multimedia tools.
3. In the course of the implementation of the project, students interacted very well with the engineering concepts and applications presented.
4. Having completed the development of the Transportation Engineering multimedia courseware, and arranging for dissemination and training of faculty from other universities in utilizing the courseware, a unified course material available in a high technology format will assist in the linkage of interested instructors and facilitate the exchange of ideas, and will lead eventually to common understanding and to subsequent upgrading of the courseware.

6. RECOMMENDATIONS

Recommendations include the following:

1. It is recommended to utilize the already developed procedures for developing other engineering courses.
2. It is recommended that universities upgrade their computing and networking capabilities as well as their distance learning facilities to be well prepared to cope with the advanced technologies being currently practiced world-wide.
3. School students at the basic and secondary levels can greatly enhance their capabilities in different disciplines by using multimedia tools, which will prepare them for interaction with more advanced applications of the tools at the university level.
4. Having the multimedia courseware posted on the Internet, it can be utilized in continuing education programs and self education, where engineers can upgrade their knowledge in the field.

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E-learning potential in education sector of developing countries: relationship marketing tool and cost cutting tool in times of financial downturn

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ABSTRACT

E-learning and on-line teachings are major transformation methods when it comes to traditional ways of education. No longer is it necessary to be physically present in classrooms-education materials and lectures are available online. Though developed countries have found ways to implement e-learning as a major tool in providing education and it is widely used and accepted by students and professors, developing countries' educational institutions are still lagging behind.

E-learning still poses a big challenge, and its usage to the full potential is constrained by poor infrastructure and relative low awareness of the relevance of e-learning benefits due to the traditional mindset of people. A common belief is that education is not good enough unless provided in the classroom. Additional problem is the mentality of education institutions as whole which do not consider students as clients and which do not perceive the education as a service sector. Therefore running the risk of losing their clients and not offering variety of service which will improve the quality of education and facilitate access to all information for every student no matter where he or she is.

Due to the global crisis and its side-effects, increased competition of private and public institutions which provide higher education, the most important goal is to stay on the market without decreased quality in providing the education. This requires articulated cost cutting strategies to ease the negative aspects of financial downturn and to maintain good financial results for educational institution.

Universities also have to find ways to attract prospective students and maintain the existing ones who are eager to receive high quality education. Education in its traditional model has to be backed up by e-learning platforms which will leverage classroom education method allowing the access to education from everywhere in any time. E-learning becomes a centerpiece of good relationship marketing between provider of the service-education institution and a client-student, with more customized approach to education. Moreover, it provides a possibility to decrease cost incurred in the existence of physical offices, classrooms and technical apparatus needed with traditional methods of learning and it allows wider geographical distribution of education available to those who would like to pursue distance learning.

Zagreb School of Economics and Management (ZSEM), one of the fist private business schools in Croatia, has been responding, right from its existence, to the technological changes and need for more dynamic ways of learning. Paper will give an insight of their strategy in using e-learning as relationship marketing tool and cost cutting tool as a possibility for other institutions in developing countries to capitalize their experience.

Keywords – e-learning, relationship marketing, cost-cutting tool, developing countries

1. INTRODUCTION

Literature findings depict that it is not yet possible to define clearly what constitutes quality in e-learning and its benefits because it is only since the 1990s that the expansion in information and communications technology (ICT), especially the Internet, has motivated the explosion of research and practice in this field. [1] Moreover, even International Organization for Standardization (ISO) has yet to finalize framework standards for quality e-learning. Given this statements, this paper tries to argue about possible benefits as well as explores the concept of quality in e-learning in higher education.

2. E-LEARNING INSIGHTS

E-learning is designed to deliver training, education and collaboration using various electronic media but, with Internet tools as main drivers of e-learning. [2] If e-learning is designed and managed properly, it can overcome many barriers associated with traditional educational methods. [3, 4] These barriers include students' tardiness, conflicts in schedules, unavailable courses, geographical problems, and economic disadvantage. [5] E-learning can be defined as any technologically mediated learning using computers whether from a distance or in face to face classroom setting. Therefore, it is a clear shift from traditional education or training to ICT-based personalized, flexible, individual, self-organized, collaborative learning based on a community of learners, teachers, facilitators, experts etc.

This paper will focus on blended learning i.e. an integrated approach that applies a mix of e-learning and traditional education, found in most of the universities that combine traditional education with innovative learning and teaching methods. The rationale behind is a premise that human interaction is a critical component for learning. Indeed, much criticism is raised about situations in which classroom training cannot be replaced and therefore is not possible to be offered through pure usage e-learning. With blended learning, new technologies are used to create a synergetic, dynamic learning structure that can enhance learning process. [6]

E-learning is appealing to educational institutions for number of reasons. Thanks to the wider availability of Internet, e-learning eliminates learning barriers of distance, time and financial inadequacy, offering to students' access to variety of experts and resources that may not be available locally. As well, the materials and delivery can be replicated easily and very economically, which seeks lower costs in the face of increased learning demands [5]. A learning organization has the additional advantage of boosting staff morale and motivation. [7]

3. E-LEARNING IN DEVELOPING COUNTRIES WITHIN EDUCATIONAL INSTITUTIONS: CROATIAN SCENARIO

The following change factors described have fuelled the current interest in the quality of higher educational institutions in developed [8] as well as developing countries:

- The rapid expansion of student numbers in the face of public expenditure worries;
- The general mission for better public and private services of education;
- Increasing competition within the educational 'market' for resources and students;
- Tension between efficiency and quality

All these factors will be explained later on in the text, but they have been one of the motivators for implementation of new way of educational delivery also in developing countries. When it comes to the representative developing country used in this paper the situation depicted in the paragraphs bellow.

By the end of the 2008 in Croatia there were 9 accredited Universities, 16 Polytechnics and 30 Higher Education Schools.[9] The main role in introducing new technologies in process of education in Croatia played Croatian Academic and Research Networks (CARNet) [10]. Thanks to the CARNet technical support the first videoconferences in education were held still in 1997 [11, 12] while from the 2000 CARNet enabled a free use of Learning Management System (LMS) WebCT [13] for the whole academic community.[14] Next very important step CARNet made is the foundation of E-learning academy (ELA) in 2003. E-learning management, E-learning Tutoring and E-learning Course Design are one year programs developed in association with the University of British Columbia in Canada. [15, 16] During the last five years ELA qualified many experts in a field to promote the implementation of e-learning in education. Although CARNet pioneered the e-learning the most of the Croatian Universities were late in systematically implementing it. The largest Croatian University, the University of Zagreb that counts 60 000 students brought the strategy of e-learning development just in 2007. [17] Situation is not better neither on the other Croatian Universities. [18] As followed we will describe the example of the first systematically use of e-learning in Croatia through the ZSEM case study. [19]

4. E-LEARNING AS COST-CUTTING TOOL

The educational institutions are under intense pressure to get the best course to their learners, in the right format, at the right time, for the right price, for appropriate quality level and to reach lower costs in the same time. To do this, they have to spend considerable time and resources on planning their service in order respond to the demand. This goal can only be reached if the educational institutions introduce usable and innovative tools, which serve the above mentioned.

Moreover, competition has always been in the centre of attention for higher educational institutions, namely universities, with more localized approach. With the increased usage of innovative technologies in providing education, educational institutions are shifting from localized physical institutions and becoming more nationalized or internationalized. Educational institutions

behave more and more as companies on the market, actively seeking new markets and increasing number of students. Therefore, with the usage of e-learning, geographical barriers of learning are eliminated in a cost-effective way. The technologies allow the ability to use tools and resources that are impossible in a traditional educational system.

The growth in demand is continuing to be a transition in the type of students undertaking higher education. Educational needs of individuals become more of a life-long learning process, and educational institutions need tailored programs adapted to these target groups. The growing diversity of the higher education population must be harmonized by the offerings of universities, as students demand more of their knowledge providers. [20] As a result, e-learning could provide for the significant growth in the mature student market.

Universities need to consider cost-effective and efficient methods of operation if they are to survive [20], while technology alone might not be the answer to all of the university's problems, it can play an important role. E-learning cuts the costs, shorten product development cycles, less expensive to produce and maintain, reduces costs for the e-Learning service providers. Learning standards create ways that cut costs and development time. By developing jointly learning materials the expenses are relatively smaller. E-learning programs can reduce the students' fees without negatively affecting the compensation for high quality presenters. Overall costs for learners, travel time and other associated costs are also reduced.

Due to the global crisis and its sideffects, increased competition of private and public institutions which provide higher education, the most important goal is to stay on the market without decreased quality in providing the education. This requires articulated cost cutting strategies to ease the negative aspects of financial downturn and to maintain good financial results for educational institution.

5. E-LEARNING AS CENTERPIECE OF RELATIONSHIP MARKETING

The concept of relationship marketing has emerged within the fields of service marketing and industrial marketing. Relationship marketing can be defined as attracting, maintaining and in multiservice organizations enhancing the customer relationships. [21] A common belief exists that blending technology with customer requirements is an important success element in establishing and developing customer relationships. Relationship marketing has the potential to radically transform any institution. The centerpiece of relationship marketing is creation of value with individual customers and then sharing the benefits of this over a lifetime of association.

Relationship marketing is essentially establishing, developing and maintaining successful long term relationships with students. Education being a service cannot adopt marketing strategies meant for a company which is manufacturing products. Marketing educational services is more about building trust and commitment, more about making students loyal alumnus. In this respect, marketing strategies and e-learning are interrelated because they deal with the creation of a product that cannot be copied by anyone else, and with creating an atmosphere of nurturing for students. For the student, any educational institution is attractive if it has the right mix of pricing, academic experience, and credibility. If an educational institution is able to provide services beyond these three parameters, it has earned the loyalties of any student enrolled with it. Furthermore, e-learning a powerful medium particularly for part time work based students who find changeable attendance requirements and study difficult. [22]

Universities also have to find ways to attract prospective students and maintain the existing ones who are eager to receive high quality education. E-learning becomes a centerpiece of good relationship marketing between provider of the service-education institution and a client-student, with more customized approach to education.

6. GOOD PRACTICE – ZAGREB SCHOOL OF ECONOMICS AND MANAGEMENT

ZSEM uses the so-called Hybrid Model of Teaching – a combination of traditional teaching methods and an intensive usage of e-learning. ZSEM is the first higher education institution in Croatia that has been systematically using e-learning from its foundation with precisely defined development strategy. When we say systematically we understand the following: [23]

- E-learning is obligatory for all students and lecturers. Lecturers are due to generate and develop a course by the e-learning standards up dating it permanently. Students have the obligation of monitoring any of e-learning activities, downloading new contents, actively participating in on-line discussion, quizzes, etc.
- It's crucial to implement the Learning Management System (LMS), until today it has been WebCT. The same LMS has been used on every course enabling students to manage it easier.

The main role in systematically introducing e-learning at ZSEM played the ZSEM management.[24] In order to manage quality of already existing e-learning

system the e-learning team has developed 11 standards that might be divided into three groups: statical, dynamic and administrative standards.

The developed standards are depicted in groups on Figure 1. [25]

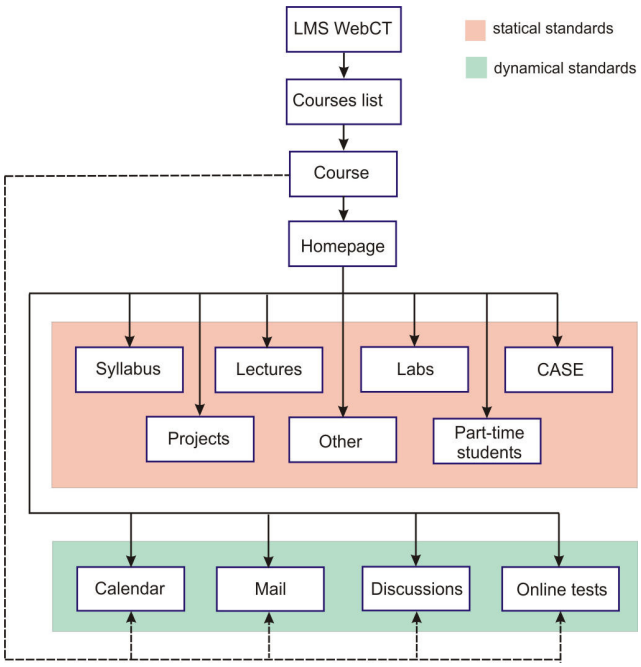

FIGURE 1
DEVELOPED STANDARDS

Static standards are tied for a part of the page that has to exist and be regularly updated, but it is not directly associated to communication between professors and students. It encompasses syllabus which is regularly updated at beginning of every semester and it is on the first place on the cover page, together with directories of lectures, workshops, case studied, projects, as well as design and appearance of pages. [25]

Dynamic standards refer to the continuous communication between students and professors. Mails, discussion, chat, calendar, and online tests fall under the category of dynamic standards. Dynamic standards are especially important as students log on the WebCT and automatically see the news on course they have that semester. In that manner, e-learning course, besides traditional linear way through homepage, can be accessed through matrix solution using hyperlinks. Especially notable elements of every e-learning system are discussions which are exceptionally developed in certain subjects. [26, 27] Dynamic elements imply also online quizzes which are used for evaluation or self-evaluation of knowledge. [28]

Administrative standards address updating of data base of students and they count for 10% of the grade. In students' evaluation on satisfaction by LMS system students do not perceive this part, so that the grades e-learning team are lower that the grades given by students. Nevertheless, there is a correlation between students' evaluation and administrative standards. Professors who communicate more often with their students and are more active on WebCT in typically maintain better students' data base.

Currently the ZSEM attend 1200 students with 120 developed e-learning courses. Table 1 shows the comparison of the e-learning courses quality in the last two years.

TABLE 1
COMPARISON OF THE E-LEARNING COURSES QUALITY IN THE ACADEMIC YEAR 07/08 AND 08/09

Standards	**07/08**	**08/09**
S1 – Syllabus	7.67	8.44
S2 – Lectures	9.89	10.00
S3 – Part Time Students (PTS)	6.36	5.94
S4 – Design	8.56	8.44
Other	3.56	3.54
Static standards	**36.04**	**36.36**
D1 – Calendar	8.22	8.44
D2 – E-mail	8.56	8.23
D3 – Discussion	8.11	8.13
D4 – Online tests	1.67	2.81
Dynamic standards	**26.56**	**27.61**
A1 – Number of students	2.22	2.60
A2 – Self-registration	1.78	2.71
Administrative standards	**4.0**	**5.31**
Total - average	**66.6**	**69.28**

In the last two evaluations the average increased from 66.6 to 69.28 (on the scale from 1 to 100). Static elements increased from 36.04 to 36.06. However, the individual elements analysis shows the increment of S1 and S2, and slightly decrement of S3 and S4. Dynamic standards have the slight increment from 26.56 to 27.61. Standards D3, D1 show the slight decrement, D2 show the slight increment while the greatest increment shows D4 (on-line tests). Administrative standards increased in both their elements A1 and A2, from 4 to 5.31.

7. CONCLUSION

As ICT was expanding, especially in the 1990s, it has brought about the increasing need of e-learning initiatives to the extent that e-learning constitutes one of the major topics of many institutions. Both educational and non-educational institutions are providing and using it. The newness of the e-learning discipline makes it difficult on what constitutes the quality in e-learning, and what are the crucial benefits of it. However, without good quality e-learning offering benefits to higher education, many financial and human resources would be wasted while many of insitutions are struggling with flexible and economically cheap education, such as e-learning has the potential to deliver, especially in developing coutries. E-learning, as argued in the paper, posseses a facility of creation of educational value to individual customers and then sharing the benefits of this over a lifetime of association.

Zagreb School of Economics and management depicts implementation of the statements argued in the paper and depicts a positive example which should be a guideline for other institutions to follow if they want to maintain or enhance competitiveness on the market.

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Video Captioning Time Stamp Calculation

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Abstract

Video materials have been widely used in classroom enable the development of media literacy, higher order thinking skills, and a deeper connection to the curriculum being explored. Synchronized and equivalent captions will help students study video materials efficiently. Our recent research of a video captioning application—ACITVE system, integrates speech recognition technology to address automatic captioning and automatic timing issues. In this paper, we present one of the functions of this system which designed to generate time stamps for synchronizing caption with video file. We apply an algorithm to calculate the time stamp of each recognized word. This algorithm could adapt time stamps according to users' operation such as insertion, deletion and so on. First we introduce our application and related technique. Second, we analyze our algorithm with respect to different situations. Finally, the conclusion and future work are discussed.

Key word: automatic timing, automatic captioning, time stamp calculation, speech recognition

1. Introduction

1.1 Features of ACTIVE system

ACTIVE system is a feature-rich system. It provides many empirical functions to users. Besides auto-captions, functions like auto-timing, highlighting caption, image library, screenshot, Text-to-speech are available to users. One of the distinguishing features is auto-timing. Traditional captioning requires user providing information indicating when each line should be displayed. In ACTIVE system, we seek to reduce work load of user by generating timing information automatically. In this paper, we present the algorithm used to implement this function. The proposed algorithm uses timing information gathered by speech recognition engine, and adapts the time information according to users' operations such as insertion and deletion. In such case, it would beneficial when user needs to modify machine-generated caption.

1.2 Background of Speech Recognition Applications

The ACTIVE system get transcript from video file by making use of speech recognition technology. Speech recognition is a technology which recognizes speech and converts spoken words into text. Speech recognition applications include voice dialing, simple data entry and so on. And it is especially useful for people who have difficulty accessing to audio or inputting text into computers such as hearing-impaired people. In education domain, the potential for effective usage of speech recognition is great yet underdeveloped.

2. Time Stamps Calculation in Video Captioning

To produce captions for video files, getting the text contents by speech recognition technique is only half way through the final goal. The following step is to synchronize caption with video file, thus time stamps of words must be provided. In this application, we develop a time stamp calculation algorithm to provide time stamps of each word recognized.

2.1. Calculate Time Stamps without Editing Transcript

When speech recognition engine completes recognition of an audio stream, it generates each word recognized along with relating time information such time length and time offset. We store this information in a XML file. [3] The sum of a word's time offset and time length approximates to the time offset of the next word. We noticed that the speech engine accelerates recognition speed by dividing audio stream into several audio segments, and the time offset is the local offset within each segment. So we must use the time length and time offset to calculate the time offset of each word from the beginning of the audio stream. Here we call this offset the global time stamp.

Now, we record the time stamps in a XML file and display transcript in the edit field. Users could manipulate the transcript in the edit field by splitting one line into several lines, or merging some lines into a single line. In most of the cases, users only concern with the starting time and ending time of each line for synchronization. We use a searching algorithm to get the saved time stamps from XML file for the first and last words of each line.

The searching algorithm can be summarized as below:

1) Get the first or last word of each line and its index in the edit field.

2) Compare the word of the same index in XML file, if they are the same, then the time stamp is displayed on the edit field.

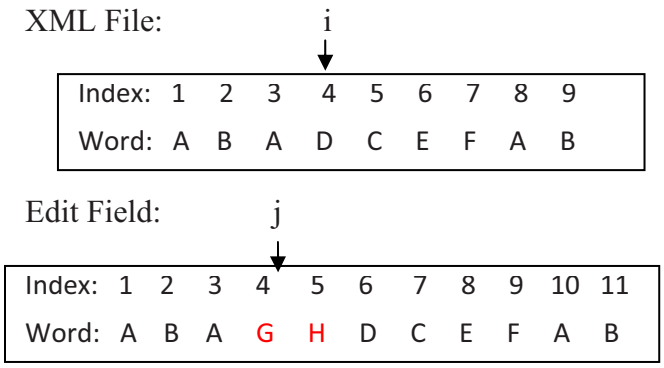
2.2. Calculate Time Stamps after Editing Transcript

Due to the limitation of the speech engine, the accuracy of the recognition cannot be perfect. Thus, users may want to edit the transcript by adding, deleting or modifying words to achieve good captioning. These operations will cause problems for time stamps, since we only have the time stamp information of the words recognized by speech engine. We try to solve this problem in the following methods:

1) Insertion

If some words are inserted into the transcript, we first need to identify which words are inserted to what position. Logically speaking, the time stamps of the words following the inserted words should be increased by the time length of the inserted words. Unfortunately, ask user to provide time length of each word inserted, and then calculate the time stamps of the following words is the only solution, which is very expensive. So when insert words into the transcript, we simply assume the inserted words will not affect the time stamps of the following words and assign "NULL" as the time stamp and length of the inserted words.

Here we illustrate how to identify which words are inserted:

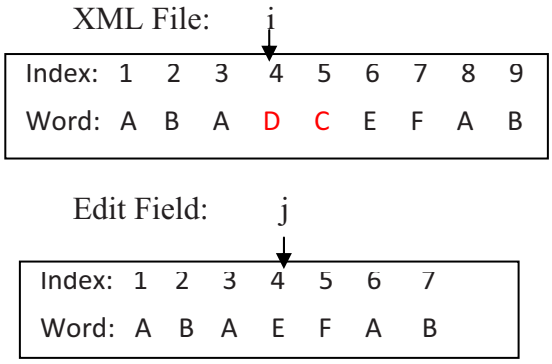


We could see that the 4th and the 5th words are inserted. If we compare the 4th word in the XML file and the 4th word in edit field, we will know immediately that they are different. Then we increase the j pointer by 1, and the i pointer remains. It means we will compare the 5th word in the edit field with the 4th word in XML file. If they are still different, we increase the j pointer by 1. Continue this process, until we find a word in edit field identical to the 4th word in XML file. In this example, we find the 6th word could match with the 4th word in XML file. If too many words are inserted between 2 words, the assumption that the inserted words will not affect the time stamps of the following words will become invalid. So, we only allow user to insert at most 5 words between 2 words, if more than 5 words are inserted, we will give user a warning about potential error

of the time stamps. Otherwise, we claim the inserted words are identified.

2) Deletion

If words are deleted from the edit field, we need to delete these words in the XML file and subtract the time length of them from time stamps of the following words. The deletion process can be viewed as a reversion of insertion process:



We could see that the 4th and the 5th words in the XML are deleted. If we notice that the two words of the 4th pointer in XML file and edit field are different. Then we increase the i pointer by 1, and the j pointer remains. It means we will compare the 4th word in the edit field with the 5th word in XML file. If they are still different, we increase the i pointer by 1(It is the opposite operation with the one we used in identification of the inserted words). Continue this process, until we find a word in XML file identical to the 4th word in edit field. In this example, we find the 6th word could match with the 4th word in edit field. Now we can claim the deleted words are identified without worrying about whether there are too many words deleted. Then, we could subtract this time length from subsequent words.

3) Modify words

a) Modify words without changing the length of the transcript

In this case, we assume the time length of the modified word will not change, and assign the time stamps of the words before modifying to them. So we simply compare words in XML file and words in the edit field, and modify the word in XML file according to edit field without changing the time stamps.

b) Merge words

We assume that merging some words into one word will not change subsequent words. This is different from deletion since we only need to identify the word from XML file and delete unwanted words without the subtraction step. Thus user should put some ellipses in the position where words are deleted to reserve the time length of them.

c) Split words

In this case, we assume splitting one word into several words means the time period will not change. So, we treat this scenario as insertion.

The calculation process can be demonstrated in a flow chart as Figure 1:

(See next page)

3. Conclusions and Further Work

Automatic time stamp calculation could relieve users from time consuming work. One drawback is that it is based on the assumption that only limited edit operation will be carried out. It relies on the accuracy of the speech recognition result. Overall, the automatic time stamps are served as a reasonable suggestion rather than precise prediction. We also allow users to correct the time stamps to get a better result.

ACTIVE system possesses huge potential in education area. To build the state-of-art application, the following objectives must be realized:

(1) Improve the accuracy of the speech recognition

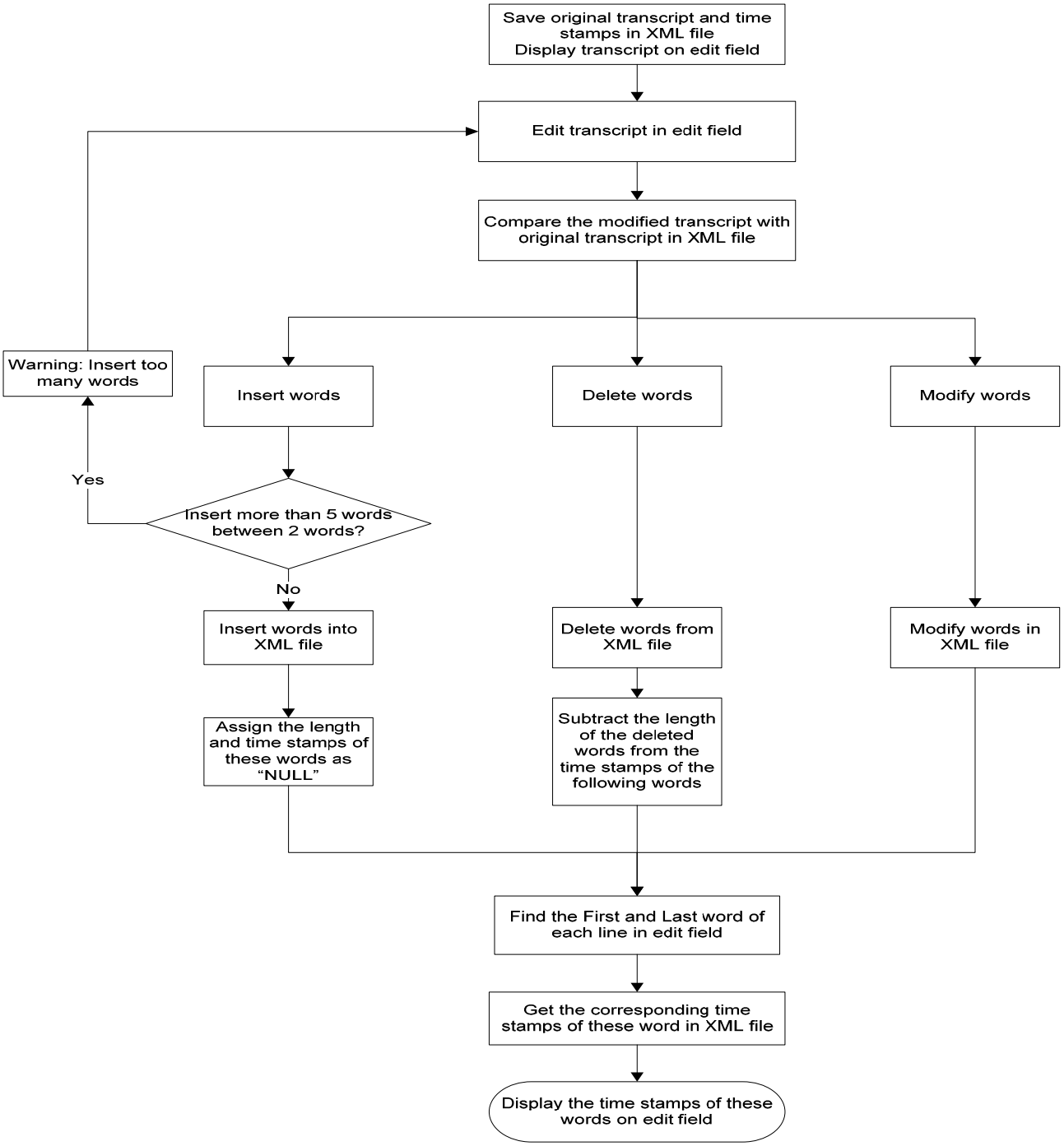
(2) Allow video searching and manipulating

As for the first objective, although we have achieved the basic goal of generating transcript automatically from any video files and the accuracy is above 80 percent for slow and clear audio streams, the performance of the speech

recognition remains as a problem in terms of accuracy. Observed during the research, the accuracy degrades as the wpm (word per minute) rises or the pronunciation is nonstandard or background noise exists. Compare to commercial speech systems, this shortage is a serious drawback against the promotion of the application.

Secondly, if accuracy problem is solved, to search and manipulate the video according to key words becomes possible. This function will be very useful for teachers trying to arrange the video material with specific curricular goals such as start or replay from certain point by simply input the key word of the section, and mark crucial sections for students to review.

In contrast with traditional captioning methods, this application enables user to create captions effortless by generating transcript and time stamps automatically. It forms the blueprint for flexible and practical video processing system. Our future research goal will be geared towards



- **Figure 1. Flow Chart of the Calculation Algorithm**

two directions: (1) continue doing research on the accuracy issue, improve the performance of speech recognition; (2) design advanced features to enhance the competitiveness of this application

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An Evaluation of the Effectiveness of, and Students Attitudes towards, Technology Enhanced Learning (TEL) in a Clinical Skills Laboratory Environment

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ABSTRACT

The learning of students within the Department of Nursing and Midwifery at the University of Limerick is increasingly supported and mediated by computer based technology. New techniques, such as self-record and review of laboratory practice procedures and "clicker" response to quizzes in lectures, facilitate individual student engagement even with large classes. Further support is provided by the use of the Moodle learning management system. This paper illustrates how these techniques are integrated in the Clinical Skills Laboratory class and present the findings of a study aimed to discover how Irish nursing student view these technology supports.

Keywords: Blended Learning, Video Analysis, Self-Recording, Technology Enhanced Learning. Student Views

INTRODUCTION

This paper aims to present the perceptions of Irish Nursing students with regard to the use of technology in their learning environment. Within the University of Limerick, where this study was conducted, undergraduate student nurses have access to a plethora of technological instructional equipment. The laboratory-learning environment – called the Clinical Skills Laboratories – has a touch screen enabled video and audio recording facility called the DNA – Digital Nursing Archive[1]. This is available and accessible to any registered Nursing student in the University. Many instructors at both large and small educational institutions have begun to use classroom technology that allows students to respond and interact via small, hand-held, remote keypads called "Clickers". It resembles the "Ask the Audience" portion of the game show "Who Wants to be A Millionaire," and enables instructors to instantaneously collect student responses to a posted question, generally multiple choice. The answers are immediately tallied and displayed on a classroom projection screen where both students and instructor can see and discuss them. This technology is known under many names and will be referred to as an audience response system (AR system or ARS). Audience Response Systems are an evolving in-class-student-polling technology designed to create an engaging and inviting learning environment that maximizes active learning. This is a relatively new technology and one that offers easy deployment of active learning and engagement within the classroom environment. The above listed technologies, in conjunction with a blended learning approach with the Moodle Content Management System, was used to educate these 2nd Year Nursing students. A voluntary questionnaire at the end of the academic semester was administered to gather the students thoughts and views on how the technology aided or hindered their learning process.

BACKGROUND

The undergraduate Bachelors of Science in Nursing has a significant nursing skills component embedded into the modular structure and taught to students in conjunction with relevant theory. 2nd Year Students from the Module – NS3201 - Microbiology Immunology & Infection Control were selected for this piece of research. The focus of the research was on determining if technology aided students in learning practical skills via self-recording, critiquing and Clicker technology – in this case wound care management and suture removal. The theory was taught via an online module delivered with the Universities Content Management System – "Sulis". Lectures were two hours per week, eight lectures in total in which the students focused on the theory applications of the module. There was also a two-hour laboratory session that was facilitated by the staff of the Nursing and Midwifery Department, in which the students practiced what they learned in the classroom. The "traditional" method for teaching labs involved demonstration of the skill by a facilitator to groups of 15–20 students, in the Clinical Skills Lab Environment, followed by an opportunity to practice under supervision. These large class sizes, which were determined by timetabling constraints and availability of teaching staff, posed several challenges. The requirement for large numbers of staff led to concerns about procedural consistency [2]. The lab facilitator believed a single demonstration was insufficient and that students would benefit from being able to see the skills repeatedly, if necessary. To this end, the students were allocated a task of recording a specific skill – Suture Removal. This required them to use a specific piece of equipment called the DNA – Digital Nursing Archive[1]. The students were charged with watching video resources online relating to the task at hand and familiarising themselves with the technique. The lab facilitator demonstrated the procedure first and then randomly chose two students from each group to repeat the process to their colleagues. The lab facilitator was at hand in case there were any questions on the procedure. Once this was completed, the students – in pairs of two – logged into the DNA system and recorded themselves removing Sutures. Upon successful completion of the task, the students saved the video clip for critiquing later on in the week. The lab facilitator provided the students with a checklist that was used when the recording was taking place.

LITERATURE REVIEW

Many methods are used to enhance student engagement in instructional nursing education courses [3, 4] and systems are introduced as new technologies become available[5-9]. Content Management Systems are popular nowadays and there are several main contenders in this market – with systems like Blackboard, WebCT, Moodle and Sakai to name but a few.

The usage of learning technologies can transform the concept of teaching and learning by redefining the role of the teacher and transforming the meaning and content of the learning procedure [10]. Learning moves from a Tayloristic or behavioristic linear model that treats learners as products on an assembly line, to a more constructivist approach fostered by web-based instruction where learning is a more authentic self directed personal experience [10-15].

Currently, students have a preference for digital literacy, experiential learning, interactivity, and immediacy [8, 16]. Greater use of technology has been introduced into classrooms to encourage student involvement [3, 17, 18] in the past several years. Research has shown that actively engaged students will absorb and retain more content [3, 19]. It has also been shown that using a variety of teaching/learning methodologies enhances learning for students with differing learning styles [5, 20]. A learner-centred teaching approach [9] and the creation of significant learning experiences [5, 20] are touted as means of creating interaction in the learning environment.

Self-video recording permits the students to take control and work at their own pace. Once a recording is completed, there are various methods available for reviewing and recalling the recorded clips. Any personal computer connected to the Universities network can be used for viewing a user's recordings, subject to the login privileges assigned to the user. Standard users have access only to their own recordings and to public recordings used for tutorials, etc. Lab facilitators and system supervisors may, subject to administration permissions, be able to access recordings of students in their group. Recordings are saved in high-quality MPEG-2 format, at a choice of quality settings, up to DVD quality. At the same time, a lower-resolution MPEG-4 copy is made automatically, which can be viewed across any allowed network or Intranet connection. Once a student is content with the recording, they submit it to their lab facilitator or Supervisor via a web-based portal. Upon successful use of this technology, we introduced the ARS approach.

The ARS enriches the students' engagement and activity levels in the learning environment. The operation of an ARS is a simple three-step process:

1) During class discussion or lecture, the instructor displays or verbalizes a question or problem – previously prepared or spontaneously generated "on the fly" by the instructor or a student,

2) All students key in their answers using wireless handheld keypads – aka "Clickers"

3) Responses are received, aggregated, and displayed on both the instructor's computer monitor and an overhead projector screen. The distribution of student responses may prompt the students or instructor to explore further with discussion or perhaps one or more follow-up questions.

This interactive cycle can continue until both the instructor and the students have resolved ambiguities or reached closure on the topic at hand [21].

RESEARCH AIMS

The aims of this research were to:

- Evaluate student experiences of the use of technology in supporting their learning of a practical skill.
- Examine the students' perceptions of a technology enhanced learning approach and whether it aided or hindered their learning.
- Contribute to the body of research in this area in order to enhance discipline specific curriculum resources.

RESEARCH METHODOLOGY

This study evaluated students' perceptions to the use of technology in the classroom to actively enhance and engage their learning cycle. This pilot group was a 2nd Year Nursing module in an Irish University. Nursing is divided into three distinct disciplines – Mental Health, Intellectual Disability and General Nursing. The students were assigned to their respective groups by the Student Service department within the University. These groups have a random allocation of students from the above three listed disciplines. The groups were allocated a given day and time that their laboratory session would take place. This session ran from week 1 to week 12 of the academic semester. The first four weeks of the semester, week 1 to week 4, the students focused on hand hygiene, standard precautions, infectious diseases and specimen collection. The middle four-week period, week 5 to week 8, the students were out on placement. This means that they were not physically on campus and therefore not available for lectures or laboratory sessions. The final four-week section of the semester, week 9 to week 12, focused on aseptic technique, wound care, wound management and suture removal.

The first four-week section was delivered via the standard means of delivery. The students attended the laboratory session and the facilitator taught them the material under review. Content was delivered via PowerPoint presentation on the overhead projector. The students had the opportunity to ask questions or engage in discussions with the facilitator. The students did have an opportunity to fill in an evaluation form at the end of each laboratory session voicing their thoughts and feeling with regards to the content they were studying and their understanding of said content. The only technology that was used was the overhead projector with the aim of displaying the content to the students.

Upon completion of placement and after returning to the University, the students were welcomed back to a different scenario. The content for the laboratory session was made available to them online via a content management system called Moodle. The students could access this system from on and off campus locations. Material in the form of PowerPoint slides, additional reading in PDF format and video clips in web based flash format was made available to the students on a week-by-week basis. The same material was taught in the laboratory sessions. An additional new technological strategy was the Clickers. The students were introduced to the concept of the Clicker technology and two groups – Group 1 and Group 2 – availed of this feature in the week 10 laboratory session. The other group – Group 3 – used the Clicker technology in week 11 – directly before an in class Moodle quiz. The question

of how time would affect the retention rate of the group was prominent here when introducing the different groups to the ARS. The overall results from the online Moodle quiz for these three groups are shown in Table 1.

Group	N	Average Score	Lowest	Highest
1	12	7.67/10	6	9
2	10	7.45/10	6.5	9
3	21	8.07/10	6.5	9.5

Table 1: Student Results from Online Moodle Quiz

The teaching in the last four weeks of the semester focused heavily upon the technology that was available in the department. Students had access to online resources via Moodle as well as discussion boards, assignments and other technology-enhanced features. Video clips were available in a YouTube style format where the students could play, pause and remind a clip as often as they deemed necessary. At the end of the academic semester, the students were asked to voluntarily fill in an anonymous questionnaire online that would provide feedback to the facilitator with regards to their thoughts on Technology Enhanced Learning via Moodle, the Clickers and the use of the DNA recording system.

RESULTS

The students were asked to record themselves performing the aseptic technique of Suture Removal. The students paired off and used one of the four beds in each laboratory setting. Student A logged in while Student B ran through a printed checklist of the procedure. Once Student A was logged in, s/he used the touch screen and started recording the procedure. Student B ran through the checklist as Student A was carrying out the recording. At the end of the session, the recording was saved and the students swapped roles and repeated the above steps. After the successful recording of the procedure, the students were able to review their own recording online. Based on this review, the students critiqued the recording and uploaded their findings onto the Moodle system for the facilitator to review. Figure 1 shows a student carrying out the required procedure.

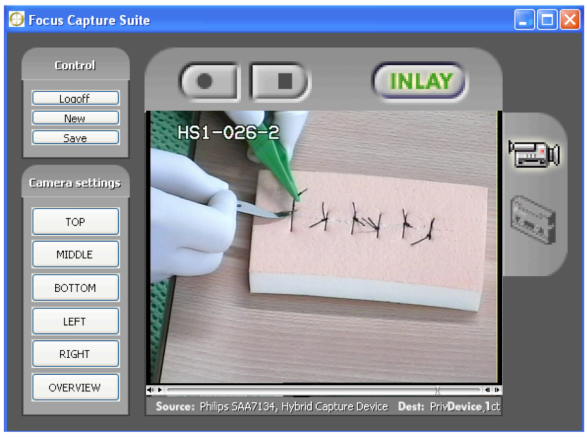

Figure 1: Students performing a Suture Removal on the DNA

Forty-eight students responded to the critique of the video recording. The students were asked several questions in relation to the recording and the procedure itself. 15% of the students were from a Mental Health background, 35% from Intellectual Disability background and 50% were General Nursing.

Some of the comments received when asked if the video recording experience enhanced their learning included:

- "…found that this experience did enhance my learning. It provided us with the chance to revisit our skills demonstration and learn from our mistakes"
- "…really good way of looking back on a procedure as trying to remember details is not easy. This is more accurate"
- "…you could see the procedure you done on a video and to see your mistakes"
- "…could see for myself afterwards what I did wrong"
- "…doing it practically and being video recorded it enhanced our ability to do the procedure and by being video recorded we can critique ourselves."
- "…I feel the DNA has enhanced my learning"
- "…I thought it was a good idea to record us taking out the stitches. This way we can access the recording anytime and refresh our memory on how to carry the procedure out."
- "…This experience allowed me the opportunity to review and reflect on how I had performed during the aseptic procedure and suture removal. I was a bit nervous at first but if recordings are used more often I feel that people would be far more relaxed and view it as a chance to visually reflect on practice."

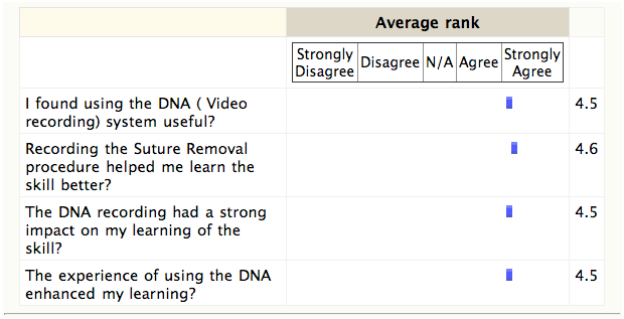

Figure 2: Students thoughts on using the DNA System

Figure 2 shows the students thoughts on the DNA system. The information was gathered via the questionnaire survey on Moodle.

Not every student was as positive with the use of the recording technology but the few who commented negatively were minor in their voicing. Comments like:

- "…i think the video part could be avoided....that the lecturer could just monitor and grade us."
- "…I wasn't fully comfortable but I learned the correct procedure."

It was not feasible to have the lecturer teach every student individually. The time required for such a task was beyond the two-hour laboratory limit.

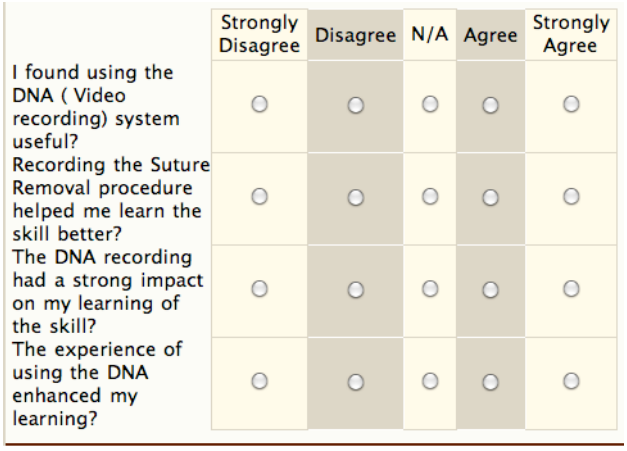

Figure 3: Sample Question from Lab Overview Questionnaire

44 students filled in this anonymous questionnaire – a sample of which is shown in Figure 3. Students were asked several questions in relation to the use of technology in the teaching of the module. A 5-point Likert Scale was used in the questionnaire. The student could strongly disagree, disagree, N/A, agree or strongly agree to any question. Students strongly agreed (4.5/5) that the DNA system was useful to their way of learning in the laboratory setting. There was a strong agreement that recording the suture removal procedure helped the students learn the skill better (4.6/5). Students strongly agreed that the DNA recording had a strong impact on their learning with regard to the skill (4.5/5) as well as enhancing their learning (4.5/5).

Several important aspects of the DNA system with regard to the learning of the skill and the use of technology in the laboratory environment are listed below (taken from students submissions):

- "Being able to see the mistakes that I did make"
- "Good to use new technology"
- "It benefits as a fundamental learning opportunity to look back on what I have done and reflect on mistakes and learning opportunities."
- "It is important to develop IT skills"
- "It was good for reflective practice"
- "Using this system we were able review what we had done during the lab and find any faults we may have made. This allowed us to improve our nursing skills"

When asked to comment on problematic or troublesome qualities of the DNA, the following responses were submitted (taken from students submissions):

- "Camera only covers a small area"
- "It can put you on the spot and make you nervous and uneasy"
- "Not being confident enough using the DNA system"
- "None" – several students reported that there was no drawback to using the system
- "We never used this system in first year and i think that a lot of people are nervous using the system. If we were allowed use it more often it would make people less apprehensive and enhance learning."

Overall the students were positive with the record process associated with the procedure. They liked the aspect of being able to review the recording afterwards and critique it. This provided them with the possibility to re-record the procedure or submit the already recorded clip. The students made the decision on what clip to submit to the lab facilitator. This further empowered them in the session and provided them with further responsibilities in the laboratory, further treating them as adult learners. The students were asked to critique the recording online in the Moodle environment. Sample questions from the online critique are shown in Figure 4.

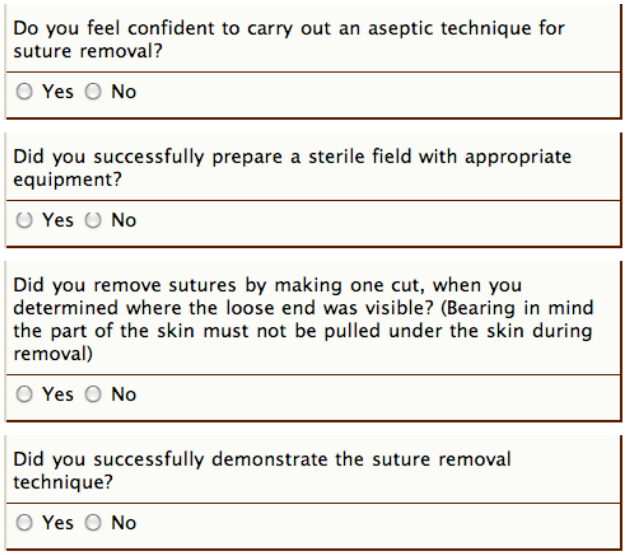

Figure 4: Sample Critique Question from Video Recording

The semester was split into three four-week periods. The students had no access to Moodle in the first four-week period.

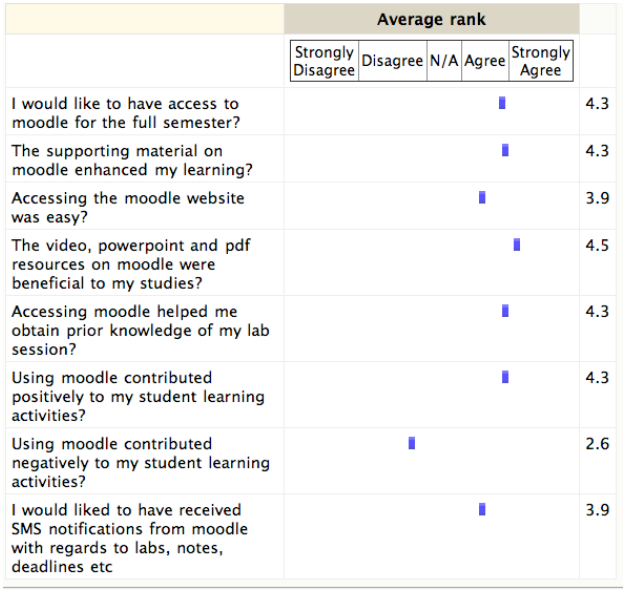

Figure 5: Students thoughts on Using Moodle

When asked, via the questionnaire, if they would like to have access to Moodle for the full semester, 4.3/5 students agreed that they would. A similar 4.3/5 students noted that the supporting material on Moodle enhanced their learning.

3.9/5 students said that accessing Moodle was easy. There was some concern here with regard to why students agreed but did not strongly agree. Upon further verbal discussion with the students, it was found that the website address was inaccessible at certain times. Later, it was discovered that the IT department had to carry out maintenance and essential upgrades. Students agreed or strongly agreed to the following points:

- The online resource were beneficial to their study
- Accessing Moodle helped the students obtain prior knowledge to their lab sessions
- Using Moodle contributed positively to the student learning experience

When asked if Moodle contributed negatively to their learning experience, the results shows that students disagree to this statement.

Students were asked if they would like to avail of SMS (Short Messaging System) technology in the future with regard to notifications and updates in the module teaching. 3.9/5 students agreed to the introduction of this new technology into the lab. Full results are shown in Figure 5. Another form of innovative technology availed of during this pilot was the Clickers.

The Clicker technology was new to the department and University as a whole. The operation of an Audience Response System is a simple three-step process:

1) During class discussion or lecture, the instructor displays or verbalizes a question or problem – previously prepared or spontaneously generated "on the fly" by the instructor or a student,

2) All students key in their answers using wireless handheld keypads – "Clickers"

3) Responses are received, aggregated, and displayed on both the instructor's computer monitor and an overhead projector screen. The distribution of student responses may prompt the students or instructor to explore further with discussion or perhaps one or more follow-up questions.

This interactive cycle can continue until both the instructor and the students have resolved ambiguities or reached closure on the topic at hand [21].

Students liked the idea of actively engaging with the lab facilitator on topics relating to their learning. The Clickers empowered the students to clarify their understanding on the related topics. The lab facilitator had the possibility to create impromptu slides if the need arose.

Comments with regard to the use of the Clickers in the laboratory included:

- "Provided a bit of variety in the classroom"
- "The whole experience was very good"
- "They were fun!"
- "Very useful"
- "Found the Clickers to be a very helpful learning aid."
- "It was a good way of finding out if you had the right answer as everyone else, but kept private."

The general consensus from the students was that the Clickers helped them validate their own learning (4.5/5), helped them stay focused and motivated towards learning (4.5/5), increased the students' interaction (4.5/5) and involvement (4.4/5) in the laboratory environment. Students strongly agreed that using the new technology – the Clickers – enhanced their learning (4.5/5). Full details are shown in Figure 6.

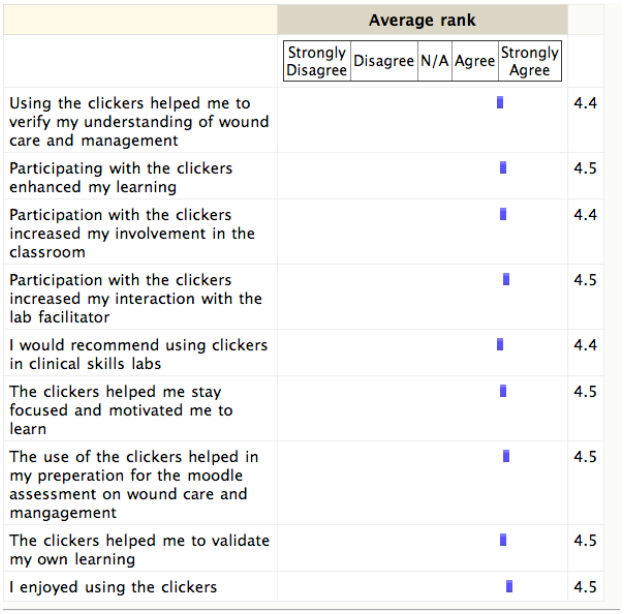

Figure 6: Students thoughts on using the ARS - Clickers

CONCLUSIONS

This paper has presented an analysis of the perceptions of Irish nursing students of various based technology supports designed to enhance their learning and skill acquisition in the laboratory and classroom. Some of these tools were introduced to assist with personalised learning in big classes, but had an added result of greater student engagement. For the majority of students this is a positive experience with the technology tools greatly assisting their learning. Although the sample group was small, it bodes well for future integration with lecture and laboratory material. A greater support system needs to be in place to support students with this new influx of technology in their learning environment, thus ensuring that they are not intimidated.

A further study is required with a larger group of students, possibly across several departments or Universities. The results from this pilot study show the benefits and advantages of using technology to educate and train our students. From this, an enhanced or improved method of teaching, resulting in higher knowledge retention rates, will emerge and benefit all – from the students to the end users- in this case – the general public.

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Sustainable Mountain Development and ICT: *Furthering Cooperation between the Rocky Mountain States and Central Asia*

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ABSTRACT

This paper highlights the new opportunities presented by ICT to the mountainous developing nations with contribution from the communities of the Rocky Mountains of the United States to sustainable mountain development pursued by the United Nations. In this paper we analyze the current situation in mountain countries in Central Asia where geographical location constitutes main constraints for people in education, employment, participation in governance and business. We discuss the initiatives for sustainable mountain development by use of ICT-applications to promote values of democratic society and good governance through capacity building and networking between educators, legislators, and critical thinking among the people of Central Asia through independent e-media. The initial activities in deepening ties between the Rocky Mountain States of the Northern America and Central Asia demonstrate the increased interest among players to such type of cooperation for sustainable mountain development. In addition, we suggest further ways in facilitating networking for sustainable mountain development through use of ICT by joining efforts of all active players.

Keywords: ICT for Development, E-Government**,** Open Source, Sustainable Mountain Development, Mountainous Nations.

1. INTRODUCTION

It is well known today that ICTs give to everybody new opportunities for development. However, lack of access to them in mountainous regions creates obstacles to people for individual and social advancement as well. That causes challenges for them in education, employment, participation in governance and business.

Needless to say, there are many barriers to people in remote areas for access to ICT especially in mountain countries. Geographical location constitutes main constraints together with limited infrastructure, lack of necessary equipment, hardware, affordable software and low Internet penetration. Due to that, citizens in general lack an understanding of the opportunities made available by ICT.

This paper highlights the new opportunities presented by ICT to the mountainous developing nations under the umbrella of the sustainable mountain development pursued by the United Nations with more contribution from the mountainous communities of the United States (U.S.) in networking and capacity building. The paper analyzes the current results and future potential of ICT for mountainous developing nations. The authors of this paper have participated in a number of activities in developing this new approach and further implementation steps.

The paper is organized as follows: strating with background information in Section 2, it discusses the importance of ICTs for deeper ties between mountainous nations in Section 3. Subsequently, Section 4 considers the ways and initiatives for cooperation between the Rocky Mountain States of the Northern America and Central Asia, in particular Kyrgyzstan through use of ICT applications for networking, capacity-building, and supporting independent electronic media outlets. Finally, the paper concludes with recommendations for future work in facilitating networking for sustainable mountain development through use of ICT by joining efforts of all active players.

2. BACKGROUND

Central Asian mountainous nations since independence developed ties with several states in the Rocky Mountains, such as Utah, Montana and Wyoming with an emphasis on Sustainable Mountain Development (SMD). They managed to convince several institutions from the Rocky Mountains and Utah Valley University (UVU) with the Utah-Russia Institute in particular to be pro-active in that area. As a first step, they joined the Mountain Partnership in 2006 and held different regional events in the states of the Rocky Mountains on the basis of existing worldwide programs of cooperation with a focus on Central Asia.

One of the active promoters of the idea of SMD is Central Asian nation Kyrgyzstan. It has a population of 5.2 million. Over 90% of the territory is covered by vast mountains and 65% of its population lives in mountainous areas [1]. This land-locked, mountainous country has a predominately rural population that is relatively poor. At the same time, the country has some advantages. Further integration of Central Asia and Kyrgyzstan in particular to the regional trade with a prospect of a large increase in land-based cargo could bring them benefits because of their location at the intersection of some of the largest markets in the world: China, India and Europe. Kyrgyzstan is committed more than its neighbours to democratic reform and has a vibrant civil society, including a vigorous NGO sector and a clear independent, although small, media sector [2]. National Strategy "ICT for Development of Kyrgyz Republic" with focus of effective use of ICT in the area of governance, economy and education was approved in 2002 and Council on ICT for Development was established under the President of Kyrgyz Republic [3]. More than 150 public access points established in the regions with the assistance of the international donor community with the aim to provide access to computer literacy courses and Internet services. Although the mountainous terrain of much of Kyrgyzstan makes network expansion countrywide a difficult task, but there is clearly a potential for growth [4].

Kyrgyzstan was one of the first countries who proposed in 1998 the initiative for international community to focus on the problems of the mountainous nations world-wide caused by such features of geography as high altitude, remoteness, harsh natural living conditions, etc. Due to that mountainous areas are experiencing high unemployment, poverty and becoming breeding ground for violence and terrorism. For example, data for 2006 say that of the 27 military conflicts around the world 25 took place in the mountainous areas [5].

Because of such initiative and further support to it from the global mountain communities, the United Nations designated 2002 as the "International Year of the Mountains (IYM)" [6] and held a First Global Mountain Summit in Bishkek as a sign of recognition of contribution of Kyrgyzstan to this initiative. [7].

Further, a new coordinating institution for global mountain activities, "Mountain Partnership" was created under the United Nations Food and Agriculture Organization in Rome [8] (www.mountainpartnership.org). There were the World Bank, the different U.N. institutions, developed countries like Switzerland, France, Germany, many mountainous countries in transition and NGOs among the major supporters of the "Mountain Partnership".

The U.S. supported the U.N. resolution celebrating IYM and various institutions and NGOs participated in the activities under the IYM agenda, including the Summit in Bishkek and some of them joined "Mountain partnership" [9].

However, the U.S. on a federal level was not actively involved in subsequent activities promoting the U.N. sponsored SMD initiative, as it was done by such European nations as Switzerland, Italy, France, etc. This could be explained by different priorities of the U.S. on a federal level and not enough level of awareness of those issues among the mountain constituencies nation-wide. Therefore, the initiative of Central Asia and the Rocky Mountains in joint cooperation under SMD agenda was very timely and got support from the Mountain Partnership.

3. ICT FOR MOUNTAINIOUS DEVELOPING COUNTRIES

The Declaration of Principles, adopted on 12 December 2003 at the World Summit on the Information Society in Geneva [10], emphasized that the development of ICTs provide enormous opportunities for people in remote area who should be key actors in sustainable development.

Taking into account all challenges and opportunities for ICT use in mountainous developing countries like Kyrgyzstan it is evident, that ICT can provide more opportunities for people in remote areas by creating an environment, including through training, where they feel comfortable participating in community development activities and advocating for their needs and priorities of economic empowerment. In this regard it is important to develop ICT-based tools that address specific needs in mountains.

High illiteracy rates of citizens in mountain regions and lack of ICT training are two of the most serious barriers that prevent them from entering the information economy. Continuing gaps in education due to lack of mobility and socio-cultural practices that downplay the importance of education in remote regions, constitute enormous challenges for the mountain nations. New technologies allow the process and content of education to be adapted to learner preferences and priorities, thus opening up possibilities for designing and providing education in forms that are locally relevant. ICT literacy programmes, business planning courses, e-trainings access to market and trading information services and e-commerce initiatives can offer economic opportunities in salaried employment and entrepreneurship for rural people. As producers and distributors of goods and services they can capitalize on the potential of these technologies as knowledge and networking tools.

Organizations in mountainous area can gain access to news and pertinent information that allows them to conduct research and participate in global mountain initiatives, collect and share information on specific issues related to the life in the mountains.

It is well known now from the world-wide experience that ICT is a forceful tool to improve governance and strengthen democracy and citizen empowerment [11]. In recent years, e-governance has become a priority area of many governments resulted in the implementation of programmes that apply ICT in delivering public services and promoting transparency and accountability [12]. The main focus of e-governance shifts on using new technologies to strengthen public participation in the democratic processes and reduce the digital divide [13]. It can help foster transparent governance by enhancing interaction between government and citizens in the mountain regions, revitalizing civic institutions and public debate, promoting equity and equality, and empowering minorities. Best world experience shows that citizen centric governance involves meaningful participation of people particularly from remote area in all levels of decision-making and ensuring greater transparency and accountability in government [14].

In this regard, UNDP and UNU-IIST Center for Electronic Governance in response to Kyrgyz Government request provide advice in the field of ICT for Development () and e-governance. They help to the country's integration into the world information society, to foster use of ICT as a tool for achieving the Millennium Development Goals. Both UNDP and UNU-IIST Center for Electronic Governance promotes improvement of public services delivery and access to them by supporting development of e-public services and building human and institutional capacity in government institutions in the area of e-governance. UNDP assist the country in three key areas: national policy formation, capacity building in ICT4D and e-governance, and also practical implementation of ICT4Drelated projects. UNU-IIST Centee for Electronic Governance is contributing to capacity building activitiesin e-government.

In terms of practical ICT implementation, UNDP helped the government to establish a national computer network and create its own web presence through the governmental portal www.gov.kg. UNDP assisted the private sector with creation of the Association of Telecommunication Operators and with other donors the first Public Access Points (PAPs) have been established.

Among significant achievements of UNDP support in Kyrgyzstan in ICT4D area are establishing 12 pilot e-municipalities in rural villages including land management and local tax administration [15]. Public Information Centers (PIC) and awareness raising activities open up the opportunities for access to government information and public services. As a result citizens in those areas before going to the government agencies to receive any public service [16] can familiarize with rules and procedures for services from the government web sites. PICs provide trainings on computer literacy and e-trainings for different groups in the mountain regions on reasonable chargeable basis. The main priorities are small- and medium-business planning and land relations. People can communicate and share information and knowledge in the global networks through the worldwide Internet recourses.

However, it should be noted that there is a need to widen e-municipalities with Public Information Centres in remote areas. This will help to providea multitude of services like Internet, e-mail, computer literacy courses and e-trainings in all 527 Ayil Okmotu all over the country. They would offer an invaluable resource to enable people to use, produce, disseminate and share knowledge and information, and thereby to contribute to their communities' and countries' economic and social growth. Education and trainings in computer skills should be extended in the mountain regions. To make more affordable and accessible ICT facilities in rural area, Open Source technologies should be used more widely for knowledge sharing and distance learning.

4. COOPERATION BETWEEN THE ROCKY MOUNTAINS AND MOUNTAIN NATIONS OF CENTRAL ASIA

4.1. Approach for Cooperation

The partnership on the state level with U.N. related Mountain Partnership and Mountain Forum have the potential for deeper involvement of the U.S. mountains states in SMD globally and in Central Asia in particular. Joint efforts of the most active actors in SMD from one side and ICT4D and e-Governance from the other side will facilitate SMD through ICT. Such approach allows mutually beneficial interaction between the two regions. One of the specific features of this approach for cooperation between two regions is engagement of private IT companies from U.S. to support joint projects and activities.

Human and institutional capacity building in mountain countries of Central Asia in the area of Democratic Governance, ICT4D, Networking and Knowledge Sharing with U.S. mountains statesand also research activities related to ICT enabled SMD are the key among joint activities. Exchange of the best practices and other knowledge resources related to mountain development can provide significant benefits to the partners from both sides. A number of exchange initiatives and ongoing projects discussed in this paper intend to facilitate networking and knowledge sharing processes between the mountain nations in U.S and Central Asia.

4.2. Networking

IUK as one of the hosts of the First Bishkek Global Mountain Summit in 2002 and an active promoter of SMD continues partnership with UVU in further expansion of networking between the key institutions in the Rocky Mountains and Central Asia interested in SMD.

International Conference "Women of the Mountains" highlighted the new approach and potential for networking in particular. Dedicated to the fifth anniversary of the IYM, it was hosted by UVU jointly with IUK and Kyrgyz National Centre for Development of Mountain Regions on March 7-10, 2007 in Orem, Utah. It was supported by the U.N., the World Bank, and others. Their representatives, the U.S. State Department officials, the Ambassadors from 5 mountainous nations to the U.S. and the U.N. took part at the Conference together with 110 officials, scholars and experts on women issues from 22 nations. [17].

The event has broken the old stereotype about the negative attitude to the U.N. in the rural part of the U.S. The Conference, which was held in a friendly and hospitable environment, was a success from all points of view. It has allowed for the first time in the U.S. to gather representatives of the majority of ts mountainous states under the U.N. agenda. Its final document titled "The Orem Declaration of Mountain Women" defined a strategy for mountain communities to deal with challenges for women's life in the mountains globally and helped the communities of North America to be deeper integrated with activities of the UN-related institution like the Mountain Partnership and the Mountain Forum [18]. It achieved also an important goal to assist mountainous nations in SMD. Currently UVU is working on preparations for the second Conference "Women of the Mountains", which is scheduled to be held in the fall of 2010 in Orem, Utah, economic realities permitting.

A permanent interactive web site of the Conference www.WomenoftheMountains.org was developed in order to disseminate information and stimulate dialogue between mountainous nations.

In this regard the Secretary General of the U.N. in his report to the General Assembly of the U.N. on SMD on August 9, 2009

mentioned among the major developments in this area that "the Rocky Mountains there established a regional network on sustainable mountain development" between mountain nations in Central Asia..." [19].

Legislative exchanges represent an another priority area for networking and a way to promote democracy-building.

- At the beginning, the Speaker of the Kyrgyz Parliament Marat Sultanov visited Utah on February 3rd-5th, 2007 at the invitation of President John Valentine, Utah State Senate. During the visit Kyrgyz side took part at a conference call between legislators of the state of Utah, Montana, State Department and Speaker of the Kyrgyz Parliament, when all participants discussed the possibilities of further building networks and exchanges between legislators from both regions.
- In reciprocity, President John Valentine visited Bishkek on October, 1st 2007 together with Montana Senate Majority Leader Carroll Williams as a first bi-partisan legislative group from the Rocky Mountains ever to visit Central Asia. As a practical step in further networking and capacity building, President Valentine and Senator Carroll Williams discussed the idea of creation of the Parliamentary Center at Kyrgyz National University (KNU) with active use of ICT as a platform for dialogue and capacity building.
- Then, on February 2008 President John Valentine hosted in Utah a group of former members of the Parliament and opposition leaders of Kyrgyzstan led by Mr. Omurbek Tekebaev, Chairman of the "Ata-Meken" party, whom he invited during own visit to Kyrgyzstan. The visit further strengthened potential for networking of legislators between two regions.
- The same approach was used when the delegation of the members of the Tajik Parliament visited Utah in December 2007 and the following trip to Dushanbe of the group of the State Senators led by President John Valentine took place in June 2008. The goal of each visit was to exchange experiences in particular areas of SMD with further deepening of networking potential between two regions. Initiative was supported by the "Open World" program of the Library of Congress, which has sent several Central Asian delegations to Utah during 2008-2009.

Cultural Exchanges as essential tool in facilitating understanding and dialogue between both regions helped to build networking as well. UVU hosted in January 2008 a music group "Kut" from Kyrgyzstan as a part of their tour to the Rocky Mountains, arranged by VISTA 360 from Wyoming.

4.3. Knowledge Sharing and Capacity Building

This area of cooperation includes:

Educational Exchanges and Programs - UVU has ties with such educational institutions in the region as:

- IUK as a main partner in promoting the agenda of SMD between the two regions. In parallel with traditional programs of exchanges of students and faculty partners are developing a network of different NGOs and public institutions in Central Asia interested in cooperation with the Rocky Mountains. IUK expands currently its existing project on distance education with the Contemporary Humanitarian Academy in Moscow with involvement of several universities in the region, including UVU. UVU works on applying for a Fulbright scholarship for its faculty member with experience in capacity building and knowledge sharing in mountainous areas of Mexico who will be hosted by IUK during 2010-2011.
- Kyrgyz-Turkish Manas University (KTMU), which cooperates with UVU on a number of projects, including a joint research on the traditions of the rule of law and good governance among the people of the region on the basis of the 11th century manuscript "Glory of Wisdom" written by the famous philosopher Yusuf Balasagun. During the Conference in August 24-28, 2009 in Bishkek, partners organized an on-line session of the paper presentation by UVU representatives, who took part at the Conference.
- In parallel with the networking efforts from the President of Utah State Senate, UVU is working with the KNU on establishing the independent Parliamentary Center in Bishkek as a research and analytical institution, with enabling knowledge sharing and capacity building across Central Asia. As part of the contribution to the Centers development, UVU will provide access to its e-library for students and faculty of KNU.
- Two Fulbright scholars on independent media from UVU and Brigham Young University (BYU) are already working at AUCA. UVU already has several students from Central Asia.

4.4. Independent E-Media Outlets

Project pursues two intertwined goals aimed at the audience in Central Asia: first, to promote best examples of SMD in both regions by using capacities of local media; second, to promote ideas of open societies and critical thinking in particular through presenting a diversity of views on current situation in the region and worldwide from different global sources of information.

Current regimes in the region have tightened controls over the flow of information and have put more restrictions on freedom of speech [20]. Due to that it has become even more important to expose Central Asians to the broadest possible diversity of opinions from the international mass media. The easiest and the most accessible way to do so is to publish articles translations in Russian and Kyrgyz languages about the region and global politics international English media outlets on different Central Asian websites and printed media.

A project is aimed at disseminating such type of publications by posting them to a Web-site www.Zpress.kg, of the independent news agency "Zamandash-press" created in 2007. This agency focuses on the problems of migrants from Kyrgyzstan in foreign countries.

The project was developed by the Fulbright scholar Dr. Kuban Taabaldiev at the University of Montana in Missoula (2007), who studied the experiences of local media outlets in the United States. In parallel, he was involved in SMD agenda and presented a paper on the media situation in Kyrgyzstan at the International Conference "Women of the Mountains" at UVU. Back in Kyrgyzstan, he helped to implement joint projects for UVU with IUK, KTMU, KNU, etc. As a director of a news

agency he also made the issues of the SMD and cooperation between two mountainous regions an additional priority to the activities of his agency. The Web-site has already posted under special banners information about ongoing projects between UVU and IUK, KTMU and others.

As a result, the agency translated and disseminated among more than 50 different Web-sites and regional media outlets in Russian and Kyrgyz languages 80-120 articles monthly during 2008-09. The materials produced have been published with further translation into Kyrgyz in local newspapers, such as "Uchur", «Achyk sayasat», «Zaman Kyrgyzstan», etc. More than 40 western media outlets were used as sources for the original articles, including the New York Times, Economist, Financial Times, etc. Special attention is paid to the translations of the articles from Rocky Mountain media outlets, dedicated to the SMD and issues of cooperation between two regions.

Currently the agency plans to expand its services by including media sources in languages different from English. On its part UVU plans to involve students and faculty of UVU in the project by providing additional translated materials to the ones done by the news agency in Kyrgyzstan. It also is developing a new web site for the agency.

4.5. Open Source Initiatives

An approach to breach the technology gap between mountain developed countries and the ones in developing world including Central Asia is the use of Open Source technologies, which offer a variety of applications that will greatly enhance business and government operations at a very reasonable cost [21]. It will be also very important and effective tool for enforcing women's potential in the countries of the region.

As one of the practical approaches to do so it has been proposed to establish a training program at one of the universities in Central Asia and in particular at the AUCA. The main goals are to train business and government leaders, women entrepreneurs and leaders of NGOs as well in the use of Open Source software applications. As envisioned, the program will eventually offer both undergraduate training for students at the regional university as well as seminars for government and business leaders throughout the region as follows:

1. Undergraduate training will consist of coursework that specifically teaches the skills needed to use a wide variety of open software applications. In addition to that, the applications will be incorporated into the teaching protocols of the faculty at the university itself. In this way, all students will become familiar with the applications and their uses in the organizations where they will be employed in the future.
2. Training seminars will be one to two week long taught at the university for business, government leaders, women entrepreneurs and leaders of NGOs from Central Asian countries. This training will familiarize attendees with current open source applications and give hands-on experience in their use.

It is anticipated that the program will start by focusing on the students of the university and leaders from around Kyrgyzstan in the first year. Once the program is well established, an effort will be made to promote the training throughout the region and to bring both students and leaders from other neighboring mountainous countries to participate in an expanded training program. The size of the program will be determined by the funding that can be secured.

The selection of the applications to be taught is critical to the success of the program. The courses to be taught will need to be carefully developed to meet the needs of the mountainous region. At this moment UVU is discussing with representatives of the local universities in Central Asia, international financial institutions and several private ICT companies in the U.S. details of the joint activities under the umbrella of this project.

5. CONCLUSION AND FUTURE WORK

As a result of discussions in the previous sections we can conclude that ICTs open up new opportunities to the mountainous developing nations for SMD pursued by the United Nations. Due to high level support of key U.N. agencies in developing countries, particularly UNDP and UNU through its Center for Electronic Governance, ICT became a powerful tool for better governance, access to information and knowledge, human and organizational capacity building and hence, achievement of MDGs. The initial activities discussed in the paper demonstrate the increased interest among players to SMD. Furthermore ICTs enable mountainous communities of the U.S. in networking and knowledge sharing as well with further ability to participate in SMD worldwide.

In this paper we argue that ICTs provide huge possibilities for networking, sharing experience and expertise, training programs and independent e-media outlets through various ways and initiatives to promote critical thinking among the people of mountainous developing nations. We consider a new approach to SMD based on cooperation of mountain communities of the Rocky Mountains of Northern America with partners from Central Asia by engaging active research institutions and private IT companies.

Based on the findings of this research we can recommend for future work in the domain the following initiatives and activities:

1) Establishing close partnership and networking between the most active actors both in SMD and ICT4D, in particular UNU Center for Electronic Governance, Utah Valley University and such Universities in Central Asia as AUCA, IUK, KTMU, KNU for building human and institutional capacity in Central Asian region in the area of Democratic Governance, ICT4D, Networking and Knowledge Sharing and also for joint research related to SMD through ICT.
2) Further mobilizing private ICT companies from the Rocky Mountains to support joint research and development projects between UNU, UVU and Central Asian educational institutions and to foster effective use of Open Source technologies.
3) Further strengthening of the on-line Mountain Forum by creating regional Rocky Mountain network of all institutions and individuals interested in SMD and coordinating its activities jointly with the regional Central Asian mountain network.

4) As a continuation of deepening ties between Rocky Mountain States and Central Asian mountainous nations to organize a second International Conference "Women of the Mountains" with the special focus on gender issues and role of ICT in women empowerment.

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ICT SUPPORTED LEARNING AND THE EVOLVING AFRICAN UNIVERSITIES

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Abstract

The paradigm shift from traditional pedagogy to ICT supported learning in the African Universities is a rapid but very healthy response to present global ICT challenges. The upgrading of African universities as shown by the acquisition of modern technologies and improved infrastructures is already leading to a gradual globalization of the environment of each university. The latter point unflatteringly to observable movement towards information driven higher education system in Africa. From the not too old traditional "white Chalk and Black board "classroom setting comes the electronic driven optical fiber and wireless campus environments. The concern in this paper is however, the concomitant effect of such upsurge in ICT initiatives on a predominantly primitive, illiterate and unprepared African Societies. The extent to which global intervention strategies has propelled a realistic convergence of some assistant i.e. MDG, EFA, UNESCO and other powerful United Nations' aids to raise the ICT literacy level of the typical Africa society is disproportionate. The need to match the functionality of the products of the ICT enhanced African universities with the low level ICT penetrated workplace and illiterate society constitute major concern too.

Preamble

The present decade has seen extraordinary changes in the teaching – learning process, particularly in the African Universities. The evolution of the Information and Communication Technology (ICT) and the globalization of Education have significantly impacted on the Higher Education System in Africa. The paradigm shift from traditional pedagogy to the e-learning methodological approach in virtually all African universities is a rapid but healthy response to the global ICT challenges. These to a reasonable extent can be traceable to the peculiarities of the developing societies wanting to come to terms with global educational demands.

The Universities can however, not exist in isolation. The present African society is still in the infancy with respect to modern ICT technology. Kachale (2008) argued that despite years of development, ICT appears to be still in its infancy in Africa. This situation, according to him, obviously arises from the underlying sociolinguistics and educational context, observable from lack of localized software for major African languages and the scarcity of Web content. The ICT, to a large extent is hence reserved for English as second language, and for those that are hence literate and numerate.

The graduates from these universities are primarily produced to serve the immediate society. The people in the society and the entire workforce, therefore must be given priority attention too with regard to the ICT knowledge and skill acquisition. The later is seen as a logical imperative for the evolving ICT in the African universities.

Problem

The potential of ICT to transform development is now receiving greater attention worldwide (Africa inclusion) (Kabanda, 2008). Many African universities like their nations have yet to build the basic infrastructures needed to take advantage of the information age. They face a major challenge to re- invigorate the university enterprises in its entirely, using the new and rapidly advancing ICTs to build a pathway to the global information revolution (AAU Accessed, 2009). There is no doubt according to them, that the information infrastructure in African higher education is terribly weak compared with the situation in developed countries and much below the operating standard of counterpart institution outside Africa.

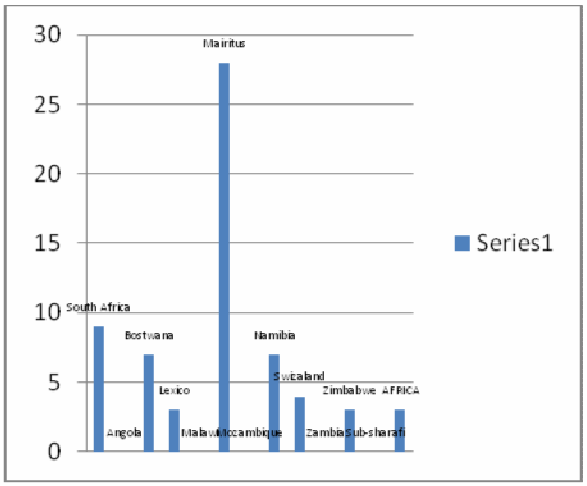
In response to these however and to catch up with global requirements, there is the rapid upgrading of African universities as shown by the acquisition of modern technologies and improvement in infrastructures for quick attainment of global standards. The modern African universities are now ICT conscious. According to Kachale (2008), the relative level of usage of ICT in Africa is hard to quantify but imperative to characterize. It is ripe here to highlight some of the problems that obstruct the ICT skills in the typical African Society.

- ***Digital Divide***:- This is the sharp disparity between the developed and the developing nations in modern ICT acquisition and usage..

- ***Diversity:-*** Africa is a complex heterogeneous society in several languages and culture.
- ***Dependence:-*** There is unimaginable dependence on the technologically advanced world that makes Africa more of consumers than producers.
- ***Declension:-*** The very rapid declension in every systems in most African countries: educational, economic, political etc.
- ***Destitution:-*** Most African countries are still very poor. According to Bandele (2002) & Kachale (2008), most African are poor and hence fails to acquire or access ICT facilities.
- ***Devaluation:-*** The economic depression coupled with political instabilities in Most African Countries account for the devaluation of standards of living.
- ***Degradation:-*** The Climates with the devastating and degradation effect further compounds the numerous problems of the African Society.

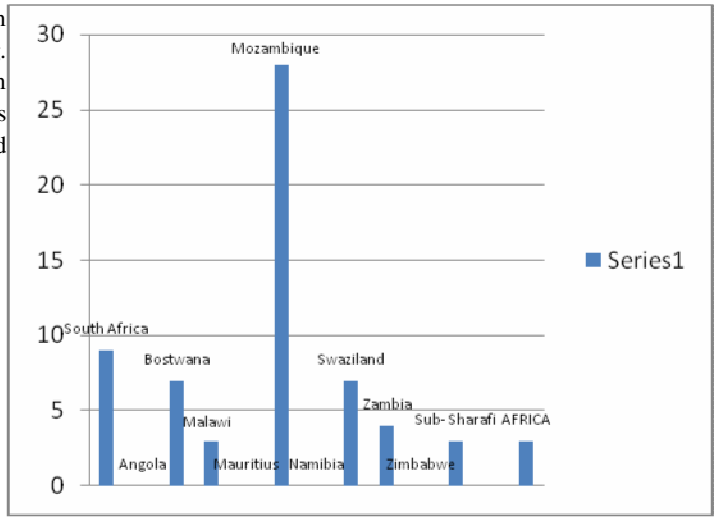
Paradigm

By Paradigm is here referred to as the example, model, patterns standard or prototype of the ICT initiatives on Africa Universities as evident in some African Countries.



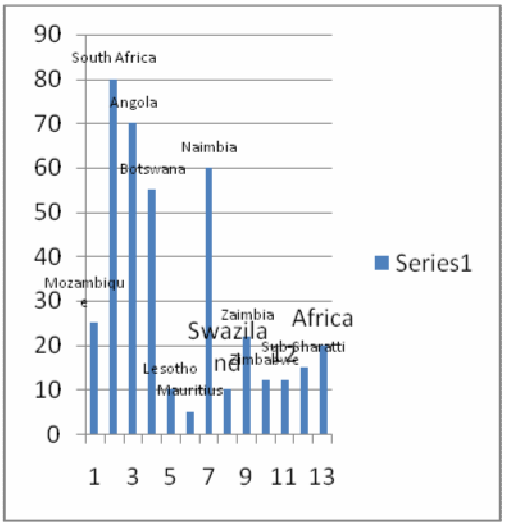
ICT INDICATOR: Teledensity/100

The synopsis of ICT indicators for the Southern African Countries as shown by Kabanda (2008) is quite revealing. Suffice to state here that these are the 'developed' African countries. A list of core ICT development indicators as agreed upon by the international community is presented below for Southern African countries (Kabanda, 2008).



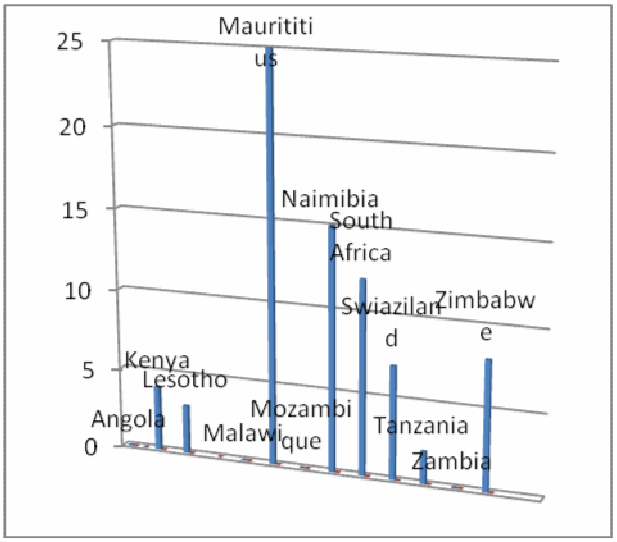
ICT INDICATOR: INTERNET/1OO

Mozambique is disproportionately higher than other African Countries in internet while Mauritius showed very high PC as ICT indicators in Africa.



ICT INDICATOR: MOBILE/1OO

The mobile phone indicator in South Africa and Namibia showed sharp increase as compared to their ICT teledensity. Curiously, Mauritius with high teledensity diminished in mobile phones.



ICT INDICATOR: PC/1OO

Progress

Almost all African Universities have some form of ICT set-up, ranging from dial-up to full internet connectivity with various band-widths (Ajayi, 2002; Herselman & Hay 2003). In recent times however, there is a noticeable high rise in the acquisition and usage of modern ICT facilities in the African Universities. Some Universities in Nigeria, for example, are ICT driven: Obafemi Awolowo University, Ile – ife, University of Ibadan and several other Federal and State Universities. In fact most Private Universities in Nigeria are ICT-driven, same Ghana. The radical improvements in ICT facilities in African Universities will make the globalization of the environment of each university achievable, pointing unflatteringly to observable movement towards information driven higher education system in Africa. There is hence a movement from the not-too-old traditional "white-chalk and black board" classroom setting as against the optical fibre and wireless internet connected campus environment. There are now dedicated interactive boards, modern teleconferencing and video-conferencing facilities that have changed the faces of modern Africa universities.

Though in Africa, South Africa presents a different but encouraging scenario in ICT acquisition and usage. In Hay & Herselman (2003), policies for South African Higher Education acknowledge the imperatives posed by ICT. They claimed that ICT has developed more quickly and provides learning mobility and that South Africa higher education institutions have no other choice but to participate in this information society. African Government are hence becoming more conscious of the need for an information driven society.

The ICT developments in the late 2000s have shown rapid development for learning assisted by a significant improvement Africa-wide in laying down ICT policies at the institutional level enhancement of infrastructural provisions especially lowering of bandwidth costs and capacity building at individual and institutional levels (AAU, Accessed 2009)

In the AAU report accessed, the submission was that ICT into high education in Africa, should be the transformation of the University into a knowledge and information powerhouse, with the ability, capacity and necessary skills not only to educate students and to generate new knowledge, but also to systematically access, absorbs, adapt, and use such information and knowledge for the advancement of national Development (p.8)

Paradox

It is paradoxical that in the contemporary African Society, the level ICT knowledge acquisition and usage is disproportionate between the Higher Institutions particularly the universities and the African society. The upsurge of ICT initiatives to drive teaching, learning and research appear to contrast with the predominantly primitive, illiterate and unprepared African Societies.

According to Naidoo (2003), the key point is that using ICT for development depends upon economic, social, cultural and technological factors. He said further that these factors need to be taken into account when creating an environment and conditions that will encourage and provide opportunities for using ICT to support the development process within countries.

Is the African society ready for the products of ICT driven universities? Are there no incongruence in the relevance of ICT skilled graduates in a non- ICT literate environment? Of what good is the Accounting software without a computer environment to drive it? Any community benefits in the evolution of digitalized learning initiatives in our Universities? Do enhanced ICT skills translate to enhance productivity in the African Context? Are the African Universities matured for ICT? If the information Society is a society in which creation, distribution and manipulation of information has become the most significant economic and cultural activity (National ICT policy for Lesotho, 2004); is Africa an Information society?

These and other similar questions attract answers that will tend to obliterate the potentials of African Universities' ICT programmes at impacting positively on its society. The fallout from the latter is the undeniable need to work assiduously for a knowledge driven African society that will respond positively to the dividends of the ICT Higher Education initiatives.

Plea

The task for us within the education sector, according to Naidoo (2003), is to identify ways of creating those necessary conditions within (and outside) the education system to maximize the benefits of ICT and thus support development. This is becoming increasingly important in

the developing countries (like Africa) that are quickly losing their tradition of lower labour cost. It is of equal relevance that there must be a joint effort of Governments at all levels in every country of Africa to focus on mass Literacy and numeracy programmes for their people. The need for foreign aids in cash and kind cannot be overemphasized.

The extent to which global intervention strategies has propelled a realistic convergence of some assistant i.e. MDG, EFA, UNESCO and other powerful United Nations 'aids to raise the ICT literacy level of the typical Africa society is still disproportionate. The need to match the functionality of the products of the ICT enhanced African universities with the low level ICT penetrated workplace and illiterate society is sacrosanct.

There is hence the urgent need to look *inward* and *outward.* African communities and countries should look inward and deliberately correct the ills of the African society that are delimiting rapid educational emancipation prominent among which is corruption,. There is also the need to look outward into areas where external assistance from the developed world becomes inevitable for the eradication of ignorance and illiteracy.

Recommendations

1. African Universities should shift major attention to a realistic upgrading of infrastructures to meet with current ICT global challenge.

2. African Governments should support Universities to give ageing Professorate needed re-training in the use of ICT to support teaching and learning in African Universities.

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Paving the Way for Inclusive e-Services for All by Identifying Enablers for Upcoming Interaction Technologies

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ABSTRACT

This paper describes a project funded by the Commission of the European Communities (EC) and the European Free Trade Area (EFTA) and carried out by the European Telecommunications Standards Institute (ETSI) in the form of a Specialist Task Force (STF). The starting point of the project is the observation that new information and communication technologies (ICT) are often introduced without taking into account the requirements of elderly and/or disabled users, resulting in products and services that are hardly usable by those users.
STF 377 on "Inclusive eServices for all: Optimizing the accessibility and use of upcoming user interaction technology" develops a roadmap of forthcoming user-interaction technologies with a scope of ten years and aims to identify relevant user requirements from an accessibility viewpoint as well as corresponding usability solutions. The project results will, therefore, allow stakeholders in different stages of the research and development lifecycle (researchers, designers, developers, etc.) of services and devices to spot potential difficulties in the design of service user interfaces which could cause elderly or disabled users to experience usability issues, and solutions that rectify those shortcomings will be proposed. At the time of writing, first results are available. However, any comments and contributions can still be considered for inclusion in the final deliverable.

Keywords: Design for All; Accessibility of novel interactive systems; technology roadmap; standardisation, ETSI.

1. INTRODUCTION

Information and Communication Technologies (ICT) have the potential of facilitating the lives of most users, including those of elderly and disabled people. However, a European Union study from 2005 conducted in 14 European concluded that despite increasing levels of ICT usage in all sections of society, the digital divide is not being bridged [4]. This state of affairs can be attributed to a number of frequently-observed obstacles to the accessibility of ICT devices and services.
Experience consistently shows that user-interface innovations for consumer products are being researched, developed, and introduced without taking into account the needs of people with mild or severe impairments such as elderly people. Many companies do not see a business case in offering barrier-free products.
This situation is made worse by the fact that product and service developers are often unaware of the requirements of customers with impairments, nor are they familiar with appropriate design solutions that may not be very demanding in terms of R&D and production costs.
For most user-interface design tasks, a number of different solutions exist that differ in terms of their suitability for different user groups, which in some cases could be very narrowly defined commercial target groups. A more general user-interface design approach encompasses the selection and combination of various user-interface modalities with the goal of supporting the most diverse user community possible.

The work on future e-Services presented in this paper is performed at European Telecommunications Standards Institute (ETSI) [1] by the members of the Specialist Task Force (STF) 377 [2] under the guidance of the ETSI TC HF (Human Factors). ETSI produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast and internet technologies and is officially recognized by the European Commission as a European Standards Organization. ETSI is a not-for-profit organization whose 720+ ETSI member companies and organizations benefit from direct participation and are drawn from 60 countries worldwide. ETSI Specialist Task Forces (STF) [3] are teams of highly-skilled experts working together over a pre-defined period to draft an ETSI standard under the technical guidance of an ETSI Technical Body and with the support of the ETSI Secretariat. The task of the STFs is to accelerate the standardization process in areas of strategic importance and in response to urgent market needs. The work on personalization presented in this paper is co-financed by the EC/EFTA in response to the EC's ICT Standardisation Work Programme.

Design for all should not be conceived as an effort to advance a single solution for everybody, but as a user-centred approach to providing environments designed in such a way that they cater for the broadest possible range of human needs, requirements and preferences, see [5]. As an obvious example of this philosophy, one solution for increasing the usability of products and services beyond the requirements of target groups such as Western teenagers has traditionally been to offer personalization features to be employed by the users in order to adapt the user interface to their specific requirements. For example, most mobile phones allow users to select individual ringer tones and display backgrounds, to adapt the acoustic frequency range and the visual contrast to their needs. Some manufacturers offer pre-set user profiles for specific user groups such as senior citizens that affect a number of device settings. There are, however, limits to the extent to which personalization of this type can increase accessibility (e.g. the physical design of a product can rarely be significantly personalized by the user and the user is only ever able to select from options that the designer has had the foresight to predict may be required). A true design-for-all approach requires a deep understanding of the range of possible solutions that may be required to meet the specific needs of users who require something different from the "typical user".

2. ETSI STF 377

As the ICT industry has not typically offered designed-for-all innovative products and services, ETSI, the European Telecommunications Standards Institute, has established Special Task Force (STF) 377 on "Inclusive eServices for all: Optimizing the accessibility and use of upcoming user interaction technology" in order to help industry to easily do so in the future. The aim of the task force is to systematically evaluate ongoing and forthcoming interaction technologies in order to sketch a 10-year roadmap of foreseen technological enablers. Without the early involvement of a design-for-all perspective in product research and development, there is a risk that large groups in quickly aging societies will be left behind, not participating in the anticipated technology progress. This paper presents the STF's motivation and approach to forecasting, analysing and structuring future interaction technology developments as well as first results of the expected access techniques foreseen for these novel systems.

The prime objective of STF 377 is to break the historic pattern where addressing the requirements of people with disabilities has often lagged significantly behind the initial availability of innovative new technologies. This pattern is so common because new applications and sometimes disruptive technologies have in the past been developed for and targeted at mainstream consumers and frequently at well-defined target groups of early adopters e.g. the wealthy (in the case of the TV) or the technology-aware (as in the case of the PC or the Internet). Those technologies did not include the easy accommodation of the requirements of people with disabilities. Subsequent measures for compensating these shortcomings have often been late and costly. Listed below are some examples of the inadequate introduction of new technologies:

1. Personal computer (PC): The first PCs with character-based user interfaces were easily usable by blind users with a Braille-reader device. The advent of graphical user interfaces (GUI) suddenly excluded blind users.
2. Document file formats Documents produced in earlier graphics-based versions of the PDF-format were not accessible to blind users.
3. The Internet The problems are similar to the ones described for the PC, as early computer services (e.g. gopher services and first E-mail services) were text based and later replaced by graphical interfaces such as web browsers. The Web Accessibility Initiative (WAI) stepped in late, and took long to evolve if compared to the very dynamic development of web technologies.
4. MP3/media players Many classic cassette players have mechanical switches and mechanisms that rely on the physical insertion and turning of a cassette to select different audio segments. However, modern MP3 players are increasingly relying on on-screen interfaces with few, if any, physical controls to offer suitable feedback and are therefore unsuitable for people with poor eyesight.
5. Biometric systems Biometric applications are more and more used for supporting authorisation and access control. People with disabilities (e.g. physical or speech

Table 1: Service-component profiles

e-Services	Service Components					
	Voice Conversation	File Sharing	Form Filling	Application Download	Information Browsing	…
eGames	X	X		X		
eGovernment	X		X	X	X	
eHealth	X		X	X	X	
eLearning	X	X	X	X	X	
eBanking	X		X	X	X	
…						

Table 2: Interaction modality profiles

Service Components	Interaction Modalities					
	Haptic Output	Visual Output	Touch Input	Audio Output	Audio Input	…
Voice Conversation				X	X	
File Sharing	X	X	X			
Form Filling	X	X	X			
Application Download	X	X	X			
Information Browsing	X	X	X			
…						

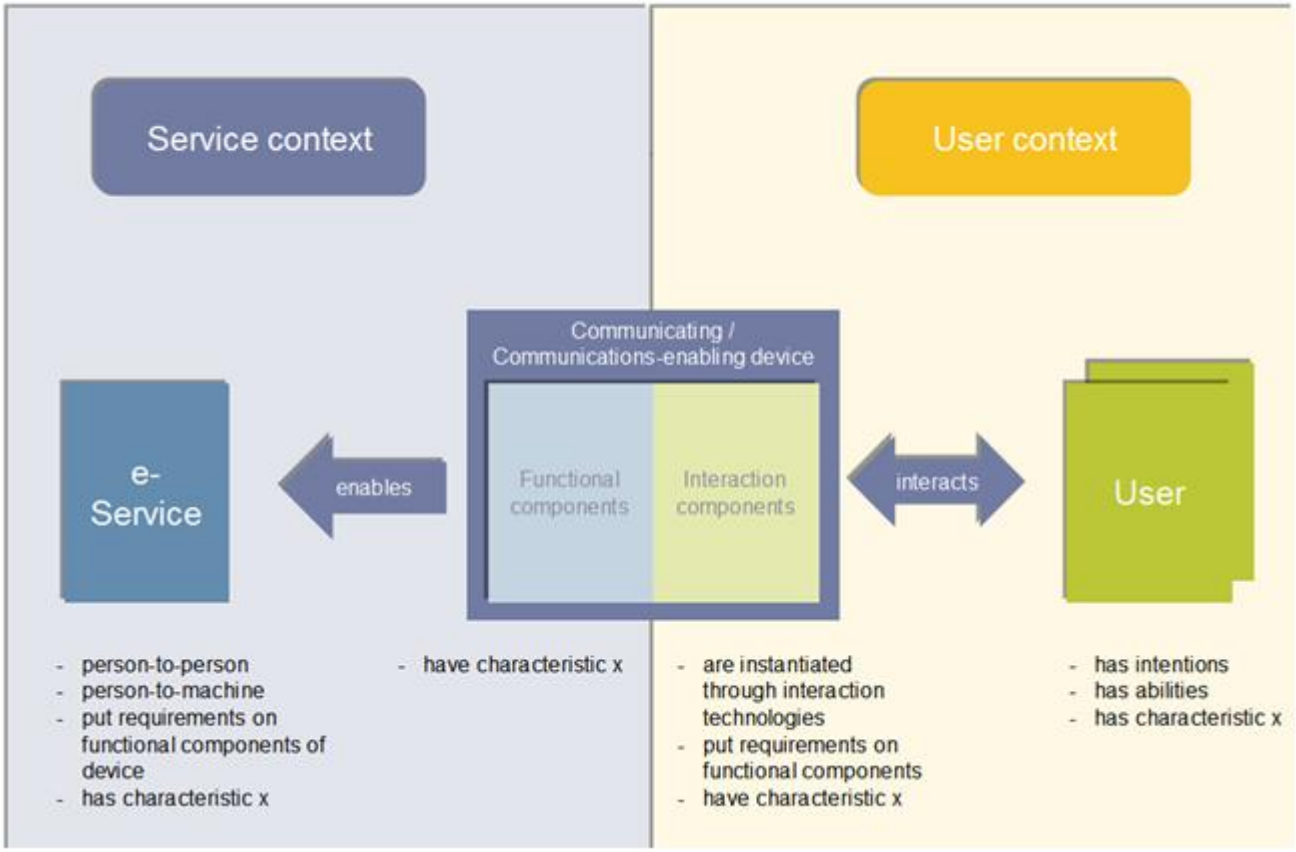

Figure 1: Conceptual framework contrasting User and Service Contexts

impairments) are likely to face barriers as users of these systems. Multimodality may contribute to accessibility in this field, as well as to higher levels of performance and user acceptance.

It is likely that the conception and development of forthcoming interaction technologies, such as natural-language input, gesture recognition, haptic and tactile interfaces will follow a similar pattern. The approach promoted by the project is that the specific requirements of elderly users and users with disabilities should be taken into account prior to the large-scale introduction of such technologies, and should be turned into provisions that have to be made prior to or at the introduction of each new technology in order to meet the needs of all users, thereby achieving a "Design-for All" approach).

Previous publications have produced an excellent basis for educating device and service designers about the requirements of older users and users with disabilities and for illustrating inclusive design for accessible eServices (see e. g. [6] for a detailed overview of design-for-all requirements for telecommunications products and services). However, the current literature focuses on existing technologies. The developers of innovative new technologies may be unaware of these resources and, if they are, it may not be easy for them to apply guidance from them to the development of new technologies.

There is a need for an analysis that anticipates the demands of new interaction technologies and for the provision of appropriate guidance in the form of design guidelines that document in which ways users with different abilities will be affected by a new technology and how accessibility obstacles can be overcome.

3. METHOD AND FIRST RESULTS

STF 377 will in October 2010 publish an ETSI Guide (EG) as the main deliverable that will contain guidelines on service design, the interaction technology roadmaps, accessibility problems identified, and proposed solutions for rectifying those problems. The first steps of this work, however, will be an analysis of forthcoming eServices and of the novel interaction technologies enabling them. The results of this analysis will be published as a separate ETSI Technical Report (TR).

Throughout this work, the focus is on the user, and how the user interacts with an e-Service. From the user perspective e-Service can be said to consist mainly of two parts; functional components and
interaction components. User intentions have to be propagated through both interaction components and functional components to achieve interaction with the e-Service. The technologies used with e-Services are predominantly related to the interaction components of communications-enabling devices allowing the user to interact with the device. Examples of these are voice interfaces or text-entry interfaces. The functional components of those devices that enable communication of the device with e-Services such as data-exchange protocols and networks have to answer to both the demands of the e-Service and the interaction components, see Figure 2. Since they do not effect the users interaction with the e-Service to any great extent they are not in

the scope of the method described. In the course of the project the following tasks are being performed:

1. Analysis of forthcoming services

The analysis of existing and forthcoming services leads to the selection, definition, and categorization of the services covered by the ETSI Guide. Those include services such as eHealth, eGovernment, eLearning, eCommerce, travel, and leisure, as these and other services are likely to affect older and disabled citizens and consumers.

2. Analysis of likely service component profiles for each service category

The services within the scope of the ETSI Guide (result of task 1) will be analysed in terms of their likely service component profiles. This is done by defining the service components a service can be expected to employ. Table 1 illustrates the underlying rationale of this step and lists voice conversation, file sharing, form filling, application download, and information browsing as examples of service components.

The service components are then mapped onto interaction modalities such as haptic ouput, touch input, visual output, audio input, and audio output (see Table 2 with examples).

At this stage, any eService can be broken down into relevant interaction modalities. At the next step, forthcoming interaction technologies need to be identified that are likely going to be employed for those forms of interaction modalities.

3. Analysis of forthcoming interaction technologies (technology roadmaps)

Roadmaps of forthcoming user interface technologies are being developed by employing established R&D procedures. During this step relevant interaction technologies for the services defined in step 2 will be identified. Figure 2 shows a technology roadmap with example data for illustration purposes.

The basis for this work is desk and internet research as well as expertise from subject matter experts in the various fields. One obvious problem is that technologies being developed by commercial companies are classified until they are being released to the market in the form of new products. Interviews with R&D staff of those companies are still worthwhile as they are usually free to discuss their view on general trends of user-interface design and related technologies.

Another major source for information are conference papers and journal articles that report cutting edge developments.

For each user-interaction technology, a number of characteristics are being collected in the form of a database. Among the data collected are:

- A description of the technology, related technologies, and expected mass-market deployment;
- User requirements in terms of user capabilities required for making use of the technology;
- Benefits for all users and potential benefits for users with disabilities;
- Cultural issues:
- Deployment pros and cons;
- Solutions for overcoming the exclusion of disabled users, implementation requirements for the solution, and harmonization issues.

4. Matching of interaction modalities and interaction technologies roadmap

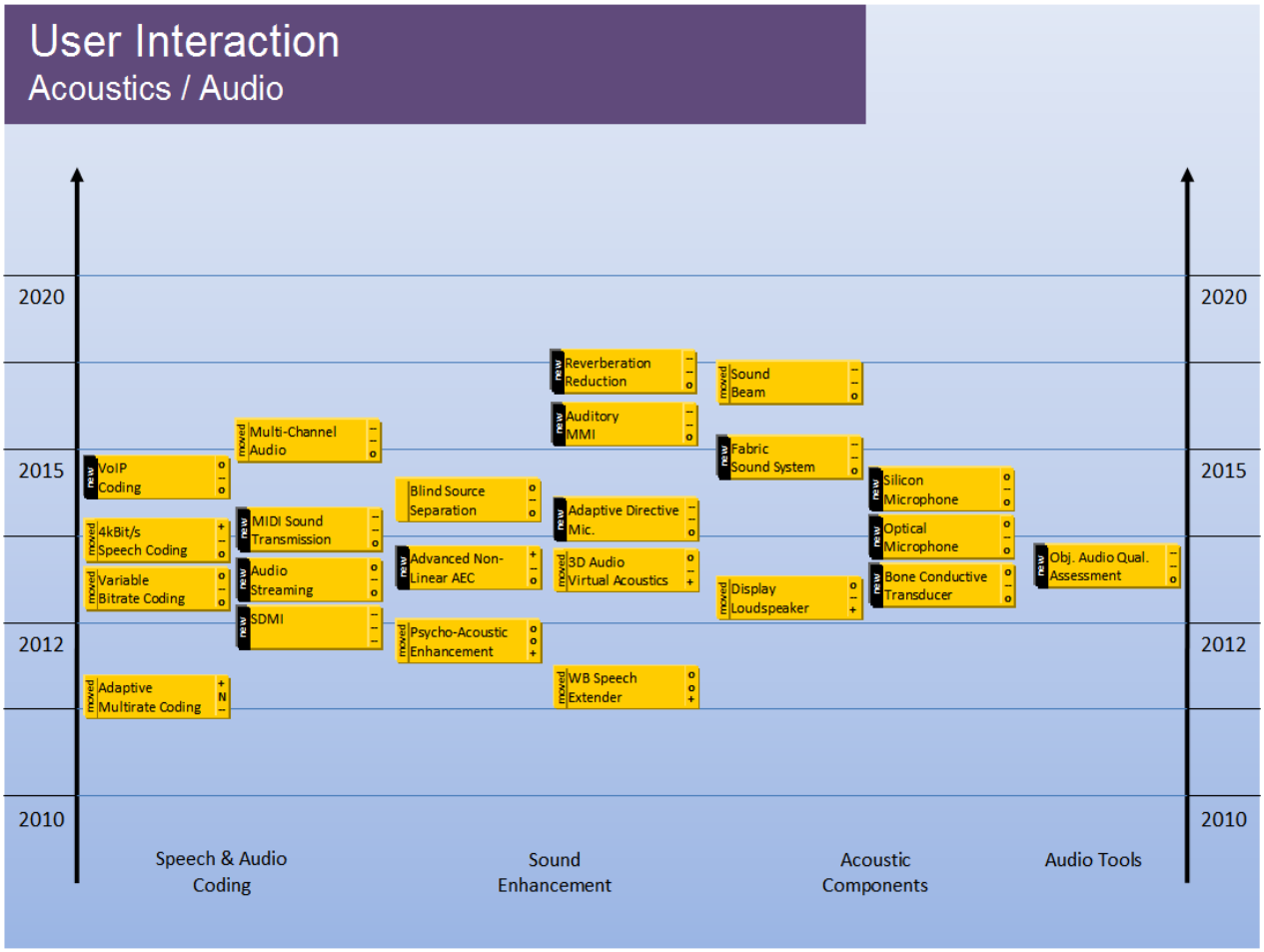

Figure 2: Example technology roadmap

In the fourth step, the interaction modalities identified in are being mapped onto the interaction technologies identified in step 3 (see Table 3 with a representation of that process with example data). The resulting modality-technology profiles establishes the relation between services and their possible interaction technologies which can be used to identify solutions for design-for-all provisions required

5. Design-for-All provisions for new interaction technologies

The outcome of this step will be the definition of provisions that have to be made prior to or at the introduction of each new technology in order to enable the support of emerging services for older and/or disabled users and citizens. Standards on accessibility to ICT, such as [6] and [7] will be used as methodological references to ensure that the accessibility requirements of the ICT-human interactions are covered when analysing new interaction technologies and styles. In addition to them, scientific and technological papers and reports on human factors of each interaction style and technology are being reviewed.

As many solutions such as multimodality (i.e. offering different interaction channels for better suiting every user's needs and preferences) apply to many of the user-interface technologies studied, these solutions will be presented in the form of detailed guidelines. In addition, interaction technology areas needing human-factors standardization work will be identified.

As an example of our work in a particular interaction technology, a preliminary list of user requirements based on [7], [8], [9] and [10] has been identified for the Head-Worn Displays (HWD), within the Visual Augmented Reality style:

- Users need to perceive visual information:
  - Renderings should disambiguate information about distance or position (eliminate depth ambiguity). This can be achieved by using the appropriate clues (e.g., motion parallax, size-constancy/scaling, transparency, occlusion, binocular clues, etc.).
  - Proper motion physics should be used for modelling the environment and moving objects. This can be achieved with properly defined geometries and metrically-accurate models of the environment that rotate and move in realistic ways.
  - Users should be able to select perceptual cues. Specific perceptual cues (e.g., motion parallax, binocular clues, or size-constancy/scaling) should be selected if displays are operating in an environment of a limited range of depths/distances, or according to user accessibility needs.
  - Information should be displayed in order to be accommodated to human visual sensitivity. To achieve this, unneeded AR motion (e.g., the slowly moving self-organization of rendered AR tags) should be removed.
  - Text should be readable with reduced visual acuity. To achieve this, ensure that the algorithms for text presentations are robust to ensure that text is readable with reduced visual acuity.
  - Visual information should also be available in auditory and tactile form.
- Users need to understand the output or displayed material (even after they perceive it accurately).
  - A rule space should be defined. For instance, Obscured Information Visualization (OIV) applications should define conditions under which augmented information should be displayed. For example, if the viewer knows that augmented information will only be presented on hallway surfaces or only within the confines of the building, then these rules can help disambiguate otherwise vague location information.
  - Visual information should also be available in auditory and tactile form.

Table 3: Modality-technology profiles

Technologies	Interaction Modalities			
	Haptic Output	Visual Output	Touch input	…
Audio input				
- Ambient noise reduction				
• Noise cancellation				
• … other Ambient noise reduction				
- … other Audio inputs				
Sensing technologies				
- Location sensing				
• GPS tracking		X		X
• Passive RFID				
• … other Location sensing		X		
- Anonymous presence sensing				
• PIR sensors				
• Fixed in-device cameras				
• Hand-held cameras	X	X	X	X
• Wall-mounted cameras				
• … other cameras	X	X		X
• Infra-red beams				
• … other Anonymous presence sensing				
- … other Sensing technologies				
… other technologies				

4. DISCUSSION

ETSI STF 377 will publish an ETSI Guide (EG) that will allow designers and implementers of novel user-interface technologies or eServices to assess at a very early stage whether a proposed product or service potentially excludes elderly and/or disabled users and to learn about corrective solutions ideally to be applied as part of the mainstream design process prior to the market introduction of the device or service. The entire path from eService to individual provisions made for specific technologies is available for a number of eServices but can be easily applied for services not explicitly covered in the ETSI Guide. The work in progress can be followed under [2], the final document will be available for download at [1].

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Internet-Based Psychiatric Interventions: Applications for Rural Veterans at Risk for Suicide

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ABSTRACT

The Internet is increasingly used to host interventions to treat depression, anxiety, post-traumatic stress disorder, and substance abuse. It is also used to deliver suicide prevention interventions and has particular potential for reaching groups facing distance barriers to healthcare or who are socially isolated, factors which can increase risk for suicide. Veterans with mental health problems living in rural areas pose particular access challenges for Veterans Health Affairs (VHA), the federal agency charged with providing their healthcare. Rural Veterans can easily become isolated from mental healthcare providers. Telemedicine provides some access but requires knowledge of its operation by the user as well as the proper equipment and venue. VHA recently launched an Internet crisis chat service to help address this issue. In this paper we review the field of Internet-based psychiatric interventions and discuss the potential of online applications to deliver suicide prevention for rural Veterans.

Keywords: Internet, psychiatric interventions, rural, Veteran and suicide

1. INTRODUCTION

Veterans of US military service living in rural areas have worse health, poorer quality of life, and greater access barriers to healthcare providers [1]. Suicide risk among Veterans is higher than the general population [2]. Suicide risk increases with a diagnosed mental disorder, particularly depression or post-traumatic stress disorder (PTSD), and is exacerbated by anxiety and substance abuse. Life stressors including financial trouble, job loss, or conflicts within personal relationships add further risk. Treatment can reduce the effects of mental disorder symptoms and suicide prevention is most effective when there are also methods available to sustain and strengthen avenues of interpersonal contact for individuals at risk. Geographic and social isolation decrease access to treatment and contact, thus placing rural Veterans at heightened suicide risk.

The Internet seems an ideal venue to increase contact and deliver suicide prevention interventions to this group. It offers a series of options through which interaction and communication can occur [3] including email, instant messaging (IM), blogs, microblogs, forums, chat (one to one or group), and social networking. Internet technology also allows users to shape that technology to address new challenges, as did Google and Microsoft in building Internet-based electronic personal health records, for example. Eysenbach [4] describes this robust and creative use of the Internet for health-related purposes as "Medicine 2.0."

Weingardt and Villafranca [5] suggest that initiatives developed by healthcare professionals around electronic information technology create demand, which can both accelerate and facilitate the transition of applications from research and development to frontline practice. As Wilson [6] notes, this demand has produced an important tension between technology-focused developers and frontline practitioners and actually serves to help propel development of the Internet for delivery of health and mental health interventions. Several technologies for social interaction and communication including Twitter, Facebook, flickr,

and YouTube can be modified in different ways to increase access to different groups. This is especially relevant to mental health in general, but may be ideally suited to suicide prevention strategies aimed at decreasing isolation in high risk groups of rural Veterans.

2. ASSESSMENT OF THE FIELD

Internet Mental Health Treatment

While the Internet is commonly used to access health-related information, it offers unique opportunities to individuals with mental disorders to receive not only healthcare information, but actual treatment. Healthcare in general has benefitted from using common Internet-based technology to increase access for patients through e-mail and IM chat systems [7,8], although more so for younger than for older patients [9]. Disease-specific blogs and forums can be efficient ways to address diverse questions about health or other problems. For example, www.diabetesblognetwork.com/ offers users a choice of blogs focused on diabetes, and www.diabetesforums.com/forum/lo-fi/f-4.html offers lists of diabetes forum topics around which users may interact. Such disease-specific forums have also been successfully used to recruit patients into clinical trials [10] and unique sites such as www.patientslikeme.com allow individuals to write not only about their symptoms but also their personal evaluation of specific medications or treatments [11]. Message dissemination technology can now rapidly access large, targeted groups of individuals through "crisis informatics" spurred by lessons learned from the tragic shootings at Virginia Tech in April, 2007 [12]. The technology offered by Twitter has had unique applications in private industry [13] and is slowly gaining use in medical settings [14].

Despite this growth of Internet technology, the actual provision of health services and medical treatments still depend largely on more traditional hardware (e.g., MRI machines) and biological (e.g., medications) technology. This remains true, but to a lesser degree, in behavioral health where treatment involves patient-provider verbal interactions within different forms of therapy and behavioral change interventions. Some therapies require the presence of the therapist only to help guide the patient through the treatment process. Other therapies require skilled and thoughtful listening and responses. Mental health symptoms are evaluated through thorough interviews and scored based on specific criteria. Consumers or family members may also attend support group meetings.

Each of these types of interventions involving interpersonal interaction (therapy, assessment, support) is now available online as either a treatment service or treatment augmentation. The electronic basis of the Internet can efficiently drive algorithms for instruments which guide users through self-assessment of symptoms, estimate symptom severity, and determine the type of feedback to provide to users, including both health and referral information. Communication technology allows patient-provider therapeutic interaction.

There are two primary forms of online behavioral health treatment: self-help and provider-driven. *Self-help* treatment has had the most development and generally refers to users operating menu-driven treatment mechanisms on their own based on the problems they are experiencing. For example, at www.cognitivetreatments.com users can choose from several problem-specific cognitive behavior therapy treatment programs (depression, anxiety, panic, and phobias). Often accompanying these treatments is emergency access to trained therapists in case help is needed (referred to as "therapist-assisted"). *Provider-driven* treatment refers to the user interacting one-on-one in real time with a mental healthcare professional through the Internet either through live chat or e-mail. There are several sites which offer online counseling (e.g., www.liveperson.com/experts/health-medicine/specialty-medicine) usually for fees starting at $3.00 per minute.

While these modalities increase choice and access, there are two primary concerns: 1) whether these modes of treatment work and 2) whether they work as well as traditional mental health care. The literature seems to concur that users respond positively to the Internet venue regardless of the disorder and treatment approach. Titov et al. [15] performed a randomized controlled trial of an online depression intervention vs. a

waitlist control group and found that symptoms in the online group were significantly reduced. An elaborate computer-based program designed to promote drug abstinence for opioid users was tested by Bickle et al. [16] and was found to increase abstinence as well as decrease the rate of interaction needed by live counselors with the participants. Kypri et al. [17] combined proactive Internet alcohol screening with a brief intervention for those who scored in a hazardous range. They found that this combination contributed significantly to reduced drinking by undergraduates in their cohort. Litz et al. [18] performed a randomized controlled trial of an Internet-based treatment for post-traumatic stress disorder (PTSD) and found that self management of symptoms through this intervention decreased PTSD symptom severity significantly at 6 months. Shandley et al. [19] demonstrated that online therapy is useful for panic disorder and Kessler et al. [20] for depression. However, Farvolden et al. [21] and Christensen et al. [22] both identify the problems of adherence and the variable propensity of patients to follow through with the treatment as potentially greater problems for Internet-based treatment than for traditional face-to-face treatment.

Support groups are also important components of mental health care for individuals as well as their families and friends. In the traditional format, support groups occur as one or more time-limited face-to-face meetings of several individuals to discuss issues specific to them. Griffiths et al. [23] reviewed the literature of behavioral health Internet support groups and found that they are widespread and quite robust, particularly for depression. Internet support groups have formats similar to Internet forums such as www.depressionforums.org and chatrooms such as those found on www.psychnet-uk.com/chat_rooms/mental_health_chatrooms.htm. Barak et al. [24] also reviewed online support groups and found that the Internet offers a level of anonymity which can help users dis-inhibit enough to engage in extensive interactions. Dialogue via keyboard and mouse may also allow an entirely different type of interaction than might occur in face-to-face meetings. Participating online allows users to simultaneously have sidebar conversations, look up related information, or take a break from the discussion by surfing as the group discussion continues. These functions could be considered threats to traditional group process, but may instead represent informal, real-time stress release mechanisms which could actually enhance engagement.

Although suicide prevention is an intrinsic component of all mental health interventions, its use as a stand-alone online intervention is still minimal. However, this slow development is likely due more to caution than to logistics. The Internet is actually uniquely suited as a means by which to deliver suicide prevention [25,26], with particular potential to isolated Veterans living in rural areas [27]. Other studies have explored Internet venues for suicide-related needs. For example, Barak [28] describes a field study which successfully used the Internet as a venue for communication between individuals in crisis and healthcare providers. Crilly and Lewis [29] explored the presence of Veterans on military-related blogs and forums and suggest that these venues are well-suited for dissemination of suicide prevention and treatment links. Understanding the interaction between logistic and clinical challenges will be important for developers, clinicians, and policy makers as online suicide prevention begins to build momentum.

3. DISCUSSION

Internet-based mental health treatment is a viable approach for reaching individuals who may ordinarily shun face-to-face treatment or those for whom distance is a major barrier to accessing healthcare [30]. Evaluation data suggest that these online treatment approaches for specific behavioral health problems are effective. However, many of the treatments presented here are not available on a broad scale, while others which are available have a high cost for access. In addition, these treatments make full use of all the interactive and graphic technology available today. This makes them ideal for use across Broadband Internet connections but literally inaccessible to those without Broadband. Depending on the state and area, over 50% of rural Internet users have only dial-up Internet access and others with cable only have low-speed access [31, 32]. Therefore, much of online mental health treatments are likely inaccessible to many rural Veterans who may derive the most benefit.

The key to reaching rural Veterans at risk for suicide is to develop the most essential services which can be used by individuals with both the greatest and least access. The VHA has met this challenge by developing a 24/7/365 1:1 crisis chat service (Veterans Chat at www.suicidepreventionlifeline.org/Veterans/Default.aspx). Chat communication technology requires relatively minimal bandwidth and so is ultimately accessible by rural Veterans with dial-up access.

Veterans Chat is an important service, but it operates alone as an online mental health resource for rural Veterans. This burgeoning field of Internet-based mental health treatment has a quandary. On the one hand, current development of mental health services using all of the graphics power available may incline Broadband users to use it as a substitute for clinic-based services. In fact, clever use of technology to develop aesthetically pleasing and easy-to-use tools is critical for enticing and keeping such users. For those individuals who may use the Internet not as a more convenient substitute for care but literally as their sole option ironically may need to actually wait until providers and developers understand the prerequisites of Internet use for their needs and develop appropriately simple yet equally effective "low-tech" approaches. Indeed, Atkinson et al. [33] found that it is critical to include users in the development of website design to make the Internet experience more fruitful and enduring.

This issue also underscores the importance of expanding research on the factors of Internet use. In addition to Broadband availability, computer ownership and Internet services are not universal and people who are poorer and older are less likely to have and use these items [34]. Kontos et al. [35] also found that conflicts between family members (particularly with teens in the household) over computer use, difficulty in producing accurate search results, and lack of "customer support" to help novice users navigate new environments can also restrict use and thus access to online mental health services.

Although it is attracting more attention, Internet-based psychiatric treatment or Internet use for mental health-related needs is still very new and should be approached with caution. Biddle et al. [36] warn that because the Internet also contains sites which encourage or glorify suicide, therapists must understand effective Internet use and must not simply point patients to use it without guidance. Whitlock et al. [37] underscore this and suggest that therapists themselves become familiar with the Internet environment and how self-injury might be portrayed there.

4. CONCLUSION

The availability of mental health information, treatment, and support is increasing on the Internet. This medium offers great promise but there are major considerations for the critical population of individuals in rural areas, particularly Veterans. The basic mechanisms of Internet use by specific population groups have received relatively little research. Without an understanding of how the Internet is used for mental health-related needs, it is difficult to strategically shape and deploy new online mental health treatment approaches. Because of their potential for isolation, there is an urgent need for research aimed at rural Veterans, particularly those at increased risk for suicide. These new forms of online mental health services disseminated by new forms of distribution and access will likely require new forms of research methodology and data sources to study them quickly and efficiently. It is also critical that treatment providers, insurance companies, and individual users are protected from unforeseen problems which may arise from use of Internet-based psychiatric interventions, while still making them optimally available for key groups with high risk, particularly rural Veterans.

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Electric Blackout Prevention: Toward a Computer-Mediated Weather Alert Broadcasting Solution

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ABSTRACT

Electric power consumption is dependent on weather conditions. In most of the EU countries, power distribution is often subject to failure and it is frequent for the population to suffer power blackout. Within the solutions, deployed in order to avoid or face that problem, the public notification of blackout risks for a target region and the demand for reduced consumption are both interesting alternatives. This last solution is very basic but whatever meaningful. Consequently, automatic notification of cold weather and power distribution risks appears to provide many advantages especially when the alert is associated with the decision mechanism and supported by dynamic and virtual communication channels.
In this paper, we introduce a solution to broadcast weather alerts using MAS architecture associated with a Crisis Management enhanced XACML technology. This solution fosters the exploitation of a multi-layer approach required to be aligned with contextual constraints. In parallel, a decisional system allows managing the broadcasting of alert based on their utility for the population, as well as for the industry. The case study used to illustrate the feasibility of our approach exploiting weather and electric parameters and do not reflect the full constraints of any existing infrastructure in operation.

Keywords: Security; Incident reaction; Alert broadcasting; Multi-agents architecture; Decision mechanism; XACML.

1. INTODUCTION

Many regions worldwide still keep nowadays suffering of electric power blackout [1] when weather temperature is significantly decreasing [2, 3]. As example, Brittany in France is one region that recently had to face such problems [4]. Brittany is a geographic and administrative region in the north-west of France (of about 13,136 square miles) that, for some years, suffers power distribution especially during very cold weather. For instance, the week between the 14th and the 18th of December 2009 was subject to important electric load foreseen. The expected load for Monday the 14th was about 85200 Mega Watts (MW) and during the evening (around 7PM), the load was expected to raise the historical level of 92400 MW. The influence of the weather conditions on the electric load is estimated at 2100MW by 1F°. This rate is important especially since we know that the temperature of the current winter is between 6 and 8F° higher that the average.
As electricity is a not storable good, its production has to fit precisely with its consumption. To maintain and guarantee that balance, electric companies supervise the transport of the power and manage the electric network infrastructure. They keep watching in real time both production and consumption values to maintain the safety of the system. When these companies estimate that the situation is tense, they attend to face the problem with a set of solutions like i.e. the importation of power from the adjoining countries or by requesting the user to adapt the usage of electric machines like the washing machine or the dryer. Such requests are frequently made via TV and newspapers.
In this paper, we propose to enhance the system by defining a computer based Weather forecast Alert Broadcasting System (WABS). The system is elaborated based on a twofold architecture: the Multi-agent system (MAS) architecture [5, 6] that offers the advantage to be distributed and autonomous firstly. This MAS architecture is associated with the XACML [7] technology, which is adapted for the alert broadcasting on different communication channels [8]. Secondly, a decisional mechanism [9] permits to refine the broadcast of the alert based on contextual data [10] and on the weather forecasts by region. Decisions are made based on probabilistic and utility values. I.e. Informing a hospital of the risk of power cuts down has more utility than an office company. WABS main objective is to collect as much information as possible on the weather forecast in one hand, and the maximum of data regarding the consumption and the load of the network on the other hand. One main advantage of WABS is that it is structured according to the power network architecture and is able to integrate notions of geographic area, sub-area (region), and sub-sub-area (city) (see fig. 1).
The rest of the paper is structured as following: the next section introduces the MAS and depicts the broadcasting mechanism, section 3 introduces and analyses the decisional structure associated to the MAS, section 4 presents the related works and the last section concludes the paper.

2. MULTI-AGENTS ARCHITECTURE

Because of national politic constraints, the illustration of an architecture based on a real country was really not welcome. As a consequence for the usage of that paper, we have designed a fictive country named *Frost_Country*. This country is composed of four regions, namely *Bush*, *Desert*, *North* and *Waterfall*. Bullets on the map stand for cities. Electric power distribution in *Frost_Country* is enforced by high voltage electric lines that are: Double line for 240 MW, Dash line for 30 MW and Dote line for 5 MW. The MAS is composed of several components, named operators, which have different responsibilities.

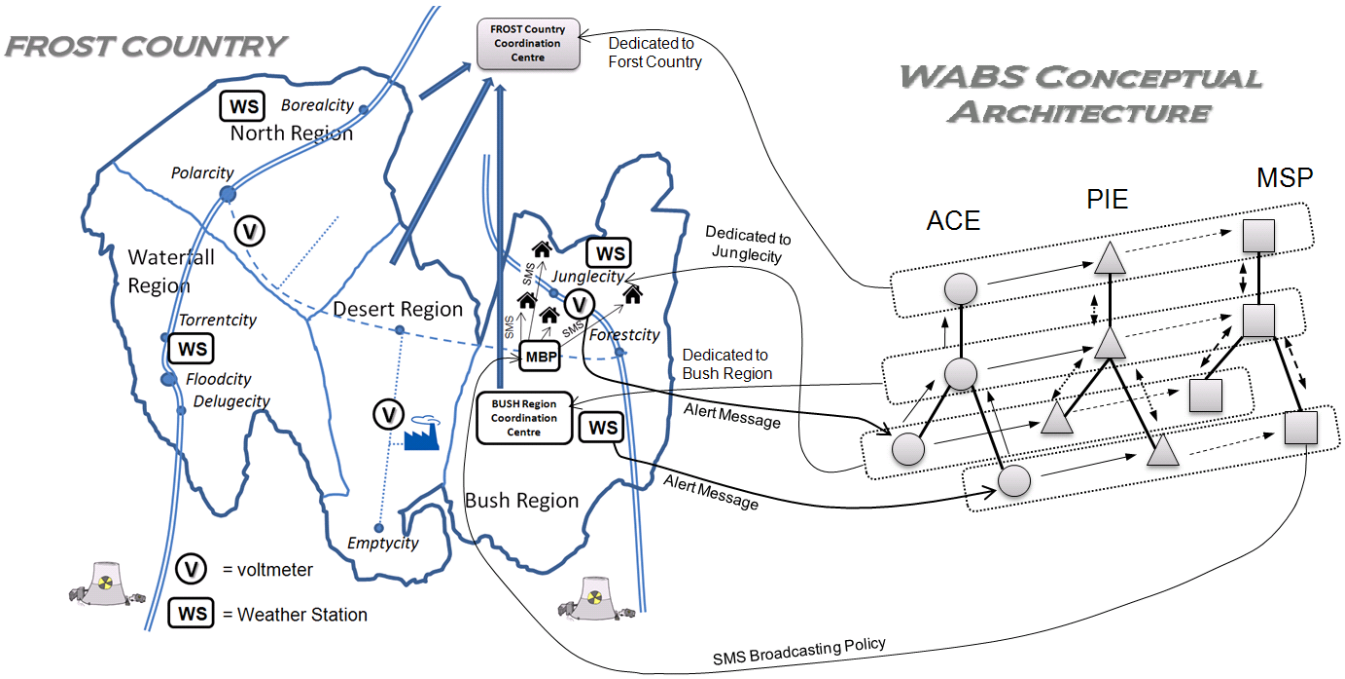

Figure 1. *Frost_Country* reaction architecture

Those operators are organized in two dimensions: the horizontal dimension structures the architecture in layers modeled based on the structure of the country. It allows adding abstraction in going upward: the lowest layer is closed to cities and towns and thus plays the role of interface between the targeted population and the management system. The higher layer corresponds to the country and is managed in the example by the *Frost_Country Coordination Centre*. It encompasses a global perception of the whole system and is able to take some decisions based on a more complete knowledge of the country's geography, administration and organizational constraints. Intermediate levels (1 to n-1) guarantee flexibility and scalability to the architecture in order to consider management constraints of the infrastructure. Those middleware levels are the regions. They collect regional information in the *Regional Coordination Centre.*

The vertical dimension contains the alert tree, the reaction tree and the deployment tree that are placed side by side and that composed respectively with the following component: (1) The Alert Correlation Engine (ACE) collects, normalizes, correlates, analyzes the alerts coming from the networks of probes. The confirmed alert is forwarded to the reaction decision component (2). The Police Instantiation Engine (PIE) receives the confirmed alert for which a broadcast is expected. The policy encompasses the broadcasting rules to be applied considering weather information. In view of the knowledge of the policy and of the geographical constraints and specificities, these components decide if a broadcast is needed and define if the message is to be sent. The messages varied from a single notification for information to a serious warning asking the population to react as a result (3).

The Message Broadcasting Point (MBP) instantiates and deploys the new message on the targeted networks. The deployment is made by the Message Supervising Point (MSP) that send the new message to the selected communication channels (Twitter, Facebook, SMS, …[8]). The terminology used is extracted from [7] regarding the ACE and the PIE. In parallel, some components of XACML have been adapted for the crisis reaction mechanism: PDP (Policy Deployment Point) has been specialized in a MBP. Both components' functions are the instantiation of a reaction or of a message in a crisis context. Additionally, the PEP (Policy Enforcement Point) has been specialized in a MSP. Both target the execution of the decision: enforcement of the IT policy for the PEP or broadcasting of the message for the MSP. Fig 1. explains how the three layers are mapped to *Frost_Country*. It is from top to bottom: The *Frost_Country*, its regions *(North Region, Waterfall Region, Desert Region and Bush Region)* and the city areas (i.e. for the *BushRegion: Junglecity and Forestcity*).

The MAS architecture is associated with a communication engine. That engine is based on a message format and on a message exchange protocol issued from [11]. The message format is defined in XML and is structured around a number of attributes that specify the message source, the message destination and the message type (alert, notification, warning, request to the population, request to the industry, level of the request, etc.). The protocol defines the exchange format and the workflow of messages between the architecture components. It encompasses a set of rules that governs the syntax, the semantics, and the synchronization communication.

The electronic institution based on agents provides the requisite characteristics to support the function of the operators. Hence, agents are assigned roles in order to specify their function in the architecture and the communication protocol is accordingly defined between them. Fig. 2 introduces the developed architecture illustrated by the weather forecast alert broadcasting.

The flow is supposed to begin with an alert detected by a probe positioned in a weather station based i.e. in the *Junglecity* or somewhere else. Have a look at the weather station of *Junglecity*. This alert is sent to the *Junglecity*_ACE agent (local layer). This agent has two choices: (1) Confirm the alert to the corresponding PIE (at the same level), or (2) Decide to forward the alert to an upper ACE (here *BushRegion*_ACE). This

decision to confirm the alert is explained in section 3. In this example, *Junglecity*_ACE agent decides to forward the alert to the upper level. Afterwards, like the ACE, the PIE agent has the possibility to confirm the alert to its corresponding MSP or to forward the alert to a higher layer (here *Frost_Country* _PIE). For this case the regional layer is sufficient, so the PIE sends the new policy to *BushRegion*_MSP. Once the MSP (at the appropriate layer) receives the policy instancied by the PIE, the policy is analyzed (this will be explained more in detail in the next paragraph) and sent to the appropriate MBP agent that knows how to transform the message in an understandable information for the target and according to the most suitable communication channel (SMS, social network, etc.).

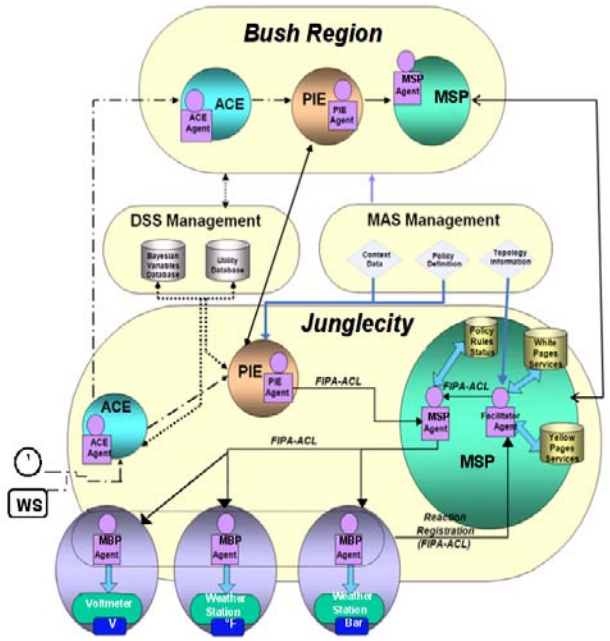

Figure 1. MAS reaction architecture

Message Supervising Point

A focused analysis of the MSP points out that it is composed of two modules (Figure 3). The Policy Analysis (PA) module performs a set of validation checks. It verifies the syntax of the *communication policy* specification provided by the PIE, and afterward verifies that newly received policies are consistent with the previously sent messages (recorded in the policy status database). A set of *communication policy* is consistent if no contradictory messages are found. If conflicts between messages are detected, the *communication policy* is sent back to the PIE.

The PA communicates with the policy rules status database that stores all *communication policies* and their current status (in progress, not applicable, by-passed, enforced, removed…). In addition, the module is able to detect rules that cannot be enforced due to a lack of MBP. As a consequence an MSP needs to be aware of the different managed MBP. Therefore the MSP agent is helped by a Facilitator agent. This agent manages the network topology by retrieving MBP agents according to their localization (cities, regions or countries), their target (hospital, citizen, industry, transport, airport, etc) and according to actions that it performs (send SMS, use social networks like facebook, etc.) For this, the Facilitator uses white pages and yellow pages services.

The Component Configuration Mapper (CCM) applies in detail the actions to be taken by the appropriate applications (SMS, social networks or press). This module receives high level policies and generates generic format policies for each type of MBP. To achieve that, it asks the Facilitator to determine which MBP are involved by the *communication policies* by mapping a set of possible actions to the effective communication channels. If some rules are not applicable, the component CCM notifies the PA which updates the policy rules status. Problematic rules will be passed by, and their status in the "policy status" database will change from *in progress* to *by-passed*. Finally, the *communication policies* are sent to the concerned MBP.

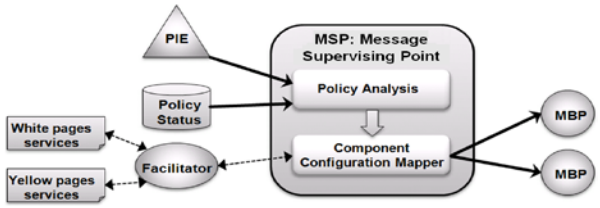

Figure 2. MSP architecture

The JADE [12] platform provides an implemented facilitator and searching services. Besides, the use of a MAS framework provides flexibility, openness and heterogeneity. Actually, when we decide to add a new MSP, we just have to provide its MSP Agent with the ability to concretely apply the policies that will register itself through the Facilitator, which will update the databases.

Message Broadcasting Point

The MBP agent (Fig.4) manages the communication channel associated to the WABS. Agents are specialized according to the kind of channel or the kind of message the channel has to deliver. I.e. SMS information messages are structured differently from a Facebook based alert information.

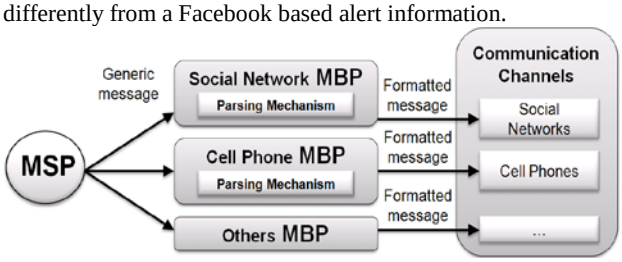

Figure 4: MBP architecture

To deal with that specificity, the MBP knows how to parse the communication represented in an abstract format (XACML [7] in our case) toward an interpretable and formatted message for a specific channel.

3. DECISION SUPPORT SYSTEM

The system provides mechanisms to make decisions in a range of situations like: conflicts between several communication channels or the necessity (or not) of communication escalation to the upper layer. One challenge of the DSS is the management of uncertainty. Uncertainty is defined as situation caused by a lack of knowledge about the environment when agents need to decide the truth of statement. Decision is a process [13] and consequently, it may be represented using its input and its output. For the weather alert communication, inputs of the alert

sending decision mechanism are for instance: the temperature, the pressure or the voltage of the alerts, the contribution of the system to weather crisis management (if any), or the criticality of that crisis. Outputs of the process are for instance: the escalation of the alert to upper ACE or its confirmation to the PIE.

As explained in [9], the decision-making mechanism is composed of four pillars: Ontology, BN, ID and Virtual Knowledge Community (VKC). In that paper, the VKC is not addressed because the use of the 3 first pillars is sufficient to understand the decision mechanism. The approach preferred to design the decision mechanism is studied from the research performed by Yang's thesis and is adapted for the weather alert reaction through a MAS architecture. This paper completes the Yang's research since our DSS is illustrated by a real architecture for weather crisis management.

Ontology

Ontology is the most import pillar in that it supports the BN and ID pillars. For the weather alert system, ontology is defined using the Web Ontology Language (OWL). Resource Development Frameworks (RDF) syntax is the most commonly used method to model information in OWL. It may be implemented in web resources and is structured based on the set [object, subject, predicate]. Both, object and subject are resources and predicate is an attribute or a relation used to describe a resource. In our *Frost_Country* case study, the DSS decides the transfer of an alert from the probe to the *Junglecity*_ACE, the forward of that alert to the *BushRegion*_ACE, and the confirmation of the alert to the PIE. On Fig 5., ovals stand for OWL class, solid arrow lines stand for RDF predicate, dash arrows for influence relations and rounded rectangles for set of domain value.

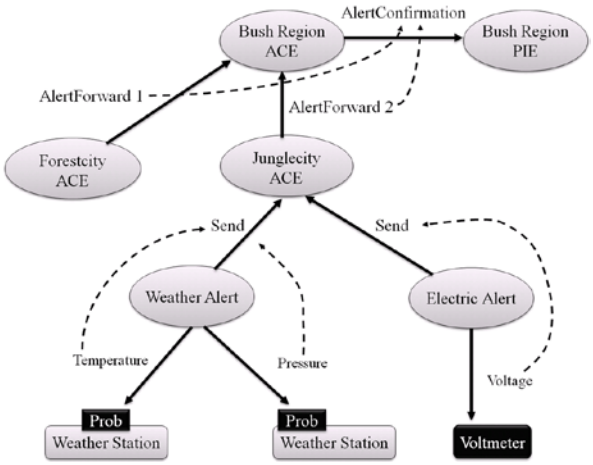

Figure 5. Decision system for weather alert transfer

The ontology permits to formalize the concept encompassed in the MAS architecture as well as their relations. However, at the ontological level of formalization, the uncertainty challenge remains unaddressed and the decision mechanism remained needed for the agents to take the decision. OntoBayes is an extension of OWL with two features: BN that address the uncertainty and ID that support the decision mechanism process.

Bayesian network extension

Bayes theorem is used to calculate conditional probabilities [14]. The calculation depends on prior knowledge that could be considered as uncertain. I.e.: the probability of high impact on the population of *Junglecity* if we have before a medium temperature alert.

	HasPParameters	*HasPValue*
Cell_1	*temperature.alert=low| JunglecityPopulation.impact=low*	*0.75*
Cell_2	*temperature.alert =medium| JunglecityPopulation.impact =low*	*0.35*
Cell_3	*temperature.alert=high| JunglecityPopulation.impact =low*	*0.17*
Cell_4	*temperature.alert =low| JunglecityPopulation.impact =medium*	*0.32*
Cell_5	*temperature.alert =medium| JunglecityPopulation.impact =medium*	*0.91*
Cell_6	*temperature.alert =high| JunglecityPopulation.impact =medium*	*0.48*
Cell_7	*temperature.alert=low| JunglecityPopulation.impact=high*	*0.07*
Cell_8	*temperature.alert =medium| JunglecityPopulation.impact =high*	*0.40*
Cell_9	*temperature.alert =high| JunglecityPopulation.impact =high*	*0.69*

TABLE I. BAYESIAN PROBABILITY

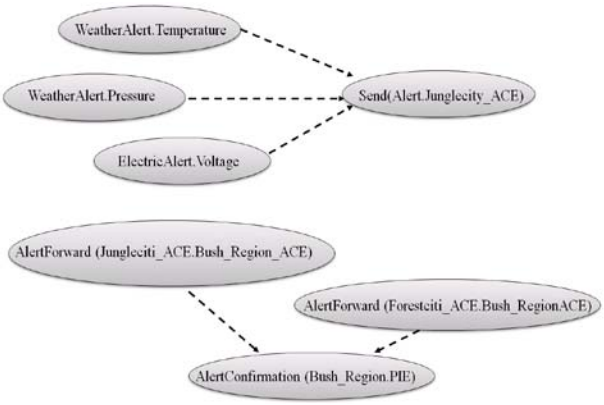

Figure 6. Bayesian graph models

The BNs extension introduces the parameters of that probability by specifying the following two perspectives: the qualitative and the quantitative. The qualitative perspective specifies the random variables explicitly as well as their dependencies and the later links quantitative information to those variables using OWL.

The specification of random variable and their dependency is performed by introducing the new OWL property element `<owl:ObjectProperty rdf.ID="dependsOn"/>` [9]. Accordingly, the qualitative extension may be represented by 2 Bayesian graph models (Fig 6, extracted from the Fig 4). The ovals represent Bayesian variables and the arrows specify their relations. The graph is to be read: i.e.1.: The alert forwarded from the *Junglecity*_ACE to the upper layer ACE has influence on the confirmation of the alert that is sent from the *BushRegion*_ACE to the *BushRegion*_PIE. I.e.2.: A voltage electric alert has influence on the action to send an alert to the *Junglecity*_ACE. The quantitative extension is performed with the association of a probability table to the Bayesian variables. In the case of the *Frost_Country*, quantitative probability P is provided by Table 1.

Influence diagrams extension

IDs extension aims at representing and analyzing a decisional model to support the decision-making process. The review of the literature that treats ID [15, 16] highlights that decision mechanisms are composed by three types of nodes: 1) Chance nodes that represent variables that are not controlled by the decision maker, 2) Decision nodes that represent choices available for the decision maker, and 3) Utility nodes that represent agent utility functions. Additionally, [17] explains that three types of arcs express the relationship between nodes: I) Information arcs (`isKnownBy`) that point out the information that is necessary for the decision maker, II) Conditional arcs (`influenceOn`) that point out the probabilistic dependency on the associated variable, and III) Functional arcs (`attributeOf`) that point out variables used by utility nodes as decision criteria.

Based on that structure of a decisional model, the alert transfer may be represented in Fig. 7. Ovals stand for Chance nodes, rectangles stand for Decision nodes, and diamonds stand for Utility nodes. The information arc relates to all information observed to make a decision and the conditional arc relates to data issued from Chance node and considered as evidence for the Decision nodes.

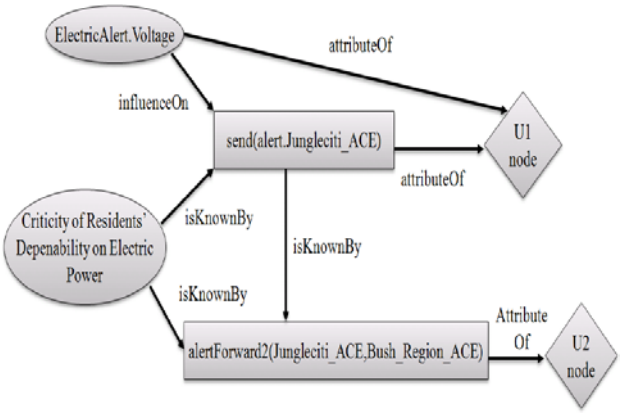

Figure 7. ID's graph model of alert transfer

Additionally, to make a decision, the agent that takes the decision needs to have its preferences quantified according to a set of attributes. The most important preference has a higher value whereas the worst has a lower one. To achieve this, the Utility node is associated with an utility table that gathers the preferences for all decision choices.

UtilityCell.	*HasUParameters*	*hasUValue*
Cell_1	*send(alert.Junglecity_ACE)=yes |electricVoltage.alert=low*	*-78*
Cell_2	*send(alert.Junglecity_ACE)=yes |electricVoltage.alert=medium*	*45*
Cell_3	*send(alert.Junglecity_ACE)=yes |electricVoltage.alert=high*	*100*
Cell_4	*send(alert.Junglecity_ACE)=no |electricVoltage.alert=low*	*79*
Cell_5	*send(alert.Junglecity_ACE)=no |electricVoltage.alert=medium*	*30*
Cell_6	*send(alert.Junglecity_ACE)=no |electricVoltage.alert=high*	*-99*
	…	
Cell_15	*send(alert.Forestcity_ACE)=yes |electricVoltage.alert=high*	*85*
	…	

TABLE II. UTILITY FOR IN-LAN ACE ALERT SENDINGl

Table II shows these preferences for the *Junglecity*_ACE alert sending decision and is recorded in the utility database represented in Fig. 2. I.e. Cell_3 of Table II shows that the utility to send the alert to the *Junglecity*_ACE if the electric voltage alert is high (utility value of 100) and consequently that it is useful. In Cell_15, the table provides a utility value of 85 for the same alert but for the *Forestcity.*

As seen in Fig. 7, a sequential path between all decisions exists. Indeed, some decision depends on previous decisions and as a consequence, previous decisions (decision nodes) become chance nodes for next chance node. This figure illustrates that send(alert.*Junglecity*_ACE) is at the same time a decision node and a chance node that is known be the decision node alertForward2(*Junglecity*_ACE, *BushRegion*_ACE).

4. RELATED WORKS

A scrutiny of the literature reveals that the problem of crisis management and alert system to handle exceptional situations based on MAS has been studied in recent years using different approaches. The work accomplished so far shows that MAS are suitable solutions for crisis situations, especially for Crisis Response Management (CRM) systems. MAS have been used to tackle disaster situation management tasks.

[18] investigates the requirement on the support of crisis response organizations by means of MAS. The research is focused on the distribution of information and the support of communities in sense of persons, like group of firemen, medicals team civilians, etc). More precisely the community is defined as *a group of people bound together by certain mutual concerns, interests, activities and institutions*. In MAS, agents are at least partially autonomous and have a local view of the system/situation. Moreover, like people in critical situations, agents are used together to solve complex problems.

In [19] a MAS is used in order to simulate evacuations of persons. Traditional crowd simulators are based only the positions of people and structures. For example the leadership is not taken into account, social interactions in a more generally manner. Since MAS are systems composed of multiple interacting intelligent agents (in this case people), the use of this technology in this context is appropriate again. This research is quite interesting but differs to our work in the fact that for us, agents are only software and enable the transmission of alerts to the population and to companies. Our agents are not human and the goal is not about optimizing the management of a crisis situation (in this case evacuation).

A further approach [20] uses discrete-event simulation (DES) applied to an agent-based model. Here the environment is modeled as a DES while the crisis response agents are modeled thanks to a MAS (using the JADE [12] platform). The MAS is implemented separately from the environment. This work is quite original since it seems that no prior research has combined agent-based solution and DES.

Again, multi-agents technology is used in [21] for crisis management in the transport domain. This work depicts a parallel with the Vehicle Routing Problem (VRP) which is generalized to the Pickup and Delivery Problem with Time Windows (PDPTW). The goal is to minimize the distance of the travel. Therefore, three kinds of agents are used: Dispatcher Agent, Execution Unit Agent and Crisis Manager Agent. The two first kinds of agents are cooperating in order to solve the problem of the PDPTW, while the Crisis Manager Agent is

responsible for the detection of crisis situations (for example by providing information about the traffic jam).
A more practical approach is presented in [22] with a proof of concept implementation of an organizational-based model. This model is especially designed to support the dynamics of crisis management during crisis escalation. One of the advantages cited for this type of simulation is the low cost compared to real-life simulations. Moreover, real-life simulation involves the personnel. This simulation uses the Netherlands' case and is based only on the level of the severity of the disaster. The crisis response management can be taken at different level (local, regional, etc.) by appropriate authorities. The difference to our work is that their model is only driven by roles assigned to actors of the response (police: maintain order, fireman: save people). Our model uses a decision support system which takes decisions at different levels according to various alert parameters such as temperature or load of the electric network. Furthermore we are able to refine the scope of the response thanks to our model's different layers of MBP and MSP.

5. CONCLUSIONS AND FUTURE WORKS

In this paper, we have presented a solution to broadcast weather forecast alerts messages using a MAS based architecture associated with the XACML technology adapted for the alert broadcasting on different communication channels. The solution is composed firstly by a MAS that offers the advantage to react quickly and efficiently against an electric power or weather forecast alert while being adapted for heterogeneous and distributed communication channels. Secondly, a decision support system helps agents to make decisions based on utility preference values. This is achieved by taking uncertainty into account through Bayesian networks and influence diagram.
The architecture has been illustrated based on fictive country named *Frost_Country* that suffers blackout when the weather is extremely cold. Accordingly, our solution offers the possibility to introduce contextual information in the decision mechanism like i.e. the criticality of the electric power for the target users.
The decision support system has been explained for the transfer of an alert from the alert correlation engine to the policy instantiation engine. Other decisive points exist within the architecture. All of them could be solved using decision support system but they are not explained in the paper.
The future works based on our achievements will be the specification of a protocol, specification of the messages and thus the reaction methodology service oriented based. This protocol and methodology will be dedicated to the architecture presented in this paper and address the interoperability issues with regard of the policy representation and modeling.

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Spatial Informatics: The Key to Regional Economic Development

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ABSTRACT

One of the greatest challenges to local economic development is to assess and analyze a wide array of economic data, usually gleaned from wildly disparate sources, which manifest various levels of spatial autocorrelation. Indeed, some studies purport that over ninety percent of all decisions are controlled by some spatial aspect (distance, direction, location, spatial decay functions or temporal decay functions). Even when economic data is distilled to easily understood indices, trying to analyze the spatial variance of the data is usually beyond the abilities of the local end user yet this geographic criterion plays a significant role in the process of successful decision making.

There is a need at the municipal, county, and state level to develop an informatics infrastructure that allows seamless data translation at multiple spatial and temporal scales. In addition, a central repository of regional economic and allied data should be available that can be analyzed in both terms of econometrics and spatial attributes and provided to local entities to aid in the decision making process. Such data is usually exceptionally dense and, in many cases, ephemeral in nature requiring rapid updating and re-analysis. It is the intent of this paper to explore the use of Geo-Information Science (GIS) coupled with econometrics to aid in the analysis and visualization of complex economic-spatial relationships. Further, we will provide examples of how this synergy is utilized in education, regional planning, economic development and occupational skills training to achieve very different ends, but employs the same theoretical foundations.

Keywords: Spatial Science; Informatics; Regional Planning; Economic Development; Education; Training

INTRODUCTION

As more organizations, municipalities, and other types of agencies seek new and creative ways to manage their budget amidst a fiscal crisis, many are turning toward spatial informatics, namely Geo-Information Science (GIS), to aid in the analysis, visualization and forecasting of complex spatial relationships.

Spatial Informatics is a generally accepted term that implies integration of scientific, economic, and socio-cultural concerns with GIS planning and analytical tools. In the context of this paper the GIS acronym itself stands for both Geo-Information Science or Geographic Information Systems, which are defined the same in many instances. The following quotes offer various definitions of GIS:

1) "In the strictest sense, a GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations. Practitioners also regard the total GIS as including operating personnel and the data that go into the system." [1]

2) "A geographic information system (GIS) is a computer-based tool for mapping and analyzing things that exist and events that happen on earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps."[2]

3) "GIS is an integrated system of computer hardware, software, and trained personnel linking topographic, demographic, utility, facility, image and other resource data that is geographically referenced."[3]

In essence, GIS is a rapidly growing technological field that incorporates graphical features with tabular data in order to assess real-world problems. The reach of GIS expands into all disciplines and has been used for such widely ranged problems as prioritizing sensitive species habitat to determining optimal real estate locations for new businesses [4].

Instrumental to this technology is the key word "Geography", implying a spatial component or proportion to the associated data that is in some way referenced to locations on the earth. Integrated alongside this geo-references data, lies attribute or tabular data. Attribute data generally provides additional information about each of the features tied to spatial or geo-referenced data. A widely used example of this would be schools. The spatial data is the actual location of the school. The attribute data provides the additional information about the spatial data. In this case, the number of students attending the school, primary language of instruction, school name, and level of education are some of the possibilities. The effectiveness of

this tool as an exceptional decision-making and problem solving aid is in the ability to access and query the spatial and attribute data simultaneously [4].

GIS operates on many levels and at a variety of scales, although it employs the same theoretical foundations. On the most basic level, GIS is used as an electronic mapping tool (i.e. computer cartography). At the other end of the scale, and perhaps its greatest application, is through using spatial and statistical methods to analyze attribute and geographic information. These types of analysis can yield a variety of results such as "derivative information, interpolated information or prioritized information" [4].

There are countless applications of GIS but the scope of this paper is to explore the functionality in terms of regional economic development. Three case studies will be explored in which GIS was utilized in an endeavor to create more cohesive and economically effective planning and development initiatives. Conclusions are then drawn based not on the individual cases, rather on what can be learned and applied from their efforts.

CASE STUDIES

The three case studies that will explore uses of GIS include a workforce training program, a municipal economic development plan, a community emergency response effort, and finally a discussion on how these initiatives have furthered a regional economic development plan in a traditionally parochial area.

Contextual Background

There is a need at almost every municipal, county and state level around the globe to develop an informatics infrastructure that will allow seamless data translation at multiple spatial and temporal scales. The case of the North Shore, Massachusetts is no different and suffers from an historical lack of cooperation and coordination between and among the various political levels. The North Shore is not a political boundary per se as it extends through various counties immediately north of Boston, incorporating 34 cities and towns. Rather, it is a geographic area that has long needed a clear and strong voice for the economic development of the region. In fact, in 2008 a call was put forth to hire an outside consultant to summarize "their understanding of the economic development issues facing the North Shore and the problems/opportunities to be addressed". GIS was found to be a key solution to successful regional economic development.

1) CAMEO

One of the most prevalent and important uses of applied spatial informatics is planning for and managing emergency operations. To that end, a commonly used GIS is CAMEO (Computer-Aided Management of Emergency Operations) which is designed primarily for responding to chemical emergencies. This GIS is actually comprised of three software programs: CAMEO which is a chemical database; MARPLOT which is the cartographic program; and ALOHA which is the spatial modeling engine. The programs were designed by the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) and can be freely downloaded from the CAMEO website. The primary users of CAMEO are First Responders including fire and police departments, emergency response personnel, primary and secondary industries, and retail outlets among others. Indeed CAMEO is specifically designed to meet the requirements of the Emergency Planning and Community Right-to-Know Act (EPRCA).

Ideally, every fire department within the US should have CAMEO installed and have information about chemical hazards (reported to them, their states, and the Federal EPA annually by the entities that manufacture, transport and/or use the chemicals) within their community populated in the CAMEO database. Should a chemical hazard incident occur emergency response personnel can engage the CAMEO system to determine the type of chemical threat and model the chemical release footprint thus allowing for the proper emergency response implementation (evacuation, shelter in place, etc. etc,). Additionally, and of equal importance in reacting to a chemical hazard event is planning a response to them. CAMEO has been developed so that emergency response personnel and other community officials can run an endless number of scenarios to prepare necessary resources in case of a chemical accident.

Unfortunately, at a community level, installing and maintaining CAMEO can become difficult with the ever tightening municipal budgets. However, on the North Shore of Massachusetts a program has been initiated between municipalities and Salem State College where as part of a GIS course students install and implement the CAMEO system for fire departments. While still in its infancy the program has integrated CAMEO into five municipalities and students are working within the North Shore to develop a CAMEO regional response capability employing spatial informatics. Such a program produces a mutually beneficial outcome as students are gaining necessary system analysis and implementation skills and CAMEO systems are being populated throughout the North Shore. Perhaps of equal importance is as students work with First Responders and municipal leaders they become more invested within the community thereby creating an anchor point to stay within the region as viable contributors to its economy and culture. Additionally, as the number of municipalities maintaining CAMEO increases the spatial information derived from EPRCA required data allows for more efficient municipal, environmental, and economic planning. Indeed, in better managing chemical hazards a region can minimize the economic impact of an event through rapid and effective response.

2) Workforce Training and Education

As more municipalities are utilizing GIS to analyze everything from zoning, infrastructure, and taxation to open areas for green space, recreation and water resources, they are finding a lack of skilled people to employ. If regions are looking to use GIS they also must offer the appropriate level of training in some capacity. There are graduate degrees in GIS, undergraduate offerings, and at some high schools an introductory course or two may be offered. However, there is a large disconnect of training at the technician level where a gap exists in programs

and relatively low numbers of students are enrolled in degree granting GIS programs because of a lack of understanding what exactly it entails. Many more jobs are posted in any given area than there are qualified people. Some specific areas requiring GIS training with local jobs currently posted include: Agriculture; Biotechnology; Education Research; Financial Services; Groundwater; Health Care; Insurance; Local Government; Manufacturing; Media; Natural Resource Management; Software; Utilities. These jobs offer employment as a GIS Technician; Specialist; Analyst; Analyst/Programmer; Coordinator; and Technical Marketing Analyst.

There are countless opportunities for people with GIS training as it can be applied to virtually any industry and in any context. For example, along with nanotechnology and biotechnology, Career Voyages has named geospatial technology one of the three emerging industries. Career Voyages is a collaborative effort between the U.S. Department of Labor and the U.S. Department of Education with the focus of providing information and resources about different career paths. Additional areas include: Geographic Information Systems (GIS), Global Positioning Systems (GPS), Photogrammetry, Remote Sensing, Image Processing, Computer Science and Related Technologies and Sciences.

A recently established ARRA funded initiative is seeking to re-train individuals around the North Shore, Massachusetts with GIS skills in order to have a more diverse workforce. The hopes are not only to provide more employment opportunities to those individuals, but more broadly, it will also provide an increase in the skilled labor force which could translate into more economic development opportunities for the region by wooing companies that require these skills.

3) Analyzing a City's Economic Development Potential

A report was recently prepared for the City of Salem's Economic Development Committee in an effort to synthesize information from recent studies and highlight current ongoing efforts of the City of Salem. The aim was to maximize the City of Salem's economic development potential and provide recommendations for future directions. Various GIS software were utilized to explore best practices, benchmarks and lessons learned from a comparative analysis of successful like-communities with the intent to provide suggestions and recommendations and serve as a basis for formulating a strategy to capitalize on the identified opportunities.

Using zoomprospector.com, a tool that employs GIS to analyze communities and economic development, a like-community comparison was performed against Salem. Criteria of similar characteristics included population size and composition, education levels, commute time, household income and many others. Possible matches included all cities and town in the USA, and revealed a list of like-communities in terms of demographics and potential for growth, and in particular, those seen as successful based on specific economic criteria such as revenue growth. Comparison locations were then filtered based on similarities in climate, since comparing successful communities from warm locations would have competitive advantage based on opportunities that may not be available in a colder climactic region. As such, three successful locations and one less successful, but similar in demographic profile to Salem, were compared and analyzed.

The second phase took data from a variety of separate studies and plans that had been created and implemented for geographically separate areas within the city of Salem. While it is certainly an advantage to having an in-depth analysis of any economic sector, it was found to be counterproductive to have a development plan for one area in isolation from its surroundings. An insular approach to economic development, both within municipal boundaries and extended beyond to a wider region, is ineffective and unrealistic. Development rarely is confined by cities boundaries unless the permitting, zoning, and taxation are extremely different "over the line". Thus, in the same city there must be a cohesive plan that takes into consideration all potential areas, areas of growth and areas in decline, to achieve a healthy economy and happy residents.

Bringing together the Open Space and Recreation Plan, Winter Island Study, Salem Harbor Plan, Downtown Revitalization Plan Housing and Community Development Block Plan, may sound like an onerous task, but using GIS as a visualization tool provides as a starting point in a city-wide economic development plan. It allows a visual representation of barriers as well as possibilities for joint efforts to create better linkages.

GIS was also used to collaborate with private land owners and developers to establish an inventory of properties within the City that may be bought/sold and slated for future development. This directive will also work to build partnerships and align interests between the City, local and regional stakeholders.

Other GIS-related work:

- Developing a database to keep taxation information and the City's competitive position up-to-date. Review the competitive advantages of the City as it relates to a number of variables including taxes, especially for commercial and industrial properties.
- Ensuring that new and existing planning policies support smart growth, a mix of uses, increased densities, and directing growth within the City's existing service shed.
- Continuing to coordinate and obtain infrastructure updates and the maintenance of existing systems such as waste management matters, waste water treatment, water treatment, traffic management, and other areas -and integrate these into the visual plan.
- Increase and encourage capital investment in recreation and leisure facilities, including walking/biking trails, skateboard parks, bike parks, and other recreational areas.

It was determined that the City of Salem does not necessarily need more studies to become successful in their economic development initiatives, rather a plan to collect feedback on a regular basis and produce an annual update, taking the temperature of the community. The results should then be shared with the broader region and re-evaluate efforts annually with the feedback. Use the education and training connections already established in the City. Much of the needed research can be ascertained with a partnership between City departments and the educational/training organizations.

DISCUSSION

Similar issues surfaced with each case study, with the primary findings highlighting the reliance on spatial correlations to make decisions. Even when social or economic data were distilled to easily understood indices, trying to analyze the spatial variance of the data was found to be usually beyond the abilities of the local end user even though this geographic criterion played a significant role in the process of successful decision making. Training individuals in GIS is a good start but does not enable advanced analytics that are necessary for a region-wide economic success story.

A central repository of regional economic and allied data should be available that can be analyzed in both terms of econometrics and spatial attributes and provided to local entities to aid in the decision making process. A region-wide vision and plan would allow each municipality to retain traditional economic development strategy elements of business retention, expansion and attraction. While at the same time, infrastructure and services could be managed on a regional basis thereby loosening the fiscal noose that many cities and towns are now facing. Indeed, if properly implemented with a rapid response spatial informatics system employing shared data, many of the municipalities would become sufficiently nimble to react to a greater number of Federal grant opportunities available to them individually or as spatially defined sub regions.

After the vision has been established, an in-depth look at recently completed studies of available current relevant socio-economic and demographic information should be integrated to highlight the competitive advantages of the region. Ensuring that existing infrastructures (physical, governmental, virtual, and educational) and cultural nuances (innovation, entrepreneurship, and collaboration) are evaluated, these measures can be mapped using GIS. This Asset Map should then become the basis for future marketing and economic development efforts of the region.

Working together with the various community partners and stakeholders would produce a regionally focused economic development strategy by streamlining their efforts and creating a more unified approach, and perhaps more importantly ensuring regional “buy in”.

The proposed economic development strategy would use spatial informatics to:

- Provide direction – Which potential businesses should be targeted for retention and attraction?
- Set an overall framework – How will they be targeted?
- Build consensus – Everyone is working towards the same stated goals.
- Propose an implementation and action plan – Create tangible action steps, including crucial first steps, goals for each, objectives and implementation suggestions.
- Provide focus– Utilize the various resources as efficiently as possible by focusing them on areas of greatest importance and greatest impact.

It could also be expanded to focus resources on the emerging growth sectors of the economy, to support region-wide initiatives, necessary improvements or enhancements, infrastructure analysis, and the logistics of coordinating a unified program.

CONCLUSION

While the case studies detailed above are relatively recent it is apparent that spatial informatics holds great promise in helping to maintain the economic viability of a geographic region. The use of spatial informatics to define new economic opportunities through the analysis of place and create efficiencies by effectively defining and managing regions is essential in the current economic environment.

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Analyzing Learning Processes and Outcomes in Computer-Supported Collaborative Learning (CSCL) in the Domain of Nutritional Research Methodology Education

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Abstract

This paper was designed to investigate students' learning processes and outcomes in computer-supported collaborative learning (CSCL) within the domain of nutritional research methodology education. To do so, a pre-test was taken place to assess the students' prior knowledge before implementing CSCL. Students were asked to collaboratively design/analyse/interpret/solve an evaluation study to evaluate a certain nutritional assessment method (a 24 hour recall) with the context of the assessment of vitamin D intake in a population of immigrants in CSCL environment with *DREWLITE* platform. The post-test then was taken place to assess the students' learning outcomes. Two coding schemes were employed to analyze students' learning processes (relevancy, correctness, width, depth, and reasoning of discussion) and outcomes (knowledge construction based on level of understanding). With regard to the number of students' posted notes, no big difference was found in the pre-test and post-test (514 vs. 523 respectively). The results of multivariate (repeated measurement) test indicated that students improve their quality of knowledge construction based on level of understanding about the topic from pre-test to post-test (F= 4.22; sig= 0.043). Independent sample t-test was used to assess the learning outcomes differences between successful and less-successful pair of students with regard to different aspects of learning processes. Successful pairs of students elaborated deeper, and more relevant, correct, and logic discussions than less-successful pairs of students during the learning process.

Key words: CSCL, Knowledge construction, Nutritional research methodology.

Introduction

With the swift growth of information and communication technology, and the rapid growth and widespread accessibility of the WorldWideWeb, it is inevitable that professionals in all fields will be confronted with rapidly changing global problems and complex issues. These complexities call for appropriate action, also in the field of education. It is believed that proper educational designs have the potential to prepare and train students to become capable and qualified professionals, who can analyse, conceptualize, synthesize, and cope with complex and authentic problems (Jacobson & Wilensky, 2006). The use of new collaborative technologies as teaching and learning tools is now quickly increasing in education and science. Computer-supported collaborative learning (CSCL) has recently been seen as an important and achievable instructional strategy to facilitate and support students' learning processes and outcomes and thereby help students achieve a deeper understanding (Koschmann, 2003). In today's information and communication era, CSCL is gradually moving into the mainstream of educational designs, so that it is currently receiving enormous attention in universities and schools throughout the world (Claudia, Steil, & Todesco, 2004; Van Bruggen, 2003; Ellis & Calvo, 2004; Hung, Tan, & Chen, 2005; Wang & Woo, 2007).

Many studies have shown that CSCL environments lead to better outcomes and results than traditional forms of classroom education (face to face) in terms of constructing knowledge, gaining a comprehensive understanding, and solving complex problems (Andriessen, Baker, & Suthers, 2003; Joiner & Jones, 2003; Kirschner, Buckingham-Shum, & Carr, 2003; Weinberger & Fischer, 2006). Enriched online environments provide students with rich data to broaden and deepen their arguments (Clark, Stegmann, Weinberger, Menekse, and Erkens, 2007). Providing students with enriched information, such as visualizations (e.g., TELS and WISE) and knowledge bases (e.g., CSILE) help students to justify, evaluate, and increase the persuasiveness of their arguments (Oestermeier and Hesse, 2000; Clark, Sampson, Weinberger, and Erkens, 2007;

Clark, Stegmann, Weinberger, Menekse, and Erkens, 2007). It has been claimed that CSCL settings not only facilitate and foster knowledge construction processes but also knowledge construction (Veerman, 2000;Veldhuis-Diermanse, Biemans, Mulder, & Mahdizadeh, 2006).

In CSCL settings knowledge can be constructed through structuring, elaborating, evaluating concepts and ideas, eliciting and summarizing external information, and connecting concepts, facts, and ideas about the topic (Veldhuis-Diermanse, Biemans, Mulder, & Mahdizadeh, 2006). Knowledge construction in CSCL settings has been seen to be related to acquisition of knowledge on argumentation and domain-specific (Stegmann, Weinberger, and Fisher, 2007). Taking into account reviewed literature, this study was conducted to analyze students' learning processes and outcomes in CSCL environment in the domain of nutritional research methodology education. To facilitate this, three research questions were formulated as following:

1- What is the characteristic of students' learning outcomes in CSCL environment?

2 - What is the characteristic of students' learning processes in CSCL environment?

3 - Is there a difference in the learning outcomes between successful and less-successful pair of students with regard to learning processes in CSCL environment?

Method and procedure

Participants, design, and procedure

Forty two (42) students in nutritional epidemiology education at Wageningen University in the Netherlands participated in this study. They all followed the course "Exposure assessment in nutrition and health research, in curriculum Human Nutrition at Wageningen University. The main focus of this course is on knowledge and skills related to the design, analysis and interpretation of validation and reproducibility studies.

An introduction session (20 minutes) was held by the first author of this study and then students were given the opportunity to exercise with the platform for about 10 minutes to get ready for the real sessions. Then the pre-test was taken place before starting CSCL. Students were asked to design an evaluation study individually within 45 minutes based on what they already know about the learning task. The pre-test was taken place to assess the prior knowledge of students before CSCL. Students then were asked to collaboratively in pair design/analyse/interpret/solve an evaluation study to evaluate a certain nutritional assessment method (again a 24 hour recall) with the context of the assessment of vitamin D intake in a population of immigrants in CSCL environments with *DREWLITE* platform. They were given the opportunity to chat, discuss, and argue about the topic in pairs for about 90 minutes through *DREWLITE* platform. In the end, the post-test was taken place. They were asked to re-design the same evaluation study individually within 45 minutes based on what they have learnt in CSCL learning task. The post-test was taken place to assess the students' learning outcomes in CSCL.

DREWLITE platform

DREWLITE platform was employed for accomplishing the learning task. *DREWLITE* is a new version of *DREW* platform that was developed within the European SCALE project to support argumentative CSCL (Corbel, Jaillon, Serpaggy, Baker, Quignard, Lund, and Sejourne, 2002; developed by the Armines Team (Ecole Nationale Superieure des Mines de Saint-Etienne)). This platform comprises different tools for communication, collaboration and argumentation such as chat, graph, textboard, viewboard, multimodules, etc. *Different modules can be used* both individually and collectively. For the present study both individual and collaborative versions *were employed.* Individual version (graph module) was used to test students' pre and post domain-specific knowledge. For the collaborative learning task in CSCL part, chat module was employed. The chat module can be used to discuss a subject, to debate with other participants or to bring together a collaboratively written text. The time, the name of participants, and the corresponding corresponding in the whole process were automatically recorded by a log-file of *DREWLITE* platform.

Measurements

According to the nature of this study and research questions, available methods and instruments of content analysis were employed to analyze students' learning processes and outcomes. In the following section, two coding schemes are presented to analyze the present study.

Coding scheme 1: Analyzing learning outcomes

In this study, quality of knowledge construction based on level of understanding about the topic was taken into consideration as the indicators of learning outcomes. SOLO taxonomy (Biggs and Collis, 1982) aimed to analyze the quality of students' contributions in on-line environments to reflect their quality of knowledge construction based on level of understanding. SOLO taxonomy provides a systematic way of unfolding how a student's performance develops in complexity when handling tasks in an online environment. It has been recently used by many researchers to analyze the quality of learning results (Veldhuis-Diermanse, 2002). In terms of SOLO taxonomy, students' responses to the tasks were classified into five hierarchical levels from level E until level A, which are: *prestructura*l, *unistructural*, *multistructural*, *relational* and *extended abstract* (Biggs and Collis, 1982; Biggs, 1999; and Jackson, 2000). Elaborated version of SOLO taxonomy (see Veldhuis-Diermanse, 2002) was employed for this study to assess the quality of learning outcomes since the intention was to categorize students' notes into hierarchical boundaries with regard to quality of knowledge construction. To determine the quantity and quality of knowledge construction as well as level of understanding, the pre-test and post-test analyses were segmented into meaningful units and each unit was coded by authors of this study. Corresponding verbs were identified for each of the five quality levels (increasing from E to A level) to assess the students' learning outcomes. Using descriptive analysis, the quality of knowledge construction based on level of understanding was measured. As an indicator of level of understanding, students were given one point for each unit of contribution which was categorized as E level in the previous stage. We assigned two points for each contribution of D level, three point for C level, four point for B level and five points for A level. We added all the points of each student and divided them by the number of units in order to assess the mean score of level of understanding for each student.

Coding scheme 2: Analyzing student's learning processes in CSCL

Applying coding scheme 1 sheds light on the nature and quality of student's learning outcomes namely knowledge construction based on level of understanding. Nonetheless, the students' learning processes in CSCL environments is also important. Since no conclusions about the learning processes can be drawn using coding scheme 1, another content analysis instrument that was created by the authors of this study was used (see Table 2). As it was aforementioned, participants were asked to collaboratively discuss in pairs and argue about the question in order to find the best solution, build their boxes and write their analyses. To analyze the process of learning, the joint contributions of each pair were segmented into meaningful units and coded by the first author. Therefore, the contributions of 21 pairs were used as the data source for this study. As an indicator of the learning process, several aspects were taken into account including relevancy, correctness, number of topics, width of topics, depth of discussion, and reasoning. Based on our scoring system, pair of students were given one point for each irrelevant, incorrect, inadequate, superficial, and illogic contribution. Two points was assigned for each partly relevant, partly correct, partly adequate, simple, and partly logic contribution. Three points were assigned for each relevant, correct, adequate, elaborated, and logic contribution. Subsequently, we added all the points of each pair in order to assess the mean score of each aspect of previously discussed learning process. So, based on each aspect of learning process, pair of students could get a score between one and three.

The two coding schemes combined

The intention was to figure out whether broader and deeper argumentation leads to better learning results and outcomes in ACSCL environment. To do so, the median score of the gain of knowledge (learning outcomes) from pre-test to post-test for each pair was calculated as the criterion according to which learners were classified as either successful or less-successful. This resulted in 10 pairs of students as successful and 11 pairs of students as less-successful. The learning processes were then compared between successful and less-successful students.

Analysis process

Two coders analyzed the students' learning processes and outcomes. Cohen's kappa was employed as a reliability index of inter-rater agreement. Cohen's kappa for segmentation of this study was 0.78 (pre-test) and 0.81 (post-test) for the *Veldhuis-Diermanse's* coding scheme, and 0.81 for the authors' coding scheme which indicates acceptable and substantial levels of agreement. Moreover, intra-rater reliability-stability of two coders was calculated for about 20 percent of

the messages. Two coders agreed upon about 85 percent of the coding rating systems.

Results

RQ1: *What is the characteristic of students' learning outcomes in CSCL environment within the domain of nutritional epidemiology education?*

In the pre-test (before collaboration), in total, 514 notes were delivered by students. Majority of students contributions (34%) were assessed as level C (multistructural), 4% as level A (extended abstract), while 7% were irrelevant. In the post-test, the number of posted notes slightly increased (523 notes); nevertheless, still 34% of students' knowledge construction was coded as level C (multistructural). However, 6% of students' contributions were categorized as level A (extended abstract) and only 4% were irrelevant (level E).

In order to compare the learning outcomes with regard to the quality of knowledge construction, the mean score of knowledge construction based on level of understanding for each student was examined. The mean score for students' knowledge construction based on level of understanding in the pre-test and post-test were registered as 3.01 (SD= 0.40) and 3.11 (SD= 0.34) respectively. Multivariate (Repeated measurement) test was used to assess the effects of CSCL on students' knowledge construction over time. The result indicated that students could improve their knowledge construction based on level of understanding about the topic (F= 5.62; sig= 0.02). It means that the intervention with CSCL helped students to gain more knowledge.

RQ2: What is the characteristic of students' learning processes in CSCL environment within the domain of nutritional epidemiology education?

As an indicator of the learning process, several aspects were taken into account including relevancy, correctness, number of topics, width of topics, depth of discussion, and reasoning. So, based on each aspect of learning process, pair of students could get a score between one and three. The findings with regard to the process of learning in CSCL showed that the mean score and standard deviation of relevancy (M= 2.28; Sd= 0.28) and correctness (M= 2.19; Sd= 0.26) of students' contribution were assessed more than average. Each pair, in average discussed and argued 13 topics (M= 12.57; SD= 2.06). Students broadened the space of the debate (M= 2.08; Sd= 0.32) more than average based on the scoring system. The mean score of deepening discussion (M= 2.12; Sd= 0.30) was a little more than the mean score of reasoning discussion (M= 2.09; Sd= 0.29)

RQ3: *Is there a difference in the learning outcomes between successful and less-successful pair of students with regard to learning processes in CSCL environment?*

Independent sample t-test was used to assess the learning outcomes differences (gain of knowledge) between successful and less-successful pair of students with regard to various aspects of learning processes (relevancy, correctness, number of topics, width of topics, depth of discussion, and reasoning). The results indicated significant differences between relevancy (t= -3.081; sig= 0.006), correctness (t= -2.621; sig= 0.017), depth (t= -2.266; sig= 0.035), and reasoning (t= -2.464; sig= 0.023) of discussion (learning process) with gain of knowledge (learning outcomes) among successful and less-successful pairs of students. The mean score for successful pairs of students were registered significantly higher than less-successful pairs of students for all aspects of learning process expect the number and width of discussed topics in CSCL environment. Successful pairs of students elaborated deeper, and more relevant, correct, and logic discussions than less-successful pairs of students during the learning process.

Conclusion and discussion

The description of the conclusion and discussion parts follows the research questions and results phases. In the first research question, the descriptive characteristic of learning outcomes in CSCL was measured. With regard to the number of students' posted notes, no big difference was found in the pre-test and post-test (514 vs. 523 respectively). In both pre-test and post-test, majority of students' knowledge construction were assessed as level C and B (around 63% for pre-test and 65% for post-test of students' contributions), meaning that almost two third of students could construct knowledge as multistructural and relational levels which could be seen quite satisfactory. Construction knowledge as level C and D indicates that the students mostly were interested to describe, organize, and classify all possible solutions for the topic. In other words, they were testing, organizing, and analyzing their thoughts in order to relate, combine, and compare the possible solutions. As it was expected, the quality of students' knowledge construction improved after collaboration (from pre-test to post-test). In the pre-test, for example, around 4% of students' contributions were coded as level A (extended abstract), while in the post-test, around 6% of students contributions were coded as level A. Similarly, in the post-test the amount of irrelevant contributions in the level E (almost 4%) reduced compared with the pre-test (almost 7%). The results of multivariate (repeated measurement) test also indicated that students improve their quality of knowledge construction based on level of understanding about the topic from pre-test to post-test. It means than CSCL helped students to increase their level of understanding about the topic. It echoes that (Andriessen, Baker, & Suthers, 2003; Joiner & Jones, 2003; Kanselaar, De Jong, Andriessen, & Goodyear, 2000; Kirschner, Buckingham Shum, & Carr, 2003; Lipponen, 2002; and Weinberger & Fischer, 2006) whose have claimed that CSCL can bring added value to the learning environment.

As an indicator of the quality of the learning process, several aspects were taken into account including relevancy, correctness, number of topics, width of topics, depth of discussion, and reasoning. The findings indicate that in all aspects of learning process, the mean score of students' contribution were assessed more than average which could be seen as satisfactory. Independent sample t-test was used to assess the learning outcomes differences (gain of knowledge) between successful and less-successful pair of students with regard to different aspects of learning processes (relevancy, correctness, number of topics, width of topics, depth of discussion, and reasoning). For instance, successful pairs of students elaborated deeper, and more relevant, correct, and logic discussions than less-successful pairs of students during the learning process. The result did not reveal any significant differences between successful and less-successful pairs of students with regard to number of topics and width of discussion during the learning processes.

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Impact of Computers and Internet on the Social and Economic Welfare of Low Income People: The Case of SmartRiverside Digital Inclusion Program

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ABSTRACT

The impact of computers, Internet and information technology in businesses around the world has been manifested through widening the scope of business applications, improving productivity, helping businesses reduce cost and operating effectively and efficiently. However, there are enormous challenges and opportunities in assessing the impact of Internet and computer usage on the individual's well being. This research study was designed to assess the impact of computers and Internet on the economic and social wellbeing of low-income households. The City of Riverside, and under the management of SmartRiverside: The Digital Inclusion program, provided 2,600 low-income households in the City of Riverside a free computer, free access to the city WiFi Internet, and 8-hour training classes on the basics of computer usage and accessing the Internet. A systemic random sample of 120 households was selected from the above households. A survey research was conducted, data analyzed, and findings reported. Results showed a positive and encouraging impact on learning, social interaction, and personal development of these families; and thus achieving the objectives of the Digital Inclusion program. The paper concludes with some recommendations for policy makers and interested groups.

Keywords: Computer, Internet, Economic Welfare, Social Wellbeing.

INTRODUCTION

The benefit of business concerns around the world, in relation to the usage of computers, Internet and information technology, is a proof of the dramatic impact the Internet is having on the scope of business applications, improving productivity, helping businesses reduce cost, and operating effectively and efficiently. However, it is more challenging to assess the impact of Internet and computer usage on the individual's wellbeing. Although research on such impact show mixed results, theoretically, the benefits mentioned in the literature include: facilitating social interaction and communication; improving entertainment and learning; supporting autonomy by providing access to information services; facilitating routine tasks; improving access to health services; and finally, improving general well-being and quality of life by providing mental stimulation and challenge. This study was designed to assess the impact of computers and Internet usage on the economic and social wellbeing of low-income households in the city of Riverside, Southern California. Its practical purposes are to determine the viability of and to improve the Digital Inclusion program; and theoretically to shed some light on the above hypothesized benefits to the individual's well being.

Recognizing the enormous benefits of computers, the Internet and information technology, the City of Riverside, as part of its community development programs, provided about 2600 low-income households each with a free computer, free access to city WiFi Internet, and free 8-hour training classes on the basics of computer usage and accessing the Internet. The program is called SmartRiverside Digital Inclusion Program. City management is interested in learning about the impact of the above program for the sake of improving it and introducing changes as needed. The program is an ongoing project.

A sample of 120 households was selected from the above households using systematic random sampling. A survey research was conducted using an extensive questionnaire. The paper presents a glance at related literature to the topic, the research methodology, and discussion of the results, and concludes with limitations of the study and recommendations for policy makers and interested groups.

LITERATURE REVIEW

The Internet, computers and information technology are increasingly becoming a part of life for millions of people around the world, and considered integral tools of business practice, communication, popularity culture, and life style. They have altered the way businesses conduct operations to the extent that effective utilization of these tools is a must-have key success factor for any modern organization. However, research on the impact of computers and the Internet on the individual life reveals controversial results.

Some researchers agree that the Internet has revolutionized social interaction, allowed opportunities for economic welfare, made it possible for many to do certain activities which cannot be done otherwise, opened doors for learning and acquiring information, and overall

enhanced quality of life and wellbeing. On the other hand, the detractors argue that the Internet has led to negative impacts such as loss of privacy, impersonal communications and isolation, confusion between the real and virtual worlds, and overall questionable impact on the individual's cognitive and psychological development. This brief review will focus on selected studies pertaining to the above arguments.

Morgan and Cotten [11] conducted a survey of college freshmen to determine the impact of Internet activities on social support and wellbeing. Results indicated that increased e-mail and chat room/instant messaging hours are associated with decreased depressive symptoms, while increased Internet hours for shopping, playing games, or research is associated with increased depressive symptoms. Also, Internet use and psychological wellbeing in adults has been studied by Kraut and colleagues [10]. They found greater Internet use to be associated with reduced psychological wellbeing, reduced social support, increased loneliness and depression [9]. Similarly, Brenner [1] surveyed young Internet users who spent an average of 19 hours per week on-line and found that they reported feeling more isolated from society at the point of testing than before using the Internet. Furthermore, these individuals reported reduced personal interactions with family members and friends.

In contrast, some research suggests that the Internet increases social connectedness and results in many positive relationships [8]. Research on online interaction and education use of the Internet reveals that in the United States a significant portion of youths are actively using the Internet as an important form of social interaction [2]. The only concern is that the extraordinary growth of Internet use among youth as a primary social interaction may influence their development of their interaction ritual skills.

Moreover, in their study of the E-Rate program, Goolsbee and Guryan concluded that E-Rate was very successful as a policy to close the digital divide. The E-Rate subsidy led to substantial increases in Internet investment in California public schools and helped every school in the U.S. to hook up to the Internet, but as a means of improving performance, however, the E-Rate has shown little success on any testable measure [6].

In the Fall/Winter 2000 issue of the online journal, The Future of Children, researchers examined the effect computer technology has on development and learning in typical children and adolescents. It addressed physical, cognitive, and psychological effects of technology, and the digital divide, among other related issues. According to the review, while computers hold promise for positive outcomes in learning and development, they also have a negative impact on the health and social development of learners who spend large amounts of time in front of the screen and are at increasing risk for obesity, repetitive strain injuries, stunted social development, and clinical depression [4].

Contrary to the findings of the negative impact of Internet use on psychological wellbeing of young adults, literature on Internet use among older adults suggests positive effects on psychological wellbeing [12, 14, 15]. As per the results, older adults reported less loneliness, positive feeling toward learning how to use the Internet, developing relationships within online communities and chat rooms, and improved outlook on life. This evidence, combined with other findings that elderly Internet users reported greater levels of both purpose in life and personal growth, indicates clearly that older adults could benefit from access to computers and the Internet, as well as computer training. Older adults who are confined to their homes may be the ones who could benefit the most from having access to the Internet and the opportunities for research, communications, holiday shopping, banking, etc. [3].

At the same time, computer technology can play a critical role in promoting the education of the millions of children with specific learning and psychological disorders, and those with severe disabilities. For example, students with mild learning disorders find that word processing and word prediction software significantly improve their written language skills and allow them to function academically in regular classroom settings [7].
Stern and Messer [13] in their study of core family networks and how the family stays in touch, concluded that in addition to face-to-face visits, use of landline telephones or cellular telephones, e-mail has become an important tool in maintaining core familial social networks, especially when these family members live outside the local area.

DiMaggio and Bonikowski [5] reported that most research on the digital divide presumes that adults who do not use the Internet are economically disadvantaged; however, little research has tested this premise. Their analyses reveal robustly significant positive associations between web use and earnings growth, indicating that some skills and behaviors associated with Internet use were rewarded by the labor market. Workers who used the Internet only at home also did better, suggesting that users may have benefited from superior access to job information or from signaling effects of using a fashionable technology. However, they stated that the positive association between computer use and earnings appears to reflect the effect of Internet use, rather than use of computers for offline tasks.

The debate is going on regarding the effects of computers, the Internet and information technology on many aspects of the individual's life – economic welfare, social interaction, psychology, learning, entertainment, empowerment, autonomy, and quality of life in general.

Researchers and policy makers should not be discouraged by the controversial results of previous research, but continue the research efforts to avoid ill effects and utilize this resource in the most beneficial manner.

METHODOLOGY

Although the core of this study was the survey research, some exploratory research was conducted. Previous related studies were examined to learn about measures used to assess the impact of computer usage and Internet on the individual's economic and social welfare. Also an in-depth interview was conducted with management of SmartRiverside Digital Inclusion Program to learn more about the program. The exploratory research was very helpful in structuring the questionnaire for the survey.

The survey research used a structured questionnaire to collect primary data from a systemic random sample of the households under study. The sample frame consisted of the 2,140 individuals who were each provided a free computer and free Internet access; completed an 8-hour training class about how to use the computer and access the Internet; and had had the computer and the Internet access for more than ten months. The assumption here is that a ten-month period is adequate usage time to realize a change and recognize benefits. Based on specific assumptions regarding the distributional characteristics of the target population, a sample of 120 households randomly selected was determined as a statistically adequate representative sample.

Selected participants in the program who met the above criteria were contacted and asked if they would like to participate in the study. They were informed that the study required providing information regarding their usage of the computer and accessing the Internet, changes in their lives, and some information about themselves. They were informed also that it may last about 30 minutes, and that they would be given a new printer as an incentive for their time and efforts.

Questionnaires were self-administered with the presence of a research assistant in case of any questions or if explanations were required. The questionnaire incorporated mostly structured questions. A few open-ended questions were asked. The questions included, but were not limited to, the following: computer and Internet usage level, purpose of use (e.g., for entertainment, education, purchases, making payments, information search, and for connectivity with family, friends, and business associates; etc.), any changes in individual attitudes towards education and life in general after participation in the program, impact on children/family members' school performance, economic impact, impact on quality of life, and some classifying variables.

It is important to note that the results of the study were based on self-reporting of respondents to the questions, rather than actual documentation of any change, other than that the computer was working and Internet connection was in place as observed by the research assistant.

All the responses to the statements in the tables below were measured on a five-point Likert scale with five (5) being strongly agree and one (1) being strongly disagree.

DISCUSSION OF RESULTS

The analysis revealed that there was a major impact on the social and economic wellbeing of the sampled households, which was also sensed through their responses to some of the open-ended questions in the questionnaire. It is interesting to note that one of the major impacts in this case was the fact that this program opened a door for these families to invest time, effort, and money to upgrade their knowledge and facilities; thus creating sustainability for such impact and benefits of the program.

Sample Demographics

The following is an overview of the sample demographics as reported by the respondents. Gender: females 65 percent, males 34.2 percent. Age: 18-25 years old 22.5 percent, 36-55 years old 36 percent, and 50 years old or older 32.4 percent. Of respondents, 31.7 percent were married, and 25.8 percent were single-parent head of household. For those who were not single living alone, the average household size was four individuals.

The ethnic distribution of the sample was: White 25 percent, Black/African American 22.5 percent, Hispanic/Latino 40.8 percent, Asian 2.5 percent, and other multi-racial 9.1 percent. Respondents reported their primary language as: English 76.7 percent, Spanish 19.2 percent and other languages 4.2 percent.

The education level of the respondents was: completed or some elementary school 12.5 percent, completed or some high school 36.7 percent, some college education or technical degree 42.5 percent, completed college or higher 8.4 percent. Some respondents (24.2 percent) reported that they are currently enrolled in some educational program.

Current employment status of respondents was: retired 26.9 percent, full- or part-time employed 26.1 percent, homemakers 14.3 percent, self-employed 5.9 percent, students 23.5 percent.

Respondents reported annual household income of: under $10,000 (29.2 percent), $10,000-$25,000 (40 percent), $25,000-$45,000 (24.1 percent), and over $45,000 (6.7 percent).

Computer and Internet Usage

Regarding who uses the computer in the household, 79.2 percent reported that they themselves use the computer, 10.8 percent indicated their spouse also uses the computer, 37.5 percent reported that the computer was used by children, and 20 percent reported that others (family members, friends, visitors, etc.) also use the computer. It is important to note that 45 percent of the respondents started to use computers since they received the computer from SmartRiverside Digital Inclusion Program. As for time spent per week on the computer, 65 percent reported 10 hours or less (65 percent), the rest used it for more than 10 hours. Respondents also reported using the city WiFi free access to the Internet (32.5 percent), or accessing the Internet through other providers (50.8 percent). For time spent per week using the Internet, the distribution was as follows: more than 20 hours (11.7 percent), 16-20 hours (9.2 percent), 11-15 hours (11.7 percent), 6-10 hours (25 percent), and 5 hours or less (42.5 percent).

Purposes for which respondents used their computer included: typing documents for work 35 percent, typing personal documents 62.5 percent, as a calculator 10 percent, financial/spreadsheets purposes 5 percent, on-line education 34.2 percent, video gaming 30 percent, surfing the Internet 65 percent, and doing school homework 35.8 percent. Of those who use the computer for the Internet connection, activities included: e-mailing 67.5 percent, chatting 23.3 percent, surfing web sites 51.7 percent, checking bank accounts 25 percent, online education 25.8 percent, research and information 60 percent, making purchases, 19.2 percent, paying credit card bills 10.8 percent, paying other bills 18.3 percent, enjoyment and fun 50.8 percent.

Of respondents who had children living at home (65 percent), a majority of these households (96 percent) reported that the children use the computer and the Internet. Of those children, 44.2 percent use it for school homework and many reported using it for other purposes, such as video gaming, online education and typing. Of the 19.2 percent who reported that their spouses uses the computer, the pattern of spouse usage was very similar to that of the respondents.

Time spent using the computer and the Internet can be used as an indicator of a positive attitude toward its benefit.

Social Interaction

The majority of the respondents (74.2 percent) use the Internet for e-mailing to stay in touch with their family (70.8 percent), friends (65.8 percent), business associates (12.5 percent), and others (9.2 percent). When asked about how they use the Internet to communicate with their social network, 33.3 percent use it for Instant Messaging, 15.8 percent use it communicate through Face Book, 30.8 percent use it to communicate through My Space, only 1.7 percent use it for blogging, and 14.2 percent use it to reach other social networks.

When asked if the respondent's social networking changed after starting to using the Internet, 45.8 percent reported that their social networking increased, 29.2 percent about the same, and 2.5 percent said it decreased their social networking. As far as if the Internet affected their relationships with others, 41.7 percent mentioned that it improved the relationships, 55 percent reported that it kept the relationships the same, and only 3.3 percent indicated that it worsened the relationships.

Impact on Economic Welfare

Only 12.5 percent of the respondents do work from home; of those, the majority (87 percent) use the computer for work from home, and about 80 percent said they use the Internet for their work from home. Many respondents reported that the Internet has opened up exciting new possibilities for them 76.6 percent; helped them find a job 34.1 percent; and that Internet use increased their earning 14.2 percent. (Table 1)

At least one respondent reported in open-ended questions that the Internet helped them with their online business.

Table 1

Statement	Mean
Internet has opened up exciting new Possibilities for me	3.98
The Internet helped me find a job	2.97
Internet use increased my earnings	2.41

Impact on Family Educational Performance

As regards how helpful the Internet was in improving family members' performance at school, 62.5 percent reported it was helpful or extremely helpful. In addition, on the scaled questions, respondents expressed agreement or strong agreement to the statements: the Internet improved my learning at home 82.5 percent, the computer assisted my family's education 71.7 percent, and the Internet provided me with information from a huge variety of sources 88.4 percent. (Table 2)

Respondents reported in open-ended questions that it helped their children for school homework, and it helped themselves in their online education. It also helped respondents help their children do their homework. They further reported that they are finding lots of information on the Internet.

Table 2

Statement	Mean
The Internet improved my learning at home	4.01
The computer assisted my family's education	3.82
The Internet provided me with information from a huge variety of sources	4.22

Impact on Personal Entertainment

Respondents agreed or strongly agreed that they used the Internet for fun 72.4 percent, found it relaxing 64.2 percent, and that the Internet had an entertaining effect of their life 65.8 percent. (Table 3)

Respondents reported in the open-ended questions that they enjoyed their computer, and that the Internet access is wonderful.

Table 3

Statement	Mean
I use the Internet for fun	3.78
I find the Internet relaxing	3.65
The Internet has an entertaining effect on my life	3.62

Psychological Impact

Respondents were asked to rate their experience working with the Internet (accessing the Internet, using search engines, downloading files, creating a web page, and maintaining a web page); the overall Mean was 2.742 indicating preliminary experience, especially when it comes to creating and maintaining a web page.

Respondents agreed or strongly agreed that they felt that they could use the Internet confidently 85.9 percent, enhanced their independence 68.3 percent, decreased their feeling of being left out of modern society 28.4 percent, improved their self-esteem 45 percent, and the reduced their dependency on others 50.8 percent.

Respondents also agreed or strongly agreed that they are good at using the computer and Internet 61.5 percent, and using computers and the Internet is a frustrating experience 18.8 percent. (Table 4)

Table 4

Statement	Mean
I feel confident that I can use the Internet	4.05
The Internet enhanced myself independence	3.73
The Internet decreased my feeling of being left out of modern society	2.97
The Internet improved my self-esteem	3.20
The Internet has reduced my dependency on others	3.41
I am good at using the computer and Internet	3.54
I find using computers and the Internet frustrating	2.29

Impact on Life in General

Respondents reported that the Internet has been helpful or extremely helpful (68.4 percent) in doing everyday functions (e.g. banking, shopping, acquiring information). The mean of all responses on the 1-5 scale was 3.64.

Respondents agreed or strongly agreed to the statements: computers have opened up exciting new possibilities for me 78.4 percent; and that the Internet: changed my life 50.7 percent, improved my life satisfaction 52.5 percent, improved the quality of my life 48.3 percent, gave me more control over my life 38.3 percent, is bringing us into a new bright era82.5 percent, life is easier and faster with the Internet 78.3 percent, soon our lives will be controlled by the Internet 49.1 percent, people are becoming slaves to the Internet 43.3 percent, and the Internet enhanced my general health 27.5 percent. (Table 5)

Table 5

Statement	Mean
Computers have opened up exciting new possibilities for me	3.95
The Internet changed my life	3.35
The Internet Improved my life satisfaction	3.40
The Internet improved the quality of my life	3.32
The Internet gave me more control over my life	3.06
The Internet is bringing us into a new bright era	4.07
Life will be easier and faster with the Internet	3.98
Soon our lives will be controlled by the Internet	3.22
People are becoming slaves to the Internet	3.09
The Internet enhance my general health	2.85

Satisfaction with Program and Suggestions

Respondents were asked if they received additional training from other sources, 30 percent said yes; those who did received the additional training via general courses at a community college, did a course with vendors/consultants, or studied on their own with different number of hours spent. Respondents also agreed or strongly agreed that the program opened many doors for them 72.5 percent; and attested that the training they received from the program has been extremely helpful 79.2 percent. Most reported they were satisfied or very satisfied with the program 87.5 percent, while some were dissatisfied 7.5 percent, likely because the Internet was slow in their coverage area. The majority said the Digital Inclusion training program was effective or extremely effective 87.5 percent, while some reported it was ineffective 9.1 percent (likely because training classes were very intensive for them, hinted to in responses to the open-ended questions). (Table 5)

Following are responses to open-ended questions about satisfaction with the program: if it were not for the program, they would not have a computer or Internet access; the Internet was slow; the teacher was very informative; the class was very effective and the training was good; gave them an excellent start to continue in this area; the training program was intense and should be over a longer time, include more practice hours, or be extended to other cities around us; needs better coverage of the WiFi signal. At least one respondent was willing to volunteer to keep the program going.

Table 5

Statement	Mean
The DI program is useless	2.09
The DI program opened many doors for me	3.80
The training I received from DI has been extremely helpful	4.06

CONCLUSION

According to the results of this study, SmartRiverside Digital Inclusion program has a major impact on the lives of the respondents of the sample, and that can be generalized to all individuals who benefited from the program. However as for the support to the theoretically hypothesized positive effects of computer usage and the Internet, caution should be exerted in using these results due to limitations of the research study; such as the limited geographical scope; the ten-month usage period which could be considered short for showing effect experiencing the computer and the Internet; and finally that all individuals in the program are of low income, and were given a computer, Internet access, and training free of charge, and that by itself may bias their responses positively towards the program and its benefits.

Nevertheless, computers and the Internet are heavily integrated in our lives, and their impact is seen in how we live, communicate, and learn as individuals, as communities, and as societies. The Internet empowers individuals though the power of information; helps in developing relationships with others to share views and experiences; and open doors for learning, entertainment, economic benefits, and autonomy. The results of this study should encourage the management of the City of Riverside to continue their program, and to energize governments and industries to form partnerships, and act so that those most likely to be left behind by the digital revolution be given access, skills and motivation to embrace the new technologies and benefit from the opportunities that it provides.

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Computer Science and Society: Is a New Social Contract Possible?

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ABSTRACT

Researchers in the field of social studies advocate the need for scientific and social collaboration in the production of knowledge. In this article, the authors analyse factors preventing social engagement in the joint production of knowledge in the field of computer science. Deficient computer literacy is considered a primary obstacle to this joint production, as it leads to irresponsible computer usage and low quality software development. This proposal is discussed using two examples. Firstly, how the public reacted to the virus Sasser in 2004; and secondly, how the University of Bergen neglected accessibility requirements for its web site deployed in 2008. The authors argue for the need for education in computers and laws regulating software development, and propose free software communities as a successful model for joint production of knowledge.

Keywords: Computer Science, Software Engineering, Society, Social Contract, Computer Usage, Quality Software Development, Free Software.

1 INTRODUCTION

In [1] Michael Gibbons writes that "the prevailing contract between science and society was set up to sustain the production of 'reliable knowledge'; a new one must ensure the production of 'socially robust knowledge'. [...] A new contract will be based upon the joint production of knowledge by society and science.". It is easy to say that science should enter the Agora, but Michael Gibbons does not give concrete suggestions as to how to establish a productive and beneficial communication between science and society. The authors believe that, in computer science at least, "socially robust science" is not enough; a "scientifically robust society" is also necessary; i.e. a society which is sufficiently educated to provide feedback to science.

Although software systems have made in-roads into all walks of society, most mainstream software do not meet minimum quality standards. In [2] Gary McGraw, expert in software security, writes that "much of today's software is so fragile that it barely functions properly when its environment is pristine and predictable. If the environment in which our fragile software runs turns out to be pugnacious and pernicious, software fails spectacularly.". Although software engineering is a relatively young discipline, as researchers in computer science we do not believe that this excuses low quality software. The reasons should be sought elsewhere. Indeed, research in computer science has advanced considerably, but its outcome is not fully adopted in software engineering.

In this paper, we argue that a minimum level of computer literacy is necessary to avoid irresponsible computer usage and promote high quality software development. Education in computers, and laws regulating software development, are proposed as a solution to these problems. This is a prerequisite in the field of computer science for achieving the joint production of knowledge by science and society. This scenario is depicted in Fig. 1.

The remainder of the paper is organised as follows. Section 2 discusses the general lack of awareness of risks in computer usage. Section 3 analyses the reasons behind low quality software development. Section 4 presents free software communities as a model of joint production of knowledge in the field of computer science. Finally, in Section 5 some concluding remarks are offered.

2 IRRESPONSIBLE COMPUTER USAGE

It could be argued that present-day society has a lazy approach to technologies in general, and computers in particular. It is very seldom that people read manuals or take courses before using a computer for the first time; they just use it. However, computer misuse can have a negative impact on both economy and health considering the technologically integrated structures in which most members of society operate. This is something which is unfortunately ignored by both society and its politicians.

By way of analogy, let us discuss driving licenses. The need for a driving license for vehicles is unquestionable, at least in developed countries, because if you do not drive a vehicle properly and responsibly you may end up threatening economy and health. However, the need for a license to operate computers seems pointless to many. Why is there such a difference? Because society perceives car misuse as being far more dangerous than computer misuse. The truth is, however, that with software systems a part of our

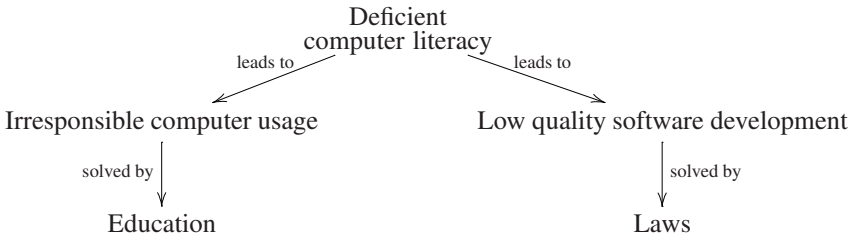

Figure 1: The lack of computer literacy and its consequences

every-day life, computer misuse can also have adverse consequences.

As an example, let us consider the computer virus Sasser (`W32.Sasser.Worm` [3]). This virus spread in April 2004 and, within a couple of days, tens of millions of computers running Microsoft Windows were infected worldwide. The virus was particularly virulent, in that it could spread without user intervention. The major effect of the virus was the shut-down of the infected system. Security solutions supplier mi2g claimed that all the Sasser variants put together caused between 10.0 and 12.3 billions EUR of estimated damages worldwide [4]. The virus could in fact have simply been stopped with a properly configured firewall.

Several months passed before the situation was normalised. Unfortunately, we would propose that the public did not learn a lesson from this technological disaster. When responsible usage of computers is encouraged, the typical reaction is "who cares?". In general, only virus writers are blamed for such software disasters. However, the responsibility must also lie elsewhere. Firstly, we argue that software vendors should develop operating systems which are not vulnerable to viruses. Secondly, we argue that people should take responsibility for protecting their computers. Even without security protections such as anti-virus or firewall, people store personal information on hard drives and make economical transactions on the web. Eventually, they become aware of risks only after their computers have been compromised. With a proper education in computers, similar problems may be avoided in the future (see [5] for a case study on how to make a campus aware of such risks).

3 LOW QUALITY SOFTWARE DEVELOPMENT

Deficient computer literacy does not only lead to irresponsible computer usage; it leads also to more subtle problems. To make a further analogy, let us compare civil engineering with software engineering. In order to ensure the quality and safety of a building, construction companies are obliged to obey all the laws regulating civil engineering and construction. If a building collapses, the construction company is liable. However, laws regulating software engineering are scarce, and a minimum standard of software quality and safety, rare. Moreover, the intangible nature of software means that individuals or organisations require the consultancy of an expert in order to verify whether a software solution is appropriate. This is such a well known-known fact in the software industry, that many providers are delivering low quality solutions, developed with the minimum of resources. This approach does not only minimise the development costs, but will guarantee the software provider additional support and maintenance income.

As an example, let us consider the case of a low quality software solution, which was delivered to the University of Bergen. Despite having a Department of Informatics, the University was not able properly to evaluate the product of the software provider. In January 2008, a new web site for the Department of Informatics was deployed. However, on analysis, it appeared to have major problems. In particular, the "new" web site did not support universal accessibility; i.e. facilitating access to contents according to the varying capabilities and characteristics of users. Unfortunately, it appears that this is not an isolated case. A recent web accessibility report for international universities has shown that accessibility is still a problem for many of the top universities worldwide [6].

There are standard guidelines that explain how to make web contents accessible to people with disabilities. The primary goal of these guidelines is to promote accessibility. "Following them will make web contents more available to all users, whatever user agent they are using (e.g., desktop browser, voice browser, mobile phone, auto mobile-based personal computer, etc.) or constraints they may be operating under (e.g., noisy surroundings, under- or over-illuminated rooms, in a hands-free environment, etc.)." [7].

Web accessibility naturally follows the principle of many developed countries that people with disabilities have the same rights to access (on-line) information. Some governments are slowly introducing laws that demand public institutions to provide accessible web sites. At the time of writing, Norway seems to have only "recommendations" about web accessibility, but not any specific law. However, the University of Bergen has internal rules, among which universal accessibility. Despite these rules, in January 2008, none of the University Departments' web sites was compliant with these rules.

Our first step in investigating the problems we encountered was to send questions and feedback to the development team of the web site, using the "Comments" form provided. Three months passed without an answer being received. The first author informed the head of the Department of Informatics about the problems in a e-mail that stated:

"I think that it is not wishful thinking to expect that a new web site of a Department of Informatics is built using the state-of-the-art of programming practices and web technologies. Unfortunately, this is not the case for us. [...] I am quite confident to say that our 'new' web site seems to be made with web development practices of 10 years ago. This way, the entire Department might loose reputation, since in the computer science/software engineering world many other researchers/technicians might notice the same faults I noticed. You will probably agree with me that this is not a good 'visiting card' for us. [...] The web site is not accessible. Most of the western countries recommend public institutions to have accessible web sites; i.e. web sites that are designed to allow people with disabilities to access its contents. [...] Therefore, it is very probable that the inaccessibility makes this web site irregular".

Fortunately the head of the Department of Informatics appreciated this input, and redirected the feedback to the project leader of the web site development at the Communication and Media Centre of the University. The project leader answered that the web site deployed in January 2008 would be replaced by a brand new one in the beginning of 2009. The reader might be puzzled by the choice of deploying a temporary web site when a new one was already in the pipeline. This administrative choice seemed inexplicable; but it was not the only problem.

The web site was replaced in February 2009 by a new content management system called EksternWeb [8], which was adopted by the entire University. Despite the feedback given one year before, the new web site was not fully compliant to accessibility standards. The development of EksternWeb costed 12.8 million NOK (1.5 million EUR) and relied on a well-known Norwegian software provider for the its technical implementation. Oddly enough, however, the Department of Informatics was not involved. Compared to the solution of 2008, the EksternWeb solution represents a big leap forward, but the authors find the cost unjustified, in light of the system's lack of important features.

This example is illustrative of the problems extant in the interaction between computer scientists, software engineers and users. Science provides elegant solutions to enable web accessibility, but engineers do not always adopt them [9]. Even top universities with departments of computer science and software engineering are not able to guarantee the quality of their software solutions. The introduction of laws regulating software development is necessary to oblige software developers to meet certain quality standards, e.g. web sites which are fully compliant with accessibility requirements.

4 FREE SOFTWARE COMMUNITIES

For many years, communities of computer scientists, software engineers and users have been collaboratively developing free software. "Free software is software that gives you the user the freedom to share, study and modify it. [...] To use free software is to make a political and ethical choice asserting the right to learn, and share what we learn with others. Free software has become the foundation of a learning society where we share our knowledge in a way that others can build upon and enjoy." [10].

Users of free software are typically more curious and keen to read documentation, and several groups provide free education and support to users. This guarantees a "scientifically robust" user base, with the sufficient skills to provide feedback to scientists and engineers developing new technologies and software solutions. Moreover, a free software project allows unrestricted access to its technical documentation, e.g. software models and source code. This guarantees peer review, and hence quality; a process integral to scientific development. In addition, features may be introduced as a result of community feedback. Managers of free software projects may have to accept choices that go against their personal preferences, on the basis of shared community opinion. The joint production of software solutions is, then, in fact a concrete reality, but only where the public involved has the necessary education to provide feedback.

5 CONCLUSION

One of the goals of computer science research is to improve software quality. However, it will not be feasible to prevent software providers from delivering sub-standard solutions, until feedback from the general public can be considered valuable. Once the users are comprehensively educated in computers, and laws regulating software development are enforced, a closer relationship between computer scientists, software engineers and users may guarantee the joint production of knowledge in the field of computer science.

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How the National Learners' Records Database of the South African Qualifications Authority contributes to excellent information management among its data suppliers

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ABSTRACT

The National Learners' Records Database (NLRD), the information system of the South African Qualifications Authority, is way ahead of the systems of similar authorities, in other countries, which manage National Qualifications Frameworks. It is a comprehensive relational database that integrates various elements.

The NLRD is used for providing policy makers and decision makers with comprehensive information on education and training, and on labour market supply, as well as for tracking the paths of individual learners, providing them and their employers with proof of qualifications obtained. Its biggest challenge is ensuring that the datasets submitted to it are of sufficient quality to be loaded into the system. This includes finding innovative ways to assist and educate people who have limited understanding of information management.

The solutions implemented during the NLRD's ten-year existence include the development and implementation of the Information Administrator Learnership; the application of a minimum standard for data loads, together with "league tables" of compliance and performance; the development and free roll-out (to data suppliers) of Edu.Dex®, a high-level data validation tool; and utilising unaudited datasets (off-line) while waiting for audited versions. The solutions' common feature is that they ensure that the information is correct at source, leading to a robust workflow that can be repeated as often as necessary.

Keywords: South Africa, National Qualifications Framework, Database, Information Management, Data Testing

South Africa is one of many countries that have National Qualifications Frameworks (NQFs), and has learnt from the experiences of those where the frameworks are well established. What distinguishes South Africa from the rest is that the information system of the South African Qualifications Authority (SAQA, see www.saqa.org.za), the organisation that oversees the NQF in South Africa (see www.nqf.org.za), is way ahead of the systems of all of the other such authorities. This system, the National Learners' Records Database (NLRD),[1] is a comprehensive relational database[2] that integrates all of the elements that, in many other countries, are housed in separate systems and usually spread across several organisations. These elements include the contents of qualifications and part-qualifications, the institutions accredited to offer them, their quality assurers, and the details of the people who have achieved these qualifications. SAQA is mandated by an Act of Parliament to gather this information and hold it in the NLRD. The volume is substantial, as there are almost 50 million people in South Africa. Furthermore, SAQA's mandate is wider than the NQF mandate of most other countries: in South Africa, redress is always a key feature of any policy concerned with human resource development[3]. The objectives of the NQF are to:

- create an integrated national framework for learning achievements;
- facilitate access to, and mobility and progression within, education, training and career paths;
- enhance the quality of education and training;
- accelerate the redress of past unfair discrimination in education, training and employment opportunities; and thereby
- contribute to the full personal development of each learner[4] and the social and economic development of the nation at large.

[1] This is a name that was chosen rather hastily, so that there would be some way to refer to the system in the documentation of the project to specify, design and implement it. A more appropriate name would have been something like 'NQFMIS' or 'NQF Knowledge Base'.
[2] The NLRD is an Oracle database with a Visual Basic front-end.
[3] South Africa's national Human Resource Development Strategy (HRDS) is concerned with skills development in its broadest sense. SAQA is required to be a key contributor to the implementation of this Strategy, which is overseen by the national Department of Higher Education and Training.
[4] Term encompassing students, graduates, pupils, etc.

Information management is a key feature of the implementation of these objectives, as well as to the measurement of the extent to which they are being fulfilled. The NLRD is the repository of all NQF information, and is thus used for providing policy makers and decision makers with comprehensive information on education and training, and on labour market supply, as well as for tracking the paths of individual learners, providing them and their employers with proof of qualifications obtained and their personal record of life-long learning. The latter includes the recent further mandate given to the NLRD, to verify the qualification achievements of all public sector employees (current and job applicants) in South Africa.

The NLRD was developed between 1997 and 1999. Thanks to the vision of SAQA's executive management team and the excellence of the developers who won the tender to implement this vision, the NLRD is able to mirror the NQF, including the changes to the NQF that have occurred since its inception in 1995, shortly after South Africa's change of government in 1994.[5] The structure and functionality of the system are both robust and flexible, and the procedures and validations that govern how it runs allow for maximum user input (at administrator level) and minimum hard-coding. Thanks to the quality of the NLRD, SAQA has assisted many countries (including the United Arab Emirates, the Seychelles and Mauritius) to conceptualise their systems and to move towards implementing them.

The biggest ongoing challenge facing the NLRD is ensuring that the datasets submitted to it, especially where learner information is concerned, are of sufficient quality to be loaded into the system. This includes finding innovative ways to assist and educate people who have limited understanding of information management. These people work within a variety of organisations and institutions, and submit information that ranges from the achievement of a single unit standard (a type of part-qualification) such as "Conduct a guided nature experience" to that of a Ph D from one of South Africa's twenty-three universities.

Several solutions to assist data suppliers have been implemented during the ten years of the NLRD's existence. In order to understand the methods used for acquiring the data into the system, a conceptual distinction can be made between two 'streams' of the NLRD (while acknowledging that, in an integrated relational database, this distinction is artificial). The first stream consists of qualifications and part-qualifications and all of the NQF resources that support them, such as NQF Levels[6], Organising Fields[7] and the expert groups[8] that write the qualifications and part-qualifications. The second consists of learners and their achievements and all of the resources that support them, such as Education and Training Quality Assurance bodies (ETQAs – there are 31[9]), Assessors (over 40 000), and education and training institutions (over 30 000) – often referred to as Providers within the NQF.

In order to acquire the data for the first stream (qualifications and the resources that support them), the contents of qualifications and unit standards (current numbers registered on the NQF: 11 716 and 15 280 respectively) are captured on-line, via copy-and-paste, directly into the NLRD. This capturing method caters for the fact that these records vary considerably in length and structure, and requires the capturers to be skilled in evaluating the information received for capturing, as well as in giving feedback to the originators of this information.

In 2003, SAQA realised that its allotted staff complement and budget did not accommodate the need for a team of people skilled in evaluating and capturing this type of data, and developed and implemented the Information Administrator Learnership[10]. This entailed establishing partnerships with several other institutions, one of them the University of South Africa, the main distance higher education provider in the country, which offers the National Certificate in Datametrics. Now in its fourth cycle (of six to ten people at a time), this learnership has

[5] The National Education Policy Act of 1995, which included the commissioning of the NQF, was the first Act of the new government.

[6] In 2009, the South African NQF changed from an eight-level NQF to a ten-level NQF. Thanks to the NLRD's flexibility as an information system, it was easily able to accommodate the change.

[7] The South African NQF has twelve Organising Fields: Field 1 is Agriculture; 5 is Education, Training and Development Practice; 6 is Manufacturing and Engineering; 12 is Physical Planning and Construction; etc.

[8] For the first decade of the NQF, these were known as Standards Generating Bodies; now differently constituted Task Teams write qualifications and part-qualifications, as do the Council on Higher Education (CHE) and the Quality Council for Trades and Occupations. In addition, the qualifications of South Africa's universities have been captured on the NQF from the start: they make up about 8 000 of the registered qualifications.

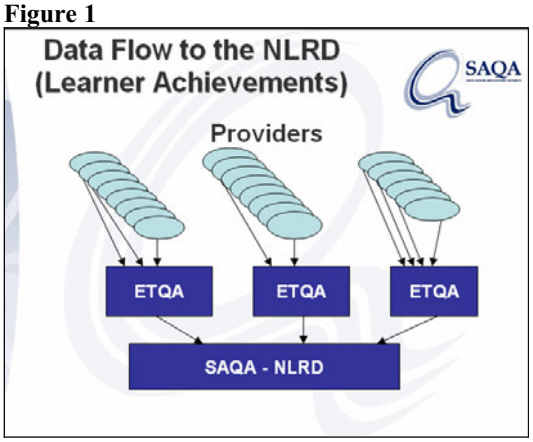
[9] ETQAs are the quality assurance wings of several types of organisation that have applied for, or are deemed, as such. These organisations are: all 23 Sector Education and Training Authorities (SETAs), six of the many professional councils or boards in South Africa, the CHE, and Umalusi – the certification authority for general and further education. Since 2009, the latter two also comprise two of South Africa's Quality Councils (QCs); the third, the Quality Council for Trades and Occupations (QCTO), was launched on 23 February 2010. Together with SAQA, the QCs are responsible for the implementation and further development of the NQF.

[10] People on a Learnership (which is loosely comparable to, but not the same as, an apprenticeship) work and study concurrently. At SAQA, they are temporary employees for the two-year duration of the Learnership.

ensured excellent quality for the qualifications and unit standards information, as well as the development and maintenance of a data quality manual. Other spin-offs have been peer support among the learners themselves and the emergence of a community of young information experts, many of whom have found permanent positions in organisations associated with the NQF, including nine of the 26 past incumbents of the learnership who are back at SAQA itself (including the manager of the current incumbents, the NLRD's Data Quality Coordinator).

For the second stream, learner achievements and a large volume of other supporting data are batch-loaded from large submissions received from the NLRD's data suppliers, most of which are accredited ETQAs functioning within the parameters of the NQF. They receive their data from the providers that they have accredited to offer the qualifications (see Figure 1). To date, the information of approximately 3.5 million learners is held directly on the NLRD (2 million of these from higher education and 1.5 million from the ETQAs concerned with professions and occupations), while that of a further 5.5 million learners, including those with school-leaving qualifications only, is held as "unaudited" (see below).

Figure 1



A detailed load specifications document is maintained and issued to the data suppliers. This document was initially drawn up by the developers, as part of their remit, and handed over to SAQA in 2001 at the end of their contract. It is maintained by the staff of the NLRD, and has also been much expanded since 2001. The fifty-page document consists of general specifications (formats and naming conventions) and detailed specifications for each file to be transmitted. The specification states that they must be text files with fixed-length records, as the data suppliers have a very wide range of information systems between them, and this format is independent of all of these. There are also eight appendices: data definitions and acceptable values; unique identifiers (mnemonics and IDs) for data suppliers; NQF "Subdomains" (and the organising fields to which they belong); allowed characters (added because data suppliers had trouble understanding which characters were and were not acceptable to an Oracle database); best practice for validating and extracting data[11] (based on years of observing questionable practices); minimum standard for data loads (discussed below); solving data capturing errors that are listed in Edu.Dex® reports (discussed below); and the document history (what was added or changed, when, by whom).

Meetings of the NLRD Partners Forum (for data suppliers and their IT service providers) are held six times a year: data requirements and best practice are discussed, and the data suppliers are encouraged to share experiences and concerns. However, the staff turnover at these organisations is often high, and newcomers (as well as some of the more seasoned participants) have, at best, an uneasy relationship with the management of large volumes of information, even though most of them have good electronic information systems and helpful IT service providers. In order to assist them to understand the requirements, these are summarised as a one-page minimum standard for data loads, which is strictly applied to all data suppliers. Issued both as a 'stand-alone' and as part of the load specifications, it states that they must submit their data, in full, at least twice a year (by specified dates); that there are four steps to the process; that certain files are dependent on others.

Early in the NLRD's existence, it was agreed that the Oracle batch-loading procedure would stop and roll back if five or more validation errors were encountered in a submitted dataset. Given the initial limited understanding of the requirements, this was happening for almost all submissions. A rudimentary MS Access data-testing utility (which required some very unscientific "eyeballing" of data) was developed and issued to the data suppliers: they imported their extracted data into the utility and then checked whether there were offset problems or other problems. One of the NLRD's main IT

[11] Examples:
"(a) Ensuring that **required fields** are not left blank:
Define *not null* and *not empty* string validations on the information system."
(b) Ensuring that **learner achievement** status is correctly recorded and that the actual achievement date is only supplied for qualifications or unit standards that have actually been **achieved**:
The extraction errors, where achievement dates are supplied for qualifications or unit standards that have not been achieved, will be eliminated by item 12 [which refers to ensuring that the achievement date is not greater than today's date].
In addition, the important value that must be changed when the qualification or unit standard is achieved is Learner_Achievement_Status_Id. The most common value prior to achievement is 3 (Enrolled) – this is associated with a null learner achievement date. The most common value after achievement is 2 (Achieved), and this is associated with a non-null learner achievement date that is less than today's date. (See Appendix A [data definitions and acceptable values] for all the other possible values.)"

service providers then developed this into a comprehensive utility, Edu.Dex®[12], into which the extracts are also imported. Edu.Dex® gives even more detailed feedback to the data suppliers and ensures continuous improvement of their data at source (there is no facility to edit or store data in Edu.Dex®, thus ensuring that the only place to do so is in the information system of origin).

An example of this feedback is a simple comment, such as "Count of Disability_Status_Code with a space as the first character: *n*." In the relevant appendix of the load specifications, this is expanded upon: "A space is not allowed as the first character in any field" (triggered where a space does appear as a first character, which is usually also an indication of an offset problem).

More complex concepts requiring extensive intervention are, for example: "Learner records that are not associated with any enrolments or achievements or registrations" (indicating the existence of orphan records in the extract). This is expanded upon in the load specifications: "A learner record was added in the Person Information file, but there is no association with any qualifications or unit standards for this learner. This error occurs where a person was entered into File 25, but no reference was made to the person in either File 28, 29 or 30." The action to be taken is then stated: "The ETQA must either enter information for this person into File 28, 29 or 30, or remove the person's record from File 25."

Edu.Dex® was rolled out to all data suppliers in 2006, and the minimum standard for data loads includes the condition that datasets are only accepted for loading when they have passed all of the stringent tests applied by Edu.Dex®. In fact, when the latter has occurred, Edu.Dex® automatically encrypts the data extract and transmits it to SAQA using secure FTP.

Once the extract has arrived at SAQA, a further step is utilised to ensure its validity: it is loaded onto the "development" instance of the NLRD. This is a direct clone of the "production instance" (cloning is repeated as often as required, but at least monthly). This test load utilises the same procedures and validations as would the live load. It is able to find issues that Edu.Dex® would not find when utilised on-site at the ETQA, as the latter finds inconsistencies within the ETQA's data, while the test load ensures that any instances of inconsistency between the ETQAs are located. If this is found to be the case, then feedback is given to the one or more ETQAs involved, and they are required – as always – to solve the problems at source.

A URL for the exclusive use of NLRD data suppliers contains the latest versions of the load specifications, minimum standard, lookup tables (code lists) and Edu.Dex® updates.

Two "league tables" are used as tools for monitoring, evaluation and motivation. In the scoring, each quartile is represented by a colour: green (best; total score 75% or more), yellow, amber and red (worst). The league tables are taken extremely seriously, because proof of the data supplier's ability to manage information and submit it to the NLRD is one of the criteria for continued accreditation as an ETQA, with its concomitant financial implications. The first league table tracks compliance with the minimum standard for data loads, giving scores for timing, correct data structure, readiness for loading, non-repetition of mistakes, and use of the specified communication channels. Currently 28 of the 31 data suppliers tracked for compliance are green (as opposed to seven when the compliance league table was established in February 2006) – see Figure 2. This is where the results of the interventions are most obvious.

The second league table (see Figure 3) tracks performance in managing information (as well as in managing the operations of the data suppliers themselves), by using the data actually loaded to compare the number of qualifications that have uptake (enrolments or achievements) with the number allocated to each ETQA for quality assurance[13], as well as to compare total learner numbers per ETQA with the targets drawn up by South Africa's national Department of Labour. Currently twelve of the 29[14] data suppliers tracked for performance are green (as opposed to five when the compliance league table was established at the beginning of 2007). This is cause for concern: it is acknowledged by both SAQA and the ETQAs that the requirements of the performance league table are stringent; at the same time it is highly valued as an indicator of where effort is required in improving the operations of the ETQAs. This goes beyond the management of the information to the analysis of the reasons for slow implementation in some business sectors nationally.

[12] See www.praxis.co.za/edudex.

[13] The process of allocating qualifications to ETQAs consists of their applying for the qualifications, followed by a thirty-day public comment period (which can include competing ETQA's raising objections), then followed by a period of presenting the recommendations to the relevant authorities and the recording of the decision to allocate the qualifications to the ETQA deemed most suitable for each.
ETQAs only apply for qualifications when they are certain that, as well as being most closely related to their own scope, the qualifications will also have a market for uptake, i.e. there will be providers wishing to offer them (the ETQAs will then accredit the providers to do so), and learners wishing to study them.

[14] The CHE and Umalusi are not included in the Performance League Table, as their accreditations and learner numbers are tracked differently from the rest.

Figure 2: Compliance League Table counts, February 2006 to August 2009: Number of data suppliers with each status (green, yellow, etc) per submission

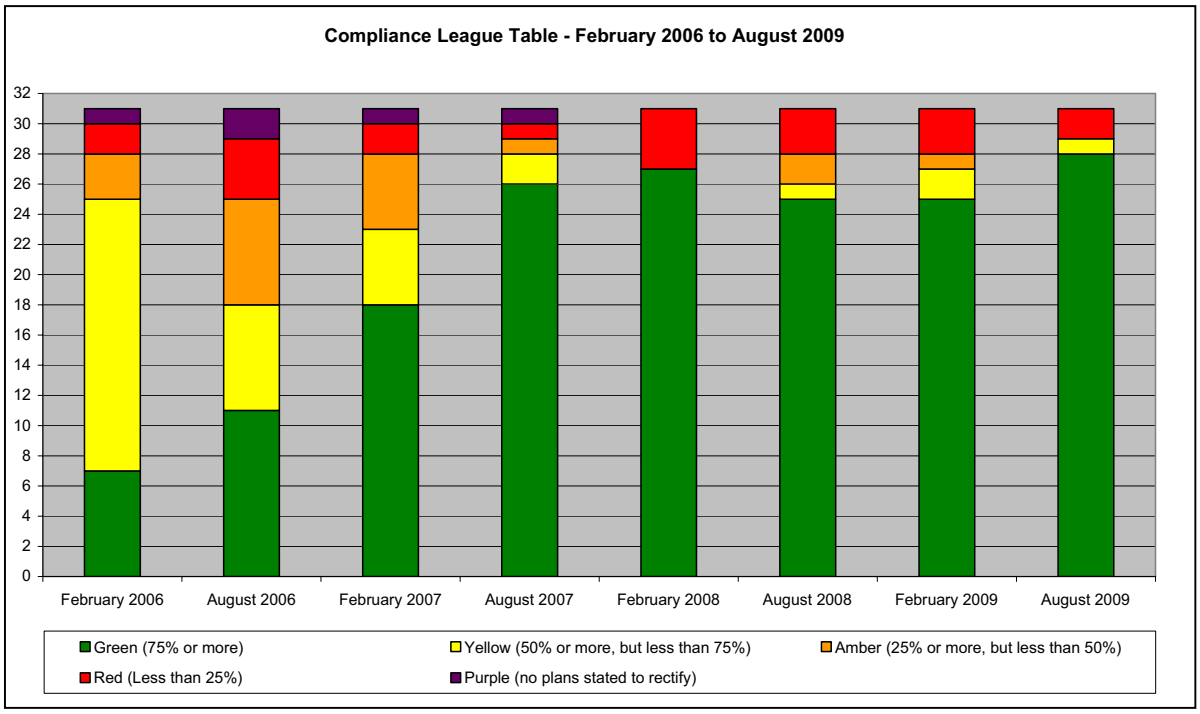


Figure 3: Performance League Table

ETQA	Learners found? Accredited Qualifications Count					Learners found? Reserved Unit Standards Count				A: Total (weight 2:1)	Total Number of Unique Learners			B: Total (ex 8)	C: Penalty for lengthy problems	Overall (weight A:B = 1:1) +C	Green (75% or more)	Yellow (50% or more, but less than 75%)	Amber (25% or more, but less than 50%)	Red (Less than 25%)
	Yes	Future Yes	No	Total	% *	Yes	No	Total	%	%	All: Actual (cumulative)	DoL Target (up to 2009/10)	Points (ex 8)	%	%	%				
AgriSETA	35		38	73	47.9%					47.9%	9186	10100	7	87.5%		67.7%		Yellow		
BANKSETA	6		10	16	37.5%					37.5%	8818	6000	8	100.0%		68.8%		Yellow		
CETA	15		36	51	29.4%					29.4%	9343	20045	4	50.0%		39.7%			Amber	
CHIETA	31		12	43	72.1%					72.1%	18118	13800	8	100.0%		86.0%	Green			
CTFL SETA	5		9	14	35.7%					35.7%	5153	2030	8	100.0%		67.9%		Yellow		
ESETA	22		18	40	55.0%					55.0%	6029	3000	8	100.0%		77.5%	Green			
ETDP SETA	23		17	40	57.5%	11	4	15	73.3%	62.8%	142794	13818	8	100.0%		81.4%	Green			
FASSET	20	5	13	38	59.2%					59.2%	4492	3120	8	100.0%		79.6%	Green			
FIETA	15		12	27	55.6%					55.6%	4581	1530	8	100.0%		77.8%	Green			
FOODBEV	36		13	49	73.5%					73.5%	17841	4768	8	100.0%		86.7%	Green			
HPCSA			2	2	0.0%					0.0%			0	0.0%		0.0%				Red
HW SETA	5	6	9	20	40.0%					40.0%	9003	10573	7	87.5%		63.8%		Yellow		
INSETA	19		11	30	63.3%					63.3%	47055	4345	8	100.0%		81.7%	Green			
ISETT	6		7	13	46.2%					46.2%	8514	7844	8	100.0%		73.1%		Yellow		
LG SETA	10		16	26	38.5%					38.5%	6618	46500	1	12.5%		25.5%			Amber	
MAPPP	16	10	39	65	32.3%					32.3%	8176	4300	8	100.0%		66.2%		Yellow		
MERSETA	72		40	112	64.3%					64.3%	65946	28405	8	100.0%		82.1%	Green			
MQA	29		12	41	70.7%					70.7%	230565	37500	8	100.0%	-15.0%	70.4%		Yellow		
PAB	10		12	22	45.5%					45.5%	2658		7	87.5%		66.5%		Yellow		
PSETA	5		14	19	26.3%					26.3%	807	14500	1	12.5%		19.4%				Red
SABPP	4	2	0	6	83.3%					83.3%	1427		4	50.0%		66.7%		Yellow		
SAICA	2	2	0	4	75.0%					75.0%	10826		8	100.0%		87.5%	Green			
SANC			7	7	0.0%					0.0%	276339		8	100.0%		50.0%		Yellow		
SAPC	0		0	0	0.0%					0.0%	4785		6	75.0%		37.5%			Amber	
SAS SETA	13		33	46	28.3%	5	1	6	83.3%	46.6%	537016	19600	8	100.0%		73.3%		Yellow		
SERVICES	50		39	89	56.2%					56.2%	70498	20520	8	100.0%		78.1%	Green			
TETA	14	20	20	54	44.4%	1	4	5	20.0%	36.3%	20771	11980	8	100.0%		68.1%		Yellow		
THETA	27		24	51	52.9%					52.9%	32282	7900	8	100.0%		76.5%	Green			
W&RSETA	9		3	12	75.0%					75.0%	18896	7250	8	100.0%		87.5%	Green			
Total	**499**	**45**	**466**	**1010**	**51.6%**	**17**	**9**	**26**	**65.4%**	**56.2%**	**1578537**	**299428**					**12**	**12**	**3**	**2**
																	41.4%	**41.4%**	**10.3%**	**6.9%**

* (2:1) / (2:1:1);
if Yes = 0 then (0:0.5) / (0:1:1)

SAQA has commissioned research into the reasons causing some data suppliers to score red or amber consistently on the performance league table, and preliminary results show one or more of three main factors for each: true underperformance in the provision of education and training; providing qualifications and courses that fall outside the scope of the NQF (leading to hesitance in submitting the learner achievements to the NLRD, although it can and does accommodate them, and measures are being put in place to communicate this); poor information management (leading to gaps and lags).

The latter is where the interventions described in this paper attempt to make an impact; it is acknowledged that this is, however, a slow process. One of the interventions that assisted in the past (2004-5) was to establish the Information Administrator Learnership at the eleven ETQAs that decided to participate. For them, the incumbents did not capture the content of qualifications and unit standards, but rather the information concerning provider accreditation to offer qualifications and unit standards, learner biographies, and learner enrolment on and achievement of qualifications. The quality of the data from those data suppliers improved considerably for the duration of the learnership. However, after that cycle of the learnership, when the funding source was no longer available (even though the entire process is inexpensive), only three ETQAs agreed to a second intake and one to a third. The quality and quantity of the information from the ETQAs was definitely affected, although it must be acknowledged that the greater problem is the uneasy relationship with the acquisition and management of large volumes of information, which is rife in South Africa and probably worldwide.

The NLRD's responsibility for the verification of qualification achievements is sometimes hampered by the need for certain of the data suppliers (especially those associated with the funding of institutions of learning) to engage in lengthy data audits before they can submit datasets for loading onto the NLRD, which leads to lags of up to three years. In order to counteract these lags, the affected data suppliers now submit unaudited datasets to SAQA, for utilisation off-line while waiting for audited versions. Qualifications confirmed in this manner are flagged as such. (A further complication concerns where the information does not exist in any electronic form, for loading, whatsoever – in some instances it cannot even be traced. But that is a topic for another paper.)

The feature common to all of the solutions discussed above is that they ensure that information quality is handled at source, leading to a robust workflow that can be repeated as often as necessary. While some data suppliers are making better use of them than others, all of them have come a long way in the last ten years. Furthermore, the NLRD is assured that the information that is loaded onto the system is of good quality.

The solutions all require communication and close cooperation. Given that SAQA sees the NQF as a framework of communication, coordination and collaboration, the NLRD is certainly making its contribution to the aspect of the NQF in which it must deliver.

Base on Micro-Learning to observe the children behaviors for improvement the Parent-Child interaction

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ABSTRACT

With the development of digital technology, image records were commonly used in children's behavioral observations. With simple video recording equipment, we can provide rich and diverse content. Therefore, the image recording strategy had become a popular trend. But many researchers still accustomed to translate the recorded images into textual information, the required resources and time to spend would be considerable. This study proposes a Child-Behavior Observation System (CBOS) to help parents to observe and record child behavior. Parents use DV to capture children's activities in the corner and send the real-time images to CBOS. Through the CBOS, parents can choice the picture exactly that they want to observe and draw some symbols on the captured images. Then parents can add textual descriptions for these symbols. Finally, parents can easily convert these records into a web page file or a Word file so that they can discuss the observed behavior with their children to increase the interaction between parents and children.

Keywords: micro-learning, indexing card technology, parent-child interaction.

1. INTRODUCTION

In the era of advanced technology, one would be hardly to ignore the use of video cameras in the observation of children (Warren, 2000). Typically, audio-visual record data was required to integrate the text description as the multimedia reports for behaviors observation. However, it is not easy for behavioral researchers to use technology to create multimedia reports. Because the required technology is supported by several computerized tools for coding and annotating videotapes (Sanderson et al., 1994; Tapp & Walden, 1993; van der Vlugt, Kruk, van Erp, & Geuze, 1992).

In the traditional observation methods, people often observed directly and wrote scripts to record the child's behavior. In this view of point, the results of the observations were often dependent on the observer's memory and the observers' subjective consciousness may lead to be incorrect. Observer may ignore the import details of the observation by the limited memory and distraction. In some cases, observers had the difficulty to understand the meaning and importance of the child's behavior, so that he could not use the appropriate words to record the occurrence of the behavior.

This study proposes a Child-Behavior Observation System (CBOS) to help parents observe and record child behavior and to improve the limits of memory and distraction. Parents use DV to capture children's activities in the corner and send the real-time images to CBOS. Through the CBOS, parents can exactly choice the picture from those captured images that they want to observe and draw some symbols on it. Then parents can add text descriptions for these symbols. Finally, parents can easily convert these records into a web page file or a Word file so that they can discuss the observed behavior with their children to improve the interaction.

The remainder of this paper was organized as follows. First, we introduce the related background techniques and theories. Then, we describe the construction of observation environment and the system implementation. Finally, concluding remarks were given.

2. LITERATURE REVIEW

Microteaching

Effective teaching has long been acknowledged as desirable goals of teacher education programs (Wahba, 1999). But the crucial question is: How should we go about it? In 2003, Pringle said "the use of microteaching within teacher education is seen as an on-campus way of introducing pre-service teacher to the complexities of teaching and as a bridge that connects theory to practice." In other words, teachers can be trained by microteaching to achieve effective teaching.

Microteaching is one of the most important developments in the field of teaching practice (McGarvey, 1986). It originated in the early 1960s at Stanford University by Dr. Dwight Allen and Ryan, and its purpose is to provide teachers with the opportunity for the safe practice of an enlarged cluster of teaching skills while learning how to develop simple, single-concept lessons in any teaching subject (Brent, 1996).

There are some benefits of microteaching : It exposes pre-service teacher to realities of teaching; It introduces pre-service teachers to their roles as teachers (Amobi, 2005; Hawkey, 1995; Kpanja 2001; Wiklinson, 1996); It helps them to see the importance of planning, decision making, and implementation of instruction (Gess-Newsome & Lederman 1990);It enables them to develop and improve teaching skill (communication, public presentation, etc.); It helps them build their confidence for teaching (Brent & Thomson, 1996).

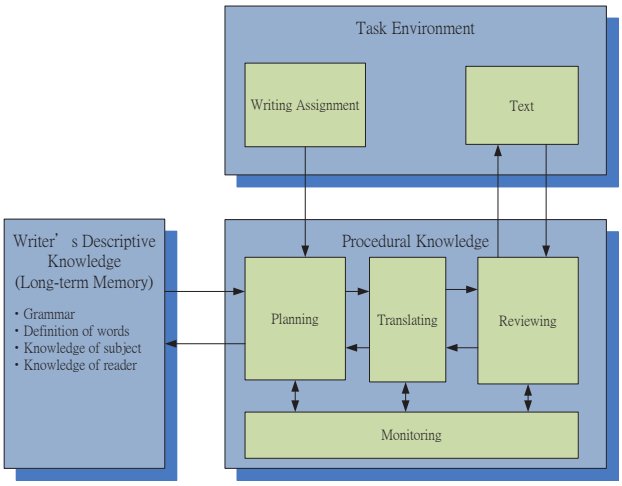
Science Writing

Science writing is a form of expression that students can represent their science concepts in research by their words (Britton, 1970; Britton, 1975). Writing can promote the level of thinking and help students to realize their own thoughts, feelings, and experience (Bulter, 1990; Shelly, 1998). Nowadays, writing is not only used in application of language and literature, but also employed in instructions of nature science and daily technology (Shelly, 1998).

Science writing is a tool used for communication, thoughts organization, and improvement of structuring concepts (Rivard, 2000). Students learn actively during the process of writing. They restructure the information and knowledge that they gained, collected, and integrates them. Science writing also helps students correlate with concepts.

Flower and Hayes (Flower, 1981) advanced a model to describe the writing process. In their study, Flower and Hayes asked subjects to think aloud when they were writing, and then researcher recorded the content and analyzed the subjects' mental progress. Figure 2-1 illustrates the model as follows.

Figure 2-1 Hayes-Flower writing process model



This model divides into two parts: one is the external task environment and the other is the writer's internal knowledge. In addition, the writer's internal knowledge also separates into two parts: descriptive knowledge and procedural knowledge. In brief, learning by writing is a process of planning what to write, translating concepts into contents, and review what writer done. In Flower and Hayes' opinion, these three activities of writing process are alternative rather than straightforward.

Knowledge Restructuring

The theory of knowledge restructuring is originally described as one of the three models of knowledge acquisition models advanced by Rumelhart and Norman (Rumelhart, 1981). These three models are accretion, tuning, and restructuring. Accretion refers to concept change that occurs through existent schemata to accumulate new knowledge gradually. Tuning depicts that a learner would modify the schema to accept new information if the existent schemata do not match new knowledge. Restructuring describes the changes in knowledge that involve establishing new knowledge structure and reorganizing existent schemata.

The role of learners in the process of restructuring is that the learner is a creator of knowledge rather than a consumer of knowledge, a disseminator of concept, or a knowledge keeper. Stella and William (Stella, 1987) stated that knowledge restructuring is "the most radical form of knowledge acquisition within prior-knowledge framework". Stephan, Mike, and Thomas (Stephan, 2000) also announced that knowledge restructuring is defined as "a shift to a new set of rules, strategies, or declarative knowledge to perform a task without overt changes to the stimuli or learning environment". This shows that a learner can create new knowledge structures when gaining new information. A learner can also recombines what he or she has known rather than tunes existent

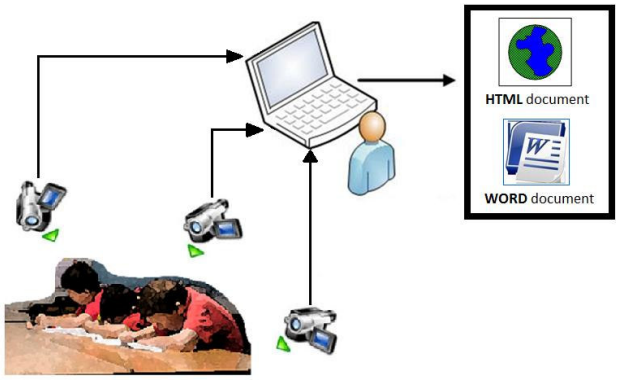
schemata.

There are two kinds of restructuring advanced by Stella and William (Stella, 1987): the first being global restructuring and the second being kinds of domain-specific restructuring. These two models are similar to "theory theories" and "knowledge-in-pieces theories" advanced by diSessa (diSessa, 1988). The global restructuring refers a learner arranging and restructuring all knowledge in his/her mind as rearranging the knowledge into theory-like structures. However, the kinds of domain-specific restructuring are regarded as the learner separating knowledge into pieces of specific domain. Learners restructure their knowledge in specific domain so that they can enhance the efficiency of creating new knowledge structures.

3. THE CONSTRUCTION OF OBSERVATION ENVIRONMENT

The Child-Behavior Observation System (CBOS) allows parents to observe their child's behavior and mark annotations in their concern to the incident. In this section, we will introduce the system architecture. Figure 3-1 shows the architecture of the Child-Behavior Observation System.

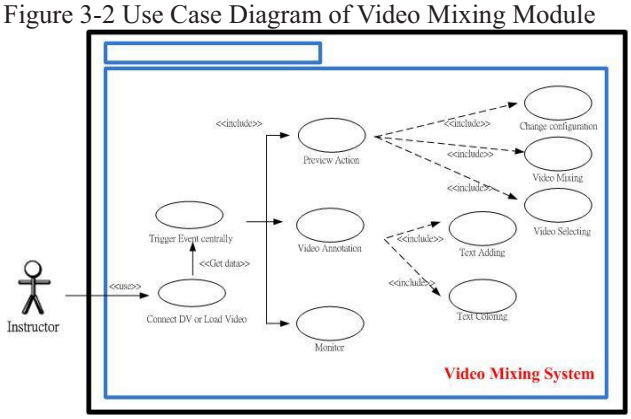
Figure 3 -1 Architecture of the Child-Behavior Observation System



Video Mixing Module

Video Mixing module is used to control steaming captured from hardware. Basically, end user using the functions of video mixing module is just like a director. He can decide which scene is best in the main monitor and switch it. And just like the people in the theater, audience can only see the screens produced by the director. Figure 3-2 shows the use case diagram of video mixing module.

Figure 3-2 Use Case Diagram of Video Mixing Module



There are four major phases of the system. Phase one is preparation scenario, which instructor has to connect hardware in advance. If the system does not detect any device connected to PC, it will be failed to set up the environment. While the phase two, the process scenario, the system will process each of streams captured from hardware automatically. At first, the system will set the stream synchronization. Then it will be split into two streams, hence the instructor can monitor images from hardware and mix the image together. The third phase, the authoring scenario, where the instructor can take some authoring options to edit the video. The last phase, the recording scenario, the instructor can use Recorder System to record the image being edited immediately. After the recording is complete, it will produce a video file in a quality format.

Video Recording Module

In order to get stream of media content such as conferences to broadcast live program, an instructor need to connect capture card to personal PC. Via the proposed system, the mixing signal can be recorded into a file or broadcasted through Internet.

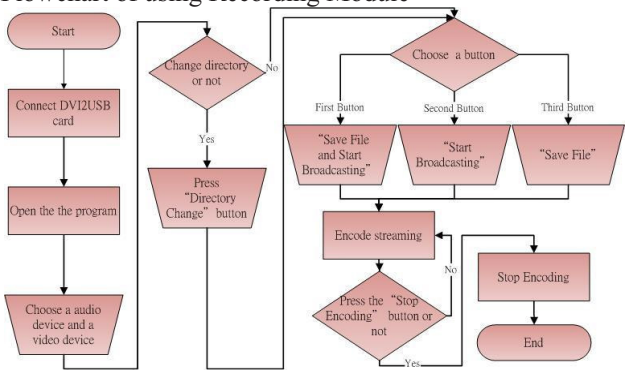
Figure 3-3 shows the flowchart of using Recoding System. A detailed description of the diagram is as follows:

1) The user first connect DVI2USB capture card to PC.
2) After connecting capture card, the user can launch the system, and the system will detect the connection of capture card to PC.
3) After that, the user can (1) change default setting of the recording system (2) encode the signal to a WMV file (3) broadcast live content or broadcast video recorded in advance.
   - 3.1 When (1) is selected, the system will show a dialog to indicate how to change System settings, including frame rate, video bit rate and audio source, etc.
   - 3.2 When (2) is selected, the system will show a preview image which will be recorded later. And user can click start to encode and save it as a WMV file.

3.3 When (3) is select, the content which has been recorded or in advance will be broadcasted as video

4) After recording completed, the user can exit the system.

Figure 錯誤！所指定的樣式的文字不存在文件中。-3 Flowchart of using Recording Module



Observation Record Module

The observation record module was divided into two parts: authoring mode and presentation mode. The authoring mode is described as the mode when users are designing content. When the system is in the authoring mode, five system components are available to the designers. They are the customized video tool, the indexing notation editor, the scene flow controller, the annotated video adding tool, and the object generator. The customized video tool allows the designer to display the video which is transmitted by the video mixing module or is recorded by the video record module and captures pictures from played video. The indexing annotation editing module allows the designer to add the information of captured pictures. The scene flow controller enables the designer to set the video pause time for each scene so that the content can display embedded information. The annotated video adding is a tool for adding video of introduction or conclusion before or after the main video. When the system is in presentation mode, it presents the content from pre-designed HTML documents that include both video and cards of annotations.

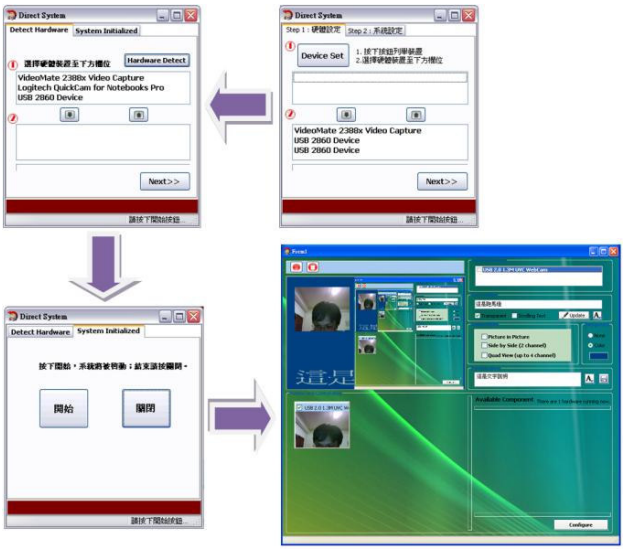
4. SYSTEM IMPLEMENTATION

In the beginning, the CBOS system will pop a window to detect electromechanical devices. It will provide a list of hardware name that user can use. After setting all the requirements, the button of start is allowed to click. Then user can capture each stream from different device and change scene modes immediately. The detail function describes as follows:

1) Streaming Switch: In order to switch scene immediately, user can select the device name and transform the scene.
2) Text overlay: User can add annotation directly in the video stream. The background of text can be transparent or opaque.
3) Scene: Some kind of display such as picture-in-picture is useful, the module provides three types of scenes use frequently.
4) Dynamic Text: User can type message in advance. And the message will show in typed order.
5) Streaming captured: It will show captured streaming in each box.
6) Monitor: This region will reflect the image on the projector. Therefore, user can monitor the project image.

Figure 4-1 illustrates how to set up the CBOS system.

Figure 4-1 Procedure of setting up the CBOS



After user captures each stream from different device and change scene modes, user can capture images he think are interested in the video. Then the CBOS system changes the state into editing annotation. When user finds a feature on the image, he can mark circle or rectangle graph on the featured part of the image. Finally the user can edit the annotation and adds audio to emphasize this annotation. Figure 4-2 illustrates the State of editing annotation.

Figure 4-2 The state of editing annotation

When the images were captured and authoring correlative annotations were completed, use enters the step of controlling scene flow as shown in Figure 4-3. In this step, user can add the title sequence of the video or the trailers of the video. Users also can design web pages related to the output screen. Finally the user can output WORD document files and web pages as shown in Figure 4-4.

Figure 4-3 User interface of controlling scene flow

Figure 4-4 User interface of the webpage

5. CONCLUSIONS AND FUTURE WORKS

The purpose of this study is to provide a simple way for parents to participate in observing and documenting. Parents can use the results of observation to understand their child's behavior patterns, thus increasing the interaction between parents and children. There are still many opportunities for the system to improve. In the system's function, the embedded information video can interact with parents. Currently, the information is only issued at a specific time. If the system could interact with specific subjects in the video, parents could get annotations anytime while video is playing. The other improvement can be achieved in indexing card editor tool. This system provides parents editing card by Excel form. In the future, it could be modified to add different frameworks of card, such as Word or PowerPoint. The CBOS is a helpful tool for the observation of child behavior. Our next step will keep improving on our interface and conduct an experimental observation of child behavior in kindergarten.

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Impact of Information and Communication Technologies on Gender Development in India

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ABSTRACT

The Information and Communication Technology (ICT) revolution has not only opened up new opportunities for economic growth and social development but has also posed problems and challenges. It can shape and enhance wide range of developmental applications in agriculture, industry and social sectors and is influencing all sections of the society. ICT provides unique opportunities for human development. At the same time, ICT has been widening the gaps between and within countries, regions, gender while increasing disparities divide between the rural-urban, rich-poor, elite neglected and also within the different categories of women in various spheres of activity. It is necessary to build up women capacities to involve them in productive activities, institutional building, family and social transformation, decision-making process, political representation, trade and commerce, entrepreneurial development and social leadership. There is a need to enhance opportunities to women to enable them to own, manage and control industries and service enterprises including IT-based units. There is also need to provide more opportunities in e-related sectors to them in higher managerial, technical positions in government and non-government agencies, research, educational institutions in private and public sectors, without confining their role to only call centers, telecentres, data-entry level and lower levels in the organizations. ICT has to address to all these problems of women as a whole and has to be used to facilitate to build a women empowered society.

Keywords: Information & Communication Technology, Gender development, Women Empowerment, ICT Tools, Knowledge Network System and Information Economy.

1. INTRODUCTION

Information and Communication Technology (ICT) has become a potent force in transforming social, economic, and political life globally. Without its incorporation into the information age, there is little chance for countries or regions to develop. More and more concern is being shown about the impact of those left on the other side of the digital divide the division between the information "haves" and "have-nots." Most women within developing countries are in the deepest part of the divide further removed from the information age than the men whose poverty they share. However, it is not a choice between one and the other. ICT can be an important tool in meeting women's basic needs and can provide the access to resources to lead women out of poverty (1).

Women work two thirds of the world's total working hours spending mainly on growing food, cooking, raising children, caring for the elderly, maintaining a house, hauling water, etc., which is universally accorded low status and without pay(2).

2. DEFINITION AND SCOPE OF ICT

Information and communication technologies (ICT) comprise a complex and heterogeneous set of goods, applications and services used to produce, distribute process and transform information. The ICT sector consists of segments as diverse as telecommunications, television and radio broadcasting, computer hardware and software, computer services and electronic media (e.g., the Internet, electronic mail, electronic commerce and computer games) as well as the content of these media.

3. OBJECTIVES

This paper focuses the current ICT tools like e-governance, e-learning, e-education, e-finance e-marketing and ICT development like BPO (Business Process Outsourcing) and KPO (Knowledge Process Outsourcing) and their impact on women empowerment in India. We are also looking at the changes there on to the educational system and build up a strong socially viable KNS (Knowledge Network System).

4. ICT- WOMEN EMPOWERMENT

Despite the numerous challenges to equity in the ICT arena, many social actors have exploited ICTs as tools for social transformation and gender equality. Women artisans are directly accessing global markets through e-commerce initiatives and are using the Internet to support their activities with market and production information. E-governance programmes have been initiated using ICTs for delivering government services; in some cases with an explicit strategy to ensure these services reach women and others who face barriers to access. Health educators have used the radio to communicate information related to women's sexual and reproductive health. Email, online newsletters and List Serves have enabled women

to communicate on a global scale, resulting in increased collaboration to push the agenda of gender equality.

New technologies do offer remarkable advantages in terms of ease of communication, unprecedented possibilities for interaction, and efficiency in information storage and retrieval; however they are not universally available. New initiatives have been most effective where they go beyond issues of access and infrastructure to consider the larger social context and power relations (3).

Knowledge acquisition

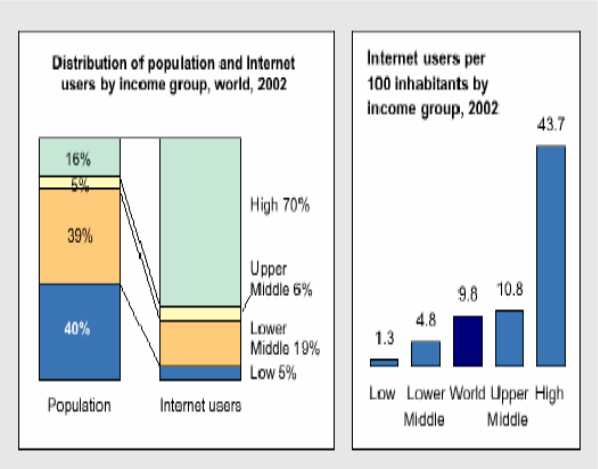
In today's developing environment usage of Information Technology has become a day-to-day activity which has exposed women to the new technologies, and hence are not difficult to be trained on them. It is observed that women in general have good concentration power owing to their nature of work, and hence are easily trained to acquire any new skills. As the women at lower strata are constrained to the homes, if we can get the technology to the women at home we will be sure to succeed in empowering them. NGO's and Government departments have to plan training programs, to provide the required skills and establish groups for the follow up action.

Knowledge Networking System-women

Women stand to benefit tremendously from the inroads laid by ICT in the domain of knowledge networking. The pertinent question is not whether they stand to benefit but how do they benefit and what are the mechanisms to ensure that the benefits accrued to the women community do not remain restricted to mere trickle-down effects? At the very conceptual level, ICT have the potential to digitally link each and every woman in the world in a star topology network, which opens up endless possibilities for information exchange. This mechanism could be used by women in creative ways, both to communicate with other people who are online, and also to disseminate information to people in the outside world who are not online through the use of convergence and hybrid technologies such as community emails, community radio broadcast, tele-centres, newsletters, videos etc. This mechanism forms the skeletal process through which women communities could overcome the constraints of seclusion, mobilise resources and support, reach out new markets, and open up avenues for life-long learning. We could broadly classify the spaces in which women stand to gain under the spheres of Empowerment and Governance. This condition forms the basis of evolution of women as equal contributors and end-users of knowledge in a knowledge society (4). NGO's and the Government bodies have to come forward to setup and build a hierarchical network comprising of social groups which are successful in a venture from the village level to the state level. The success stories should be circulated to emulate them. Training groups have to be built up from these groups to percolate the knowledge to the different levels.

Graph-1 shows, 70 per cent of Internet users belong to the top 16 per cent income bracket; and the bottom 40 per cent by income constitutes only 5 per cent of all Internet users. Apart from location and income, language is another determinant of the digital divide. The predominance of English on the Internet is a barrier for most users globally. Speakers of non- European and indigenous languages including a large proportion of women tend to be left out of the information loop. Even among the educated, proficiency in the dominant European language of a region may not be such that the user feels comfortable in using the Internet for training or involvement in List Serves (5).

Ghaph-1: Access to ICT

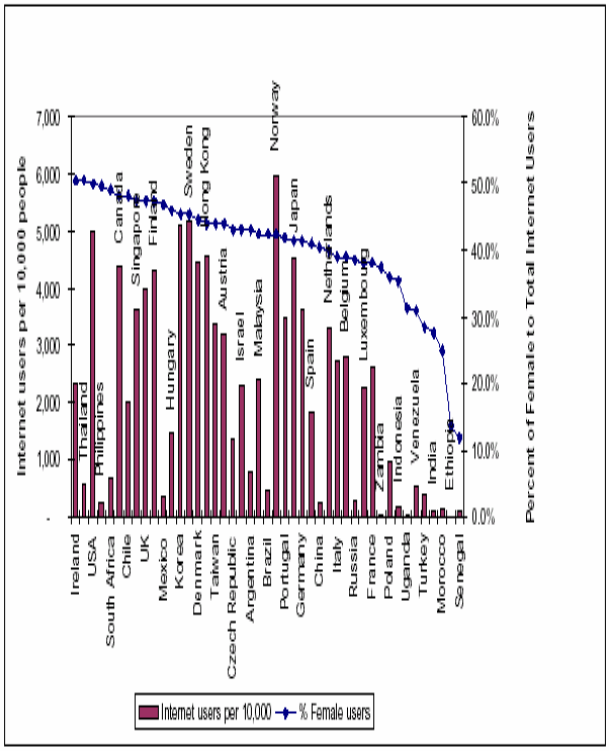


Source: Graph based on data from ITU, 2004, http://www.itu.int/ITUD/ Ict/statistics/at_glance/Internet02.pdf

Women's access to the internet

The gender divide within the digital divide can be seen in the lower numbers of women users of ICTs compared to men. One illustration of this is the number of women Internet users. The majority of the world's women do not use the Internet. They are excluded from the World Wide Web. The digital divide within countries broadly reflects the gender divide. Women are in the minority of users in almost all developed and developing countries. The trend for differentiation in use starts early, as seen in the United States where boys are five times more likely than girls to use home computers and parents spend twice as much on ICT products for their sons as they do for their daughters. It is extremely difficult to get data on use by gender by country for developing countries. Also, statistics on Internet use need to be interpreted with caution. Even in the developing countries where women do make up a high percentage of users, total users themselves constitute very small elite. Graph-2 illustrates this showing that in some cases where women make up a relatively high percentage of users, the total proportion of the population using the Internet is very small, as in the cases of Mexico, Philippines and Indonesia (6). India will have breached anew and previously unthinkable landmarks- half a billion wireless connections making it the second largest group of mobile phone users after China. The teledensity (phone connections per 100 population) of roughly 45%, an urban teledensity closer to 97% and a rural teledensity of about 18%. India had crossed 488.40 million wireless connections at the end of October 2009 and nearly 30 % of the women users (7).

Graph-2: Total internet users and female internet users



Source: Huyer and Mitter-2003.

The number of IT users as well as IT professionals has been increasing over the years. The number of Internet users has been rising over the years. It was estimated that there were .01 million internet users in 1995 which increased to 18 million Internet users in March 2003 and their number was expected to increase up to 23 million in Dec 2003. Internet usage was most widespread in 18-24 yrs age group. Men constituted 77% of users while women users were around 23% Women are expected to emerge as a large segment on the internet in the next 20 years (8).

Impact on women's work

Information and communication technologies are both enabling as well as a contributing factors to globalization. Information and communication technologies made global financial markets possible. Examining the issue of the impact of information technology on women's work in the context of globalization underlines the differences in the issues of information technology and women's work between developed and developing countries. In developed countries, most of the literature on the impact of information technology on gender and work deals with the association of men with technology and power.

In developing countries, women are looking at the issue not only in terms of gender relations with the men in their society, but also at Western dominance over innovation and as the source of technology. Some argue that the new technologies are not appropriate for women because they are imported. However, this position seems to be head-in-the-sand. Information technology is no more foreign than air travel or electricity. The technologies are there and will not be displaced. It is more appropriate and effective for women to devise ways of dealing with them to improve the situation of women than to reject them for being foreign. As with globalization generally, the impact of information technology on women's work through globalization has been most evident in Asia first, than in Latin America and the Caribbean. Africa is effectively absent from this process.

Gender in the information economy

Women have relatively little ownership and control of the ICT sector. While data is lacking, it is clear that women are underrepresented on the boards and senior management of IT companies, policy and regulatory organizations, technical standard-setting organizations, industry and professional organizations and within government bodies working in this area. Women's participation as employees in the sector presents a more complex picture. The new economy rides on the power of ICTs. Job outsourcing is an important business strategy today and has given rise to a new global division of labour. Internationally outsourced jobs, such as medical transcription work or software services, have made a considerable difference to women's work opportunities in developing countries. According to UNIFEM, women hold 9 per cent of mid- to upper-level IT related jobs in engineering and make up 28.5 per cent of computer programmers and 26.9 per cent of systems analysts. Only among data entry workers the women form the majority at 85 per cent (9).

Information technology has brought employment gains for women, but trends highlight many challenges. The ILO Report on Work in the New Economy 2001 makes the following observations about the IT sector: Patterns of gender segregation are being reproduced in the information economy where men hold the majority of high-skilled, high value-added jobs, whereas women are concentrated in the low skilled, lower value-added jobs. Therefore, a Policy should encourage girls and women to use ICTs early in education, and pursue higher studies in ICTs as well as technical careers as scientists, researchers, administrators and educators. In addition to policies that ensure gender equality at the firm level, within the ICT sector, a strong role for state regulation of job security, insurance, maternity leave, and healthy and safe working conditions is vital for gender equality in the information economy (10).

5. ICT TOOLS-WOMEN EMPOWERMENT

Livelihoods

New ICTs provide opportunities to reorganize economic activities in ways that can bypass the traditional dependence of women producers on male-dominated and exploitative market structures, including "middle-men". In many places, initiatives are being tried that link women artisans directly to global markets through the Internet, as well as support their activities with market and production information. The 'Inter-city Marketing Network of Women Entrepreneurs' project in Chennai, India has set up a communication network among women's community-based organizations (CBOs) to market

their produce. The CBOs are provided with cellular phones, and women have been trained to maximize the use of telephones for selling not only in their immediate neighbourhoods but also reaching new markets within the city. The impact is that poor women from CBOs constrained by pressures of time and mobility are able to assess and aggregate market demand by trading through their peer CBOs, and evolve cost-effective mechanisms to increase business turnover by making the most of business networking (11).

Health

The technologies are being successfully used in many places for information dissemination about health. The Self Employed Women's Association (SEWA), a trade union of women workers from the informal sector in India uses video to convey basic health information to its women members. Women themselves have produced video footage on how to address diarrhea through oral rehydration therapy, and they distribute this through their networks. New ICTs can also play a critical role in health delivery. The use of networked information exchange systems, and offline information tools like CD ROMs, databases and mobile ICT devices can enhance public health delivery. They can enable health education and information dissemination, bring communities and health facilities closer to each other through regular and systematic information exchange, and offer simple solutions for collecting and analyzing information about disease and health-seeking behaviour to help health interventions become more locally relevant. ICTs are being used in response to the crisis posed by HIV/AIDS. ICTs to promote better access to AIDS advice, counseling, and test results without fear of being stigmatized.

e-Education

ICTs like satellite, radio and TV offer many possibilities for non-formal and continued education, which can have important gender implications. They can deliver education content to the doorstep, which, for women with constraints on mobility and access to public places, can be a significant starting point. Technologies are being used the world over for open and distance learning. Azim Premji Foundation in India is among the few NGOs that work with the government to strengthen the public education system. The organization produces CD ROMs of creative content based on the primary school curriculum, which is gender-sensitive, uses local dialects and is designed to appeal to rural students. In India, computers are being introduced in schools, as a tool to support the learning process and ICT interventions is a precondition to ensure equal access and effective use by girl students of computers in the classroom environment. In the formal education at the graduation level the educational system should introduce Job Oriented Certificate courses as an add-on course and should be made mandatory for a student to get trained at least in one of them.

Apart from direct employment, ICT has benefited women in a number of ways. It is a viable tool of information and communication which goes a long way in empowerment of women. Immense amount of information is obtained through the internet. Effective and efficient use of information technology like internet can help in assimilating information about variety, range and quality of products, publicity and marketing of products and services. Apart from being used as a tool of information and communication and employment, application of ICT has created avenues for women empowerment. Noteworthy examples are that of Gyandoot, Embalam, SEWA, Datamation and Smile (12).

SEWA: (Self Employed Women's Association), uses ICT for women empowerment. The main goal of SEWA is to promote local income generating opportunities among women. The Self-Employed Women's Association SEWA, with 200,000 membership is spread over 800 villages in Gujarat. It uses an interactive satellite communication and Internet-based training programme to develop a cadre of barefoot managers among the poor women workers, focusing on women in panchayats, forests, water conservation and so on. Through ICT, training is provided on issues as disaster management, leadership building, health and education, child development etc (13).

Gyandoot: is a project started in Madhya Pradesh to fund rural networked cyber kiosks through panchayats. The project was started in Dhar district, to offer villages multiple services through internet based project. Through this project, information is available about rural life and agricultural projects. The internet gives information which was earlier available through middlemen. Information is available about education and employment opportunities. Complaints can be lodged on the internet which is of great help to men and women (14).

M.S. Swaminathan: research project in Pondicherry in Embalam district has led to creation of information villages. Ten villages are connected by a hybrid wired and wireless network, consisting of PCs, telephones, VHF duplex radio devices, and email connectivity through dial-up telephone lines that facilitates both voice and data transfer. This has enabled villagers to obtain the information that they need and use this information to make improvements. Local volunteers gather the information, feed it into an Intranet, and provide access through nodes in different villages. There is Value addition to raw information, use of the local language (Tamil), multimedia (to facilitate illiterate users), and participation by local people. Most of the operators and volunteers, providing primary information, are women more than 50%, thus giving them status and influence.

Smile: (Savitri Marketing Institution for Ladies Empowerment) is a voluntary organisation in Pune. This project has increased literacy level of underprivileged women through the usage of ICT. Internet has also helped them market their various products like soft toys, candles, bags, utility items, etc. Through Internet, there is greater awareness and exposure and market reach for the products.

Datamation Foundation: started a project in 2003 in Seelampur area of Delhi for Muslim women. The project localised appropriate communication and information networks by setting up an ICT centre at a Madarsa. This helped link resource-poor women to the information and tools for knowledge management. It also helped establish buyer-seller linkages towards eradication of absolute poverty. It has established its standing in the community and became a big attraction for the women of Seelampur. People drop in to consult on matters other than computer training. The ICT centre

has created self confidence in women and creating awareness about their interest and helped them take collective decisions.

Dairy Information Services Kiosk: (DISK) is a project which uses Information and Communication Technology (ICT) in the dairy sector in Gujarat. ICT enables the creation of cost effective solutions that strengthen the exchange of useful information between farmers and the union. ICT facilitates dairy farmers with timely messages and education to manage their milch cattle and enhance the production of quality milk. It is also assisting dairy unions in effectively scheduling and organizing the veterinary, artificial insemination, cattle feed and other related services. Usage of ICT goes a long way in empowering men and women (15).

Aamagaon Soochna Kendra: (My village's information centre) is a project started by Government of Orissa by setting up 73 Information and Communication Technology (ICT) kiosks in the rural areas of 12 districts of Orissa. These kiosks are run by Women SHGs/ Panchayats/ NGOs / CBOs / Youth Clubs and managed by the Community IT volunteers paid through user charges collected and managed by the local hosts. Under a partnership with Mission *Shakti*, women SHG members are being trained on computer fundamentals and Internet basics at the IT Kiosks on payment of an affordable fee. Access to IT training goes a long way in empowerment of women (16).

The usage of ICT is prevalent in several villages in Maharashtra. In **Warana Project**, in a VSAT-and-RF-based computer-communication network, a highly user-friendly information system in Marathi was developed. This was used for marketing of agriculture produce with a number of online features for selling the produce of the 70 villages to wholesale outlets in Pune and other cities and towns in Maharashtra. Information is updated daily with the help of the villagers themselves. Internet thus provides suitable opportunities to men and women.

Capacity building of Women

Several organizations are building the capacities of girls and women to make ICTs accessible and useful to them. At one level, girls and women are being provided general training in ICTs for ICT-related jobs; at another, women in business, women entrepreneurs and women in the professions, are systematically being supported for skill enhancement, career growth and greater work efficiency. In the Deccan Development Society, in South India, socially disadvantaged women have used radio and video to document and disseminate traditional farming practices, to reach policy-makers, and to archive their community-based development work. Such development activities in fact have deeper meanings; they reflect the recording by women of their own history and reclamation of their knowledge (17).

Rights-based information for women

ICTs have been used by gender equality advocates the world over for putting out rights-based information. From multilateral agencies like UNIFEM to feminist activists at local levels, actors at different levels are involved in creating, collating and disseminating material on rights – legal rights, sexual and reproductive rights, women's human rights. This is done through websites, e-magazines and email. In many developed countries, websites provide assistance to women seeking help on domestic violence.

6. CONCLUDING NOTES

The majority of women in the developing world do not have access to ICTs due to variety of barriers as such the infrastructural, social, cultural and linguistics. While it may be necessary for the progressive elite to mediate information dissemination, real democratization of information depends on making ICTs relevant to the majority and accessible to every woman. Today, print media and radio are used extensively by feminist groups for information dissemination. ICTs can strengthen these media strategies. Community access points such as telecentres can be a simple tool for conveying information to women that supports their social and political empowerment. Telecentres need to be used as strategic spaces where information on the law (e.g. violence, religious law), on worker rights (e.g. minimum wages), and citizenship rights can be obtained. Governments and NGOs have to take a lead in this process of universal access to rights-based information, especially in rural areas. ICTs can provide spaces for diverse, bottom-up and low-cost communication. They can amplify women's voices, help publicize women's experiences and perspectives and integrate their specific concerns with the mainstream policymaking and development process.

Engendering ICTs is not merely about greater use of ICTs by women. It is about transforming both gender politics and the ICT system. It is evident that the ICT system is organized on elitist, patriarchal, techno-centric, non-democratic lines and based on capitalist values. Transformatory gender politics will need to question these values and search for ethical alternatives. This calls for synergy between a new bottom-up culture of ICT production and use and the re-engineering of the global ICT system that will guarantee sustainable changes towards gender equality. Addressing the ICT arena is part of a larger struggle to build an information society based on protecting people's right to communicate, own and use knowledge for their own ends, and resisting curtailments on freedom to use, share and modify information tools and content.

7. SUGGESTIONS

In order to create an enabling environment and to support women's social and economic empowerment through ICT, actions are necessary by different actors, at local, regional national and international levels. The following recommendations are aimed at promoting such actors.

- Adopt legislative, regulatory and administrative measures to promote gender equality in the ICT area, and in particular, adopt legislation in ICT-specific sectoral areas to address gender equality, and create monitoring frameworks and capacity to ensure implementation.

- All educational institutes by law should be made to offer ICT based Job Oriented courses to the down

trodden women in the society for free as their societal obligation.

- Develop gender-sensitive technical and regulatory instruments when addressing such ICT policy issues as universal access, regulatory frameworks, licensing, tariffing, spectrum allocation, infrastructure, ICT industry development and labour policies; attention is drawn to the detailed list of ICT policy issues and the gender aspects related to them.
- Develop reporting mechanisms to monitor progress towards gender equality in the ICT area.
- Collaborate with national machineries for the advancement of women to promote gender equality in ICT.
- Strengthen their own capacity, through increased financial resources and technical expertise, to lead advocacy in gender equality and ICT.
- Encourage and facilitate collaborative action among government bodies with responsibilities for the ICT area and for gender equality.

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THE HOM-SCHOOL

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ABSTRACT

Beginning with the fleeing of city dwellers into suburbia in the 1950s and the exodus of commercial institutions in the 1970s, neighborhood sprawl hit its stride with the replacement of the neighborhood school by giant, remote educational facilities in the 1980s. Contrarily, in 2003 1.1 million children were being homeschooled in America, with signs of homeschooling becoming a growing trend. One of the main reasons parents chose to homeschool their children was concern about the environment of other schools. With a large number of students being sent to mega-schools and a growing number of students being homeschooled, there is an increasing gap between the two scales of schools being used for education, and neither seems to be a complete solution.

Coinciding with the fragmentation of common American neighborhood structure, there has been a significant decline in the literacy of American children relative to their international counterparts. This paper explores the ways low population learning environments can be networked into the urban fabric of a blighted neighborhood for the purpose of improving academic performance. In addition, it presents the social, civic and economic opportunities and disadvantages afforded to a neighborhood when a digital learning network is overlaid with a physical network of learning environments.

Keywords
literacy, digital network, neighborhood revitalization, learning environments

INTRODUCTION

During the second half of the 20th century, there was an epic deterioration of the urban fabric of the typical American neighborhood. Starting with the fleeing of city dwellers into the outskirts of suburbia in the 1950s and the exodus of commercial institutions in the 1970s, neighborhood sprawl hit its stride with the elimination of the neighborhood school in the 1980s. With this community-defining component being replaced by giant, remote educational facilities, the American neighborhood was finally a shell of its former self. If the neighborhood represents the cell, then the home represents the nucleus. In 2003, 1.1 million children were being homeschooled in America, with signs of homeschooling becoming a growing trend. One of the main reasons parents chose to homeschool their children was concern about the environment of other schools. With a large number of students being sent to mega-schools and a growing number of students being homeschooled, there is an increasing gap between the scales of schools being used for education, and neither seems to be a complete solution.

In addition, a significant part of relevant literacy in today's global community deals with digital literacy. The digital divide is the gap between those people with effective access to digital and information technology, and those without. Many institutions including the United Nations believe the digital divide is the key to local and global, social and economic inequalities.[1] Increasing quantities and types information is being stored and made accessible through digital means. However, if a person does not know how to access this information, they are less equipped than the person who does, and the problem of a gap in knowledge becomes exponentially larger.[2]

This paper presents a proposal which seeks to reestablish the neighborhood school, by injecting contemporary, low-population learning environments branded as HOM-S[1] to act as a type of modular architecture which will bridge the gap between the home and the school. The solution is potentially ubiquitous, but for the sake of this paper will focus on the neighborhood surrounding Holmes Elementary School and Liberty City Elementary School in Miami, Florida. This neighborhood has a high crime rate, low testing scores, high dropout rate, lack of positive identity, and low economic class, and therefore represents the extreme conditions this solution wishes to remediate.

The HOM-S solution is intended to be a bridge between the home and the mega-school, creating both an "education path" and a campus network for pre-university students. Specifically, these pre-university learning environments are meant to complement and correct at-risk education systems and the neighborhoods they serve. Through the use of flexible technology, distance learning networks, and site sensitive architecture, as well as a re-interpretation of curriculum and teacher-student roles, these environments seek to turn deteriorated neighborhoods into healthy communities.

LIBERTY CITY SCHOOL

Since 2004, Holmes and Liberty City Elementary Schools have received F scores repeatedly while their students have shown no signs of improvement. Due to these criteria, and in accordance with Florida's A+ Plan, these schools were given a list of changes from which they could choose or be forced to close (as was suggested by the superintendent). The changes taken at Holmes and Liberty City included hiring reading, math and science coaches, increasing teacher training, appointing academic deans for the worst performing students, and finally in 2008, appointing new principals. Other options available to F schools, but not utilized by Holmes and Liberty City, are increasing the school day by 3 hrs, paying students to attend school on weekends and holidays, and increasing technology through the use of computerized classrooms and whiteboards. In some ways, these latest proposed changes reflect the primary differences between a public classroom and the classrooms available at a private elementary school. The benefits of

[1] HOM-S™ is not an acronym. It is a branding for the modular architecture which will be used to bridge the gap between the "hom"e and the "s"chool.

Figure 1 162nd Street (MLK Boulevard), a commercial corridor in Liberty City with barrack style residences on the south side of the corridor and abandoned buildings on the north side of the corridor. (courtesy of Google Streetview)

Figure 2 Coral Way (Miracle Mile), a commercial corridor in Coral Gables, has tall office buildings and restaurant franchises such as Houston's. (courtesy of Google Streetview)

technology on education are well documented. However, lack of technology may not be the largest concern.

Miami Dade County's School Climate Survey is an annually administered survey distributed to approximately 83,700 parents, 41,100 elementary, secondary, and adult students, and 26,100 staff.[3] Forty-three percent of the parents, 82 percent of the students and 74 percent of the staff who were surveyed in 2008 responded. The survey is meant to gather information regarding what these groups think about their school and their perceptions concerning how their school can be improved. According to a 2007-2008 School Climate Survey administered by the Miami-Dade County Public Schools Research Services, classroom and school atmosphere is a leading reason for failure cited by students, parents and teachers. It should be noted that this result agrees with the thirty–one percent of homeschoolers whose parents said concern about school environment was their reason for homeschooling.[4] When looking at the results of the surveys for Holmes and Liberty City Elementary, one key concern of the students is the presence of gangs and school violence. At Holmes Elementary, 69% of surveyed students cite gangs as a problem at their school, while 39% of Liberty City students cited the same problem. In addition, 76% and 62% of students attending Holmes and Liberty City respectively feel violence at their school is a problem.[5] This high level of violence and proclivity towards gang mentality is one example of negative community identity.

In 1971, 15-year olds Raymond Washington and Stanley Tookie Williams founded a gang known as the Cribs. They were called Cribs because of the young age of the majority of its member. Its sole purpose was to form a street alliance against street gangs. Eventually, the Cribs changed their name to Crips. Some accounts state that the name change was due to the pimp canes the members would walk with, while others believed it was an acronym for Community Revolution In Progress. No matter the historical account, the Crips became one of the largest and most dangerous street gangs in America, and ironically became the problem they were tempting to solve.[6] Eventually the Crips, once a uniform alliance became a loosely connected network of individual sets, often engaged in open warfare with one another. The history of the Crips speaks to the problems present in Holmes and Liberty City schools. The young citizens of Los Angeles sought identity, community and safety, and therefore formed the Crips. However, over time the organization became so large that the anonymity erased those initial benefits.

The same can be said for the urban public consolidated school. According to the National Association of Secondary School Principals, large schools shroud young people in a "cloak of anonymity." [7] The re-establishment of positive community identity would be a key benefit to the students of Holmes and Liberty City Elementary Schools.

THE NEIGHBORHOOD

Liberty City (called Model City by the municipal government) got its name from the Liberty Square Housing Projects. Liberty Square Housing Projects were built in the late 1930s for Miami's low-income African-American population, and was the first of its kind in Florida. Presently Liberty City is inhabited by 23,009 citizens of whom 94.69% are African American, 3.04% are Hispanic, 1.68% are non-Hispanic and 0.59% are White (non-Hispanic). The median household income in Liberty City is $18, 887.49, which is approximately $5,000 below the general City of Miami median household income, and $30,000 below the US median household income.[8]

PROGRAMMING ANALYSIS

When formulating the program and design of the HOM-S™ solution, the needs of the community were strongly considered. This section is an analysis of the dominant needs of the community.

The Pew Internet and American Life Project 2008 found that only 42% of American households making under $30K have broadband access.[9] The median income of Liberty City is approximately $18K which puts the residents of Liberty City well below the margin set by the Pew Internet and American Life Project 2008. In addition, according to the National Adult Literacy Survey, which had a score range of 0-500, the mean scores of all African American adults on the prose, document and quantitative literacy scales were 43 to 63 points below those of White Americans while the White-Hispanic gaps were even larger, ranging from 67 to 75 points.[10] These two facts coupled with the close proximity of two F-schools, proves the existence of a literacy gap in this area, and establishes bridging the general literacy and digital literacy gap as a main priority of HOM-S solution.

Though positive role models such as Mary Athalie Range, the first African American to serve as a Miami commissioner, have come from Liberty City, Liberty City is better known for infamous characters such as for Philip Andre "Mickey" Rourke, Jr., Alvin "MVP" Burke, Jr., Chad "Ocho Cinco" Johnson and Maurice "Trick Daddy Dollars" Young. Interviews and the reputations of these individuals explain the social state of Liberty City as portrayed by the climate surveys taken at the elementary schools. Gang activity and violence are the norm. However the fact that the parents and staff seem to not see it as a problem, while the children have a completely opposite view, points to a gap between the home and society.

In a conversation with former Miami-Dade County and New York State superintendent Rudolph Crew, the issue of economic

opportunity arose. During that conversation he asked a very poignant question: "As a child, as you walk up the streets of Liberty City, what do you have to aspire to? What places of employment or economic opportunity (positive economic opportunity) do you see? There is none." This area is serviced by two main economic corridors NW 17th Avenue and NW 62nd (Martin Luther King Boulevard). This 1.25 mile economic corridor has no grocery stores or restaurants, though there are two dining establishments, Miracle Fry Conchfritter (7070 NW 15th Avenue) and Big Momma's Soul Food (6831 NW 15th Avenue) located within the boundary of the site. There are many empty lots, and when compared with other City of Miami economic corridors such as Coral Way in Coral Gables, there is an apparent lack of economic investment. Coupled with the fact that the median household income in Coral Way at $37,168.89 is approximately $20,000 above, or more than double, the median household income of Liberty City, bridging the economic gap is imperative.[11]

To summarize, bridging these predominant social, literacy and economic gaps should be the driving force of any solution. The proper solution should not only positively affect the physical environment by repairing the urban fabric, but it should also improve the value of the academic services provided. It should neutralize negative effects and create positively evolving communities, growing municipalities and a competitive nation. In short, the solution should be a form of school building. The re-established schools should create positive learning environments that educate intelligent, productive citizens who will positively influence society. Since it could be argued that our standards are declining, while our global neighbors' standards are advancing, the challenge is great. We can meet this challenge by developing approaches to education that provide both a competitive standard level of education as well as a personalized, goal inspired curriculum. The solution should also require a light handed execution with profound results. In addition, there is a need for a high level of flexibility, predominantly afforded by the use of digital technology. These are the criteria which have formed the HOM-S solution.

HOM-S DIGITAL NETWORK

The school is not embodied in one building. Instead it is an education path that includes the home, the HOM-S and the consolidated school. These paths overlap as individual education needs overlap, intersect, and form networks. In congruency with the HOM-S mission to be a non-intrusive, plug-in solution, the design of the HOM-S network begins with the creation of the digital network. The first step is to place a wireless fidelity (Wi-Fi) network over the neighborhood using infrastructure already in place. Free Wi-Fi is an increasingly popular public service being offered. In San Francisco, the office of Mayor Gavin Newsom, in partnership with AT&T and Meraki, Inc., has promoted an initiative called "Network of Community Networks" since 2008. This initiative is meant to cover San Francisco with free Wi-Fi 2.0 service, but more interestingly, it is meant to be first implemented for the benefit of the San Francisco Housing Authority.[12] For example beginning in January 2009, free Wi-Fi has been offered in the Sunnyvale housing development. According to the San Francisco Chronicle, Sunnyvale is "quite possibly the most dangerous, depressed and decrepit area of the city".[13] The hope is that by providing in-home broadband internet access to the residents of low income-housing developments, they will have more access to crucial information such as financial opportunities, jobs, and education resources. Although it is too soon to gauge the success of the Sunnyvale Wi-Fi Project, it is a suitable prototype on which to build the HOM-S design.[14]

One of the greatest amenities of urban neighborhoods such as the one presented earlier, is its access to public transportation. Four bus lines service this area, linking it to neighborhoods with similar demographics as well as the museum district, hospital district and the main branch of the Miami library system. The bus line represents the first phase of the physical network. The connections to the Main library, Vizcaya Museum and the Miami Art Museum represent access to information and increased literacy. The bus lines to neighborhoods with strong cultural identities such as Overtown, Allapattah, Coconut Grove, Hialeah and Opa-Locka is a physical network connection that can be used to bridge social gaps in the greater community. Lastly, the bus lines run predominantly on the commercial corridors. In addition to connecting to business districts such as Biscayne Boulevard and downtown Miami, the access to commercial zones as well as the constant flow of potential customers, makes the bus stop a viable location for economic improvement. For these reasons, the bus stop is seen as a gateway or portal through which information access, economic exchange and social interaction can be facilitated and enhanced.

HOM-S network Wi-Fi broadcasters are to be added to existing Miami-Dade County Transit bus stops. Every bus stop is equipped with a 10-foot pole which displays a map and schedule for the bus routes which use that stop. HOM-S network Wi-Fi broadcasters are secured to the top of these poles. The typical specifications for a HOM-S Wi-Fi broadcaster are equal to or greater than RadioLabs 2.4 GHz 11 element yagi antenna. This antenna is outdoor ready, only 2' in length, within the $50-$75 range and has a 1mile+ range. The antenna will be installed at half-mile intervals for the purpose of overlapping individual antenna effective ranges.

The HOM-S network uses mesh networking at a scale similar to that of Sunnyvale. Mesh networking is a way to route data, voice and instructions between nodes. It allows for continuous connections and reconfiguration around broken or blocked paths by "hopping" from node to node until the destination is reached. Because it can hop around blocks in the system, the mesh network is self healing.

The final piece of the network puzzle will be the devices. In addition, to allowing personal laptops, smartphones and network ready devices to access the network, all students will be given a laptop to use for e-book reading, e-learning and gaming. The student will carry the laptop along the education path. It should also be noted that the netbook is one of the fastest growing segments of the computer industry.[xv] By

be supplied with One Laptop Per Child (OLPC) XO laptop computers, which operate naturally on a mesh network. Though they have their problems, these devices are designed to create educational opportunities for the world's poorest children. The XO is rugged, low-cost, and low-power due to its rounded edges, integrated kid-sized handle, and sealed, rubber-membrane keyboard. The XO is about the size of a textbook and lighter than a lunchbox, and thanks to its flexible design and "transformer" hinge, the laptop easily assumes any of several configurations: standard

providing children with this technology, they are more familiar with the technology they will be using in future work environments.[xvi]

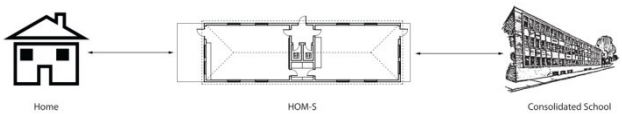

Figure 1 Education path between the home, HOM-S and consolidated school.

In addition to encouraging communication between students, the HOM-S network is designed to accumulate data as well. Site specific projects conducted in different locations and other opportunities afforded by cluster processing require the need for equipment to store massive amounts of data. Cluster processing is the practice of using a group of linked computers to perform tasks as though they were a single computer. The result is improved performance, availability and cost-effectiveness over that provided by a single computer of similar speed and power. The cluster is a digital version of the democratic society. It is a group brain. The consolidated school is the embodiment of society, and is the forum for communities coming together for competition and collaboration. For that reason, all servers for the HOM-S network will be housed at the consolidated school. These buildings are equipped to, or can be upgraded to, handle the HVAC requirements necessary to keep small data farms operable. In addition, the displacement of certain activities to HOM-S nodes and students' homes relieves space within the consolidated school building. These factors make the consolidated schools excellent sites for HOM-S network data servers.

HOM-S Physical Network

The two major trends in schooling – homeschooling and consolidated schools – point towards two extremes. One deals with grouping students into larger populations and through economy of scale providing "better to more". On the other end of the spectrum, homeschooling allows for personalized, safe childhood education more aligned with family views and goals. As previously state, the HOM-S solution is not embodied in one building. Instead it is an education path that includes the home, the HOM-S insertion (otherwise called HOM-S) and the consolidated school. These physical paths overlap as children travel between buildings, and transform the neighborhood into a community.

Over the past few decades, obesity has been on the rise amongst American children. Among that group, African American children between ages 6 -17 were 1.3 times as likely to be overweight than Non-Hispanic Whites.[xvii] HOM-S is meant to be a proponent of a healthy lifestyle. Originating at the bus stops and schools, which represent points of destination, reasonable walking distances will be used to determine placement of HOM-S nodes. According to the Congress for New Urbanism, a reasonable walking distance is ¼ mile (5mins). Due to the size and age of the children using this network, 1/8 mile interval placement of HOM-S nodes is optimal. Nevertheless, assuming the use of bicycles, scooters, Segways™ and other single person vehicles will occur, the HOM-S nodes will be at a maximum interval of ¼ mile. In conclusion, the placement of HOM-S nodes is determined by two factors. The HOM-S must be within ¼ mile distance of the portals to the community – bus stops – and they must be placed on vacant or underused lots within the community. These lots will be leased by the city. By not purchasing, but rather leasing the properties, the city partakes in improving the community

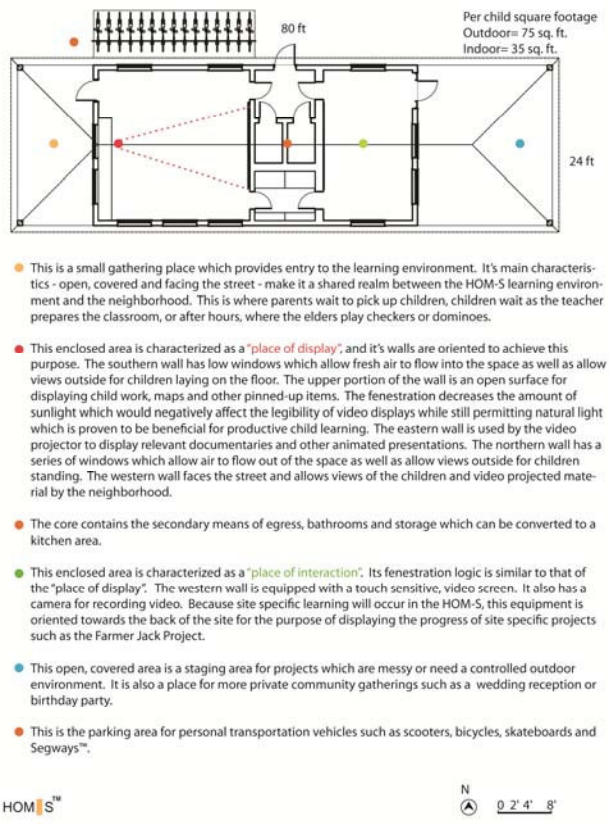

Figure 2 HOM-S node guidelines.

economically while leaving the ownership of the real estate in the hands of the community.

HOM-S Node

The HOM-S is a contemporary, low-population learning environment. According to Beaumont, education experts believe well designed schools typically have the following populations: 300-400 students for elementary school, 500 students for middle school and 1,500 students for high school. [xviii] Each HOM-S will be centered on a smaller community, and for that reason the population of a HOM-S will be 15 students total.

HOM-S Curriculum and Administration

Curriculum and staffing of the HOM-S solution is critical to facilitating the use of the HOM-S network as an education path that includes the home, the HOM-S node and the consolidated school. According to a Pew Forum on Religion & Public Life survey released in February 2008, 83.1 percent of Americans affiliate with some form of religion.[xix] Nevertheless, religious studies are not allowed in the public schooling system. This gap between culture and society offers an opportunity for the creation of a curriculum which benefits from the HOM-S solution.

Subject Based Curriculum

Specialist taught subjects comprise the dominant form of curriculum in today's consolidated schools. Considering the HOM-S solution is a non-intrusive, plug-in solution, a subject based curriculum that links the home to the consolidated school is required. Belen Jesuit Preparatory School is a nationally top

Figure 3 Place of display.

Figure 4 Place of interaction.

rated school located in Miami Dade County. Their 6th grade curriculum was chosen because it contained a variety of subject areas including disallowed public school subject areas (i.e. theology), amenity subject areas (i.e. foreign language and computers) and staple subject areas (i.e. mathematics and reading). The subject areas are Theology, Reading, Computers, Language Arts, Foreign Language, Math, Social Studies/Civics, Science, Fine Arts (Music), and Athletics. Based on issues of economy of scale, expressed preference through homeschooling surveys and desired class size, the curriculum has been spread out along the education path. Due to the personal nature of Theology and Reading, these subjects will occur in the home. Computers, Language Arts, Foreign Language, and Math lend themselves to small groups so they will occur in the HOM-S. Broad access, safe use and secure storage of hazardous materials, expensive technology and equipment makes the consolidated school the proper site for Fine Arts, Science, Social Studies/Civics and Athletics.

SITE SPECIFIC CURRICULUM

Some subjects cannot be easily relegated to one building versus another. The different branches of a subject such as science may be taught better in different locations with varying class sizes. Each HOM-S can have a character and focus of its own to accommodate the different scales and subjects of learning. Like Prairie Crossing Charter School in Illinois which focuses on hands-on environmental education, the schools can pull part of their curriculum from nearby sources, while other parts of the curriculum can be pulled together from distant, virtual sources. [xx] For example, complex chemistry lessons which require supplies be safely stored, distributed and utilized, would be better suited in a central location such as the consolidated school. However, a site that is near a pond might be better suited for the study of ecology or marine biology and the study of single cell organisms. The same can be said for a HOM-S sited near fertile soil. The same can be said for a HOM-S which has been sited near a commercial corridor. These projects can be given child friendly names such as the Farmer Jack Project (agriculture), the Fishbowl Project (marine biology) and the Lemonade Stand project (entrepreneurship).

Projects conducted in various locations can share data. For instance if two HOM-S , one in Massachusetts and the other in Florida, are both doing the Fishbowl Project, they can focus on largemouth bass. During the project, they can use the "place of interaction" to exchange information concerning the fish growth as time progresses and the weather changes. In addition, these projects can become franchises that are equipped with the dual task of educating while providing economic opportunity for their communities. In Liberty City, the Farmer Jack Project can focus on horticulture and agriculture. Part of the outside area can be used to grow corn while another portion can be used to grow orchids. Once full grown, these plants can be sold locally or exported and the funds used to benefit the community.

ADMINISTRATION

The role of the teacher in the HOM-S solution can be divided into two categories – the source of knowledge and the "dispenser of knowledge". The "source of knowledge" is a specialist concerning a particular interest. Previously, the best specialists would be accessible only by attending the schools where they taught, which in many cases would be those outside of the public school system. With the evolution of distance learning technology, the specialist is capable of reaching a larger group of students. The specialist can distribute information, perform live presentations and answer questions through the HOM-S network. In addition, specialists can communicate with specialists in other locations and exchange data that may aid them in their own personal research.

The other role, the "dispenser of knowledge", does not need to be a specialist in a particular field, but rather is more likened to a librarian. The librarian is an expert of research. The fast evolution of search tools and the increased networking of data, suggests a growing appreciation for the skill of being able to direct a student towards the right source. In addition, in places like Liberty City, the literacy and economic gaps are not limited to the younger generation. The HOM-S envisions a cross generation relationship in which the older generation acts as the "dispenser of knowledge" and authority figure, while also gaining knowledge in the topics they find interesting. This authority figure is best played by adults who command a high level of respect and familiarity within the neighborhood, and have a continuing education goal of their own. In this way, the HOM-S solution will operate as a community learning center.

CONCLUSION

During the research period of this proposal, it became apparent that the failing academic performance of two schools in Liberty City could be linked to, and were exasperated by, literacy, social and economic gaps. The result was the development of a

Figure 5 Farmer Jack Project focused on agriculture (corn) and horticulture (orchids).

four phase proposal. The first phase includes creating a digital network to provide access to information for Liberty City residents. The second phase includes setting up guidelines for a building type which is conducive to both digital learning as well as traditional hands on learning. Next, vacant lots are occupied with a design based on those guidelines for the purpose of setting up an education path between the home, HOM-S node and consolidated school, in order to convert the neighborhood into a learning campus. Lastly, the home, HOM-S and consolidated school are tied into the digital network for the purpose of gathering, storing and exchanging data. Through these phases, the network is able to not only provide access to information for the purpose of improving the academic performance of the children in the neighborhood, but also it is able to provide increased economic and social opportunities to all residents. http://maliksbenjamin.com/hom-s/

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How Safe is our Digital Tomorrow?
Role of Libraries and Information Centers in Digital Preservation.

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ABSTRACT

Libraries are in a bigger predicament to safeguard digital material as the preservation of digital information vastly differs from that of the traditional print material. Digital publications are taking the world by storm, whereas the storehouses of knowledge are finding it very difficult to safeguard these digital publications. The technological innovations, the obsolescence of hardware and software coupled with the inconsistent preservation techniques and standards pose greater problems for the libraries and information centres. Among myriad challenges in digital preservation, the important challenge is the preservation of digital contents within the context in which they were created. The role of libraries during these uncertain times especially in creating awareness among the creators and managers of digital documents, is to work towards a global digital preservation policy and invest in consortia to safeguard the digital information which will go a long way in safeguarding today's information for tomorrow's generation.

Keywords: Digital Preservation, Digital Publishing, Digital Obsolescence

1. INTRODUCTION

Preservation is an art which mankind has mastered over the years of trial and error. From time immemorial man has learnt to preserve and leave track of his activities and feelings in a number of ways. The ancient pyramids, rock painting, clay tablets, scrolls, papyrus, palm scribbles are some of the examples of man's enduring effort to preserve his memory, work and art. The purpose of preservation is to make sure that works of distinction and valuable information are organized and preserved for current use and for posterity. But, the digital era has seen an unprecedented threat to the very concept of preservation as the overflow of digital information has driven the endurance of yesterday's memory into the doldrums of despair. Smith observes that the "Digital information is easily created, quickly accessed, cheaply disseminated and provides significant benefits to users, but this versatility brings with it a new level of volatility and fragility"[12]. With this easily created information sources it is important to see how safe our digital future is and to see how the libraries and information centers can aid in the preservation of today's information for tomorrow's generation.

2. LIBRARIES AND PRESERVATION

Traditionally Libraries and archives have played an important role in the preservation of humanities intellectual output. Libraries have collected, organized and managed these information resources for current use as well as for posterity; and in doing so, they have served as the central focal points for preservation of human knowledge and creative art works in all formats. Preservation, especially in libraries, is the action taken to prevent, stop, or retard deterioration of all information resources in all format. A comprehensive preservation approach meant, choosing the most appropriate method of preservation for every item. This is accomplished through storage of materials in proper conditions, careful handling and housing, use of security systems designed to eliminate mutilation and theft, repair or replacement of damaged materials, and through refreshment and migration of electronic files. There are many other materials whose value lies primarily, or only, in the information they contain. When repair of such materials becomes impossible or prohibitively expensive, their content may be preserved through reformatting or conversion into other media. Materials of unique aesthetic or historical value should be preserved in their original form. Until the advent of electronic information resources

some of the most significant and successful preservation methods employed by both libraries and archives for their print materials include the following: provision for fire protection and adequate environmental controls; re-housing of acid-based print materials; microfilming of unique and endangered information resources; desktop publishing (DTP); use of acid-based paper instead of alkaline-based paper which is more susceptible to discoloration and quick decay. But the deluge of digital publications compounded with the complexity of digital publication has made preservation a nightmare for the present preservation community especially the libraries and information centres.

3. DIGITAL PUBLISHING AND PRESERVATION

Digital resources are more complex, right from its inception. The 'Born digital' publications as the name suggest are conceived electronically and do not have any print or paper-based backups. Some of these publications are difficult to preserve because they will work only with a certain type of hardware, software and other related equipment. On the other hand, the 'Made digital/digitized' resources are usually converted from old texts and brittle documents which were created long before the digital era. Then, there are other digital materials which were born digital however; for wide circulation, readership and other reasons, were printed into paper formats and then reconverted into digital formats, e.g. newspapers, conference papers, etc. These are relatively easy to maintain as they do not pose as many challenges as the typical 'Born digital' and 'Made digital' publications. Many of these digital creations especially the 'Born Digital' publications are created in new and different formats. The advent of new and exciting digital formats such as graphs, audio, video has transformed the document types into very colorful, yet complex multimedia documents. The imbedded audio, video, graphics, sound and other aids have enhanced the quality of digital documents yet has complicated the post-production preservation of these documents. Yet another complexity is the file format with which these documents are saved for retrieval and reuse. These different types of digital resources require different types of preservation methods and techniques. The biggest challenge with these different types of material is to capture the authenticity of the original content while retaining the original source for future innovations.

Digital preservation is broadly defined as "a series of actions and interventions required to ensure continued and reliable access to authentic digital objects for as long as they are deemed to be of value" [3]. More precisely it can also be termed as the actions needed to assure enduring access to the full content of digital resources. In digital context, content has wider implications than simply assuring that a given file can be accessed. For example, hierarchical and structural relationships among the files and metadata that make the files usable must be preserved as well as the files themselves. Preserving the content includes preserving the metadata and allied information tagged to the document. Thus, digital preservation is not only a technical issue, but it is also a strategic and long-term issue that requires constant review and selection of what has to be preserved and in what format, depending on the type of digital object under consideration.

Another dimension to digital preservation is that the users want digital information to be preserved as it was created and to appear in the same style, format and structure as it was originally created; and yet, at the same time they want to use and access the digital objects and contents using the most advanced, sophisticated and state-of-art software and hardware technology available to them. This is a paradoxical challenge which poses the choice between preserving the originality of the document on the one hand, and the use of available latest technology on the other hand. The challenge is therefore more complex because technology is dynamic, rendering digital preservation a continuous process and not a one-step solution as is the case with the print-based materials. As a continuous process, the concept of digital preservation includes constant planning, resource allocation and application of methods and techniques necessary to ensure that, digital information resources of continuing value, remain accessible and usable now and for future generations.

4. IMPORTANCE OF DIGITAL PRESERVATION

The importance of digital preservation comes from a number of factors associated with the nature of digital materials. First and foremost is the proliferation of electronic publishing industry and lack of parallel preservation strategies. When the possibilities of digital publishing was established in the early nineties many publishers and academic institutions ventured into digital publishing because the process was very simple and affordable, especially with the emergence of microcomputers and DTP softwares. Further, there are diverse digital objects, such as: e-books; e-journals; online databases on websites, networking discussion list serves; e-mails, institutional digital documents, etc. which carried the publication process. The International Digital Publishing Forum (IDPF) in its statistics released in June 2008 showed a growth of 87.4% to June 2007 in its retail eBook sales (http://www.idpf.org/doc_library/industrystats.htm). The British Library predicts that by the year 2020, 90% scholarly publishing will be switched to electronic format [2]. This deluge of digital publishing has an obligation to preservation responsibilities. But Statistics indicate that almost forty percent (40%) of websites disappear every year due to various factors (Economic Times, 29 July 2008) [1], such as revision of sites, migration and merging of databases, changes in URL addresses, etc. In the case of other diverse digital documents, they are aggravated by the constant changing technologies associated with their storage and retrieval. This is a clear message that there is a deluge of digital publication on the one side and a potential

threat to the future of those publications on the other side. Many people consider backups of digital objects as a form of preservation. Unfortunately, backups are temporary preservation methods against present calamities only, because backups are neither insured against future calamities nor against any technological obsolesce.

5. MAJOR CHALLENGES OF DIGITAL PRESERVATION

5.1. Digital obsolescence

The biggest challenge of digital preservation is digital obsolescence. Driven by market forces, new innovations, research and development and competition the technology and their associated components are regularly replaced with new products and methods on a 3-to 5-year cycle. New hardware, software and operating systems necessitate new formats, thus the digital world keeps on changing continually. Most of the equipments which were used in the beginning of this decade are now out of date and so are the softwares and operating systems. The foremost challenge in digital preservation is therefore to fight digital obsolescence because; the storage and software industries are yet to solve the problem of technical obsolescence.

Though storage media is a part of digital obsolescence, much attention is needs with storage devices as the heart of digital preservation lies in the life of storage media. Another important aspect of storage media is that, most of them are re-usable. Such reusable magnetic and optical media are vulnerable to deterioration and catastrophic loss. They can deteriorate rapidly thus the time-frame for decisions and actions to prevent loss of content and quality of the recorded information is a matter of years and not decades as is the case with print formats. Though some optical storage media promise a life span of 30 years and some even 100 years, the continuous innovations in the technological front posses a major threat to the digital preservation initiatives. The current High Density Read-Only Memory (HD-ROM) technology which uses the ion beam to inscribe information on pins of stainless steel, Iridium or other material seems to be the future technology for mass storage media [6]. Along with the storage media the play-back hardware and software technology to access information in these different media and formats poses yet another problem. The retrieval technology is also rapidly changing due to technological advancements, with increased capacity at each stage of innovation. So the innovations of technology pose an endemic danger to digital preservation.

5.2 Migration and conversion

Digital migration is broadly described as moving into the new or advanced digital standard without compromising the realities of the current standard. It can be defined as "a set of organized tasks designed to achieve the periodic transfer of digital materials from one hardware/software configuration to another or from one generation of computer technology to a subsequent generation" [5]. Migration is the most commonly used preservation strategy, especially for non-interactive digital objects such as images, databases or textual documents. Before any digital object is migrated, two important decisions must be made, format and application; the target format and the application software for migration.

Similar to migration, conversion is another widely used option for digital preservation. Conversion is transforming the present data into a current and more widely accepted and accessible format. From the preservation point of view, it consists of setting up a conversion application and executing it against a collection of digital objects. The difference between migration and conversion is that the conversions are applied only when the rollback facilities are not available. The problem of digital conversion is that at times the authenticity of the document could be lost.

5.3 Authenticity and context

Probably, the biggest challenge in digital preservation is the preservation of the authenticity of the document's content within the context in which it was created. Ideally, digital materials should be preserved within its context, i.e. within the context in which the digital document was created, along with the same software, hardware, document type/format, etc. yet, this is practically impossible because technology is forever changing. The cost to retain the older technology and the cost of maintaining the new and the old could be one of the biggest challenges due to cost implications and other reasons. On the other hand there is also a school of thought which feels that the emulation techniques should be used to capture the same authenticity. Again this will require lot of resources. The best compromise would be to migrate or convert or re-encode the objects to the latest technology.

5.4 Standards

Major challenges in the preservation of Digital objects are to follow consistent standard in the preservation of Metadata, Archival Storage and Methods of preservation.

Metadata: Semple [11] argues that metadata preservation is the key to successful digital preservation. Metadata records the information about the digital object to be preserved. It is common knowledge that in order to have a digital object preserved the technical information about the digital object is to be preserved. Currently there are a few Metadata standards available like Metadata Encoding and transmission standards (METS), Open Archival Information System (OAIS) reference model.

Archival Storage standards are crucial in safeguarding the integrity and safety of digital objects. Irrespective of the transformation in the storage media world, standards set to the archival storage will pay a crucial role in the development of the preservation strategy. Archival storage standards should specify the current storage media standards and give projections into the life-cycle,

complexity and end period of specific storage medias. These standards should also highlight the off-line storage media specifications which will stand as a non-alterable source of preservation.

Methods of preservation: The archival community is yet to come to a standard on the specific methods of preservation in terms of different file types, document types etc., it is imperative to work towards a specific standard in creating the methods of preservation. Currently many preservationists use TIFF, RTF and XML as standard file formats there needs to be a standard on this [10].

6. ROLE OF LIBRARIES AND INFORMATION CENTRES

In light of the above mentioned challenges it's clear that the digital tomorrow, especially in the scholarly publication field is a big question. With the libraries and information centres that collect, preserve and disseminate information sources are under spotlight. It becomes very clear that the mandate is upon these institutions to safe guard the information of today for a better tomorrow. Thus the role of libraries and information centres cannot be taken lightly. In order to preserve the digital integrity and longevity the libraries are expected to play a pivotal role in the following areas.

6.1 Creating awareness

Libraries should play an important role among the digital producers by creating awareness on digital preservation. The value of long-term preservation should be stressed right from the onset, i.e. from the data creation stage as it will influence the choice of the appropriate digital medium, software and hardware for preservation. Similarly, it is important that awareness is created for the existing or current standards in digital preservation including, the importance of documentation. In this way, the producers of digital documents can plan for long-term funding and sustaining any future technological innovations.

6.2 Towards a common standard

Any long term planning for preservation require to have a set of standards. Creating and working for specific preservation standards is an important role the libraries should play in order to safeguard the digital information sources. Initiatives from Library of Congress in the formation of guidelines and standardization for digitization and digital preservation, METS and OAIS are positive steps towards the formation of standards [4]. But the need of the hour is to have a uniform set of standards for libraries and Information centers which will ensure that the digital preservation amongst these places are uniform across different libraries. This will also ensure that at some stage to eliminate duplication and ensure authority.

6.3 Sound Digital Preservation policy

It's important that the libraries and Information centres should work towards a unilateral digital preservation policy. The preservation policy should encompass the important facets of digital preservation. It should take into account the digital obsolescence and project the periodic need of shifting from one technological innovation to the other with specific periodicity. It should also highlight when and how the migration from one technology to another should happen and it should specify the different standards to be followed in digital preservation.

6.4 Lobby for prolonged budget allocation

The cost implication has an important bearing on digital preservation as there are no specific tools, means, or reliable and comprehensive data to estimate or predict the future or long-term costs. Cost implications depend mainly on the socio-economic dimension of the information along with the storage, hardware and software costs; and to some extent the human resource cost. The ability to employ and develop appropriate skills in digital preservation entails training and re-training of information professionals as the technology changes. As noted earlier, digital preservation is a continuous process that requires a constant inflow of financial and other resources for any successful preservation project because, a break in the middle of a preservation project could result in loss of information and other negative effects.

6.5 Consortia

It is also important to note that only co-operative and consolidated efforts in creating strategies and solutions will provide cost-effective preservation solution. It is in this regard that consortia come into play. Consortia are excellent for the acquisition, maintenance, and preservation of digital materials. It is only through co-operative endeavors that digital preservation can be successful, not only because of cost implications, but also due to the enormity of the exercise. No single institution has the human, technological or financial capacity to embark on a successful digital preservation programme.

6.6 Collection development to collection preservation

There is an urgent need in the mindset of Information professionals to shift their attention from collection development to collection preservation. This paradigm shift is necessitated because of the vastness and changed nature of the collection itself. More and more digital content are procured in libraries with virtual access possibilities to different collections. As the shift of digital objects proliferates there is a need to plan, choose and procure digital objects with the future preservation in the mind. In this digital entanglement it is necessary that the library and information professional to look at the preservation possibilities of such collections. Such a move will pressurize the creators of digital information to look for possible long-term digital preservation objectives and plans

and at the same time provide the digital objects in the current and more user-friendly platforms.

7. CONCLUSION

Digital preservation is considered as an extremely serious undertaking, especially in the developed countries. Many countries have recognized the need for digital preservation and formulated specific programs. In 2001, the United Kingdom formed a "Digital Preservation Coalition" (DPC) to spearhead the digitization and digital preservation programme for the United Kingdom which has close to 30 members working on Digital Preservation (http://www.dpconline.org/graphics/join/ members.html). Then, in 2005, the United States of America initiated a National Digital Information Infrastructure and Preservation Programme (NDIIPP) [8] and allocated close to U$100 million for digital preservation. The Library of Congress, as the National Library for the USA was tasked with the coordination of this Programme; and has in this regard, initiated a dialogue among a number of federal agencies and other players in the information industry to establish 'Guidelines for Digitization and Standards for Digital Preservation' [4]. Further, the European Union has formulated the 'Digital Preservation Europe (DPE) Strategy' to oversee Digital Preservation Initiatives in the European Union. There are similar national initiatives springing up in Australia, Netherlands, Japan and other countries. These initiates will go a long way in formulating sound digital preservation strategies, and could be used as benchmarks for the developing countries instead of re-inventing the wheel. These initiatives could well serve as benchmarks for institutions in the Developing countries to design their own National Digital Preservation strategies instead of re-inventing the wheel. Considering the role of Libraries in information management, it is imperative that Libraries, Archives and other Information Centers throughout the world are equipped with the necessary skills to handle digital resource management and preservation. In this regard, institutions like University Libraries, National Libraries and National Archives in the Developing Countries could start the ball rolling by adopting digital Preservation policies and practices using the available technologies and expertise and spearhead national digital preservation initiates in order to avoid a possible digital blackout of their national digital information resources.

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GeoGebra and eXe Learning: Applicability in the Teaching of Physics and Mathematics

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Abstract

Today, education in the field of sciences is still characterized by excessive attention to repetitive exercises at the expense of understanding and visualizing the concepts of mathematical and physical phenomena. This article will show the potential of the software GeoGebra to build content and / or activities in Physics and Mathematics usable in isolation or engaged in other activities, such as eXe Learning. For this we constructed two activities: a mathematical content - Application of successive derivatives, and a content of physics - Application of uniform rectilinear motion. These contents were built in eXe Learning, and the graphics was built in GeoGebra and imported into the eXe by Java Applet. The content was done with the exported SCORM to Moodle, it is within this framework that the student will study the movement and display of graphic content.

Keywords: Construction content, GeoGebra, eXe Learning, Activity in Physic, Activity in Mathematic.

1 Introduction

Teachers have encountered growing difficulties of learning that students, in all levels, had presented in Mathematics and Physics. The learning in this areas seems not motivate the students, thus creating more difficulties in this process. The use of traditional methods of learning and the reduced number of inivative technologies are some reasons of this situation.

The scientific knowledge has evolved over the ages and, today, these concepts allow, by exploration of the world around us, day-by-day experience, like moving objects, walking, open windows and drawers.

In problem solving, [1], [2] and [3] shows that the concepts belonging to common sense and that occasionally arise in the process of formal learning of Science, the official concepts overlaps the spontaneous concepts rather than replace them. It is known that mathematics, science abstract and logic, helps in the process of verification of the trials and it can model an experiment, from simple to complex.

However, the teaching of physics and mathematics is still characterized by excessive attention to repetitive exercise. In physics this approach emphasizes the use of mathematical algorithms, rather than understanding of concepts related to physical phenomena involved, while in mathematics it decorates the mechanics of the algorithm, without knowing why to do it.

In its guidelines, the National Curriculum Parameters (PCNs) [4] to seek a new direction for the teaching of physics and mathematics. These suggest that dealing with issues close to the world experienced by students and pursue the development of the citizen to fully able to understand, intervene and participate in the society where he lives. The authors agree with the suggestions of the PCNs, but feel that students should have a basic knowledge and complete all areas in order to improve the performance of their learning.

The use of computers and the Internet in education, coupled with the computational tools (educational software), based on educational paradigms, can contribute to the process of teaching and learning. The use of virtual reality to build simulations and animations, offers vast potential, allowing students to understand the theoretical principles of Natural Sciences.

Specifically for the exact area, there are numerous educational software available for the construction of dynamic content, such examples are the GeoGebra, eXe Learning, Modellus, Geometric Cabri, Maple, etc.. Some of them free, as GeoGebra and eXe Learning, which can be used by teachers to create educational content. They are easy to use tools, without extensive knowledge in programming language.

This article aims to show the potential of eXe Learning to build content and / or activities in Physics and Mathematics usable, isolated or engaged in other activities. The second section will deal with the digital educational content and their specific requirements. The third section will describe about Virtual Environments Authoring (AVAu), with some software used to create educational materials for the teaching of physics and mathematics. In the fourth section will show the creation of a content of physics and mathematics using the eXe Learning, and the graphics built using GeoGebra and imported into eXe through Java applets,

and the final content available on the Moodle platform. The fifth section will focus on the pedagogical work of teachers through the use of digital content. Finally, the sixth section will be carried out other conclusions, showing prospects and difficulties of using GeoGebra and eXe Learning for building material for teaching physics and mathematics.

2Educational digital and their specific requirements

It is understood as educational content all the information and / or activity necessary for a student reaches a goal previously proposed for learning a concept or skill. Such content can have different forms, such as a learning object (LO), but they are usually digital and are characterized by the reuse in their various contexts, in order to facilitate the acquisition of knowledge.

For a content to be recovered and reused it needs to be properly indexed (completion of metadata) and stored in a repository. These metadata standards include a minimum set of attributes needed to allow these objects to be managed, located and evaluated. According to [7], currently there are several specifications that regulate the development of objects and the main the Instructional Management System (IMS) Learning Design, Object Sharable Content Reference Model (SCORM) and Aviation Industry CBT (Computer-Based Training) Committee (AICC).

To [8], the digital educational content has the following characteristics: (a) Interoperability: content from multiple vendors can be easily disseminated among consumers and a multitude of systems. (b) Reusability: the content and codes can be packed and unpacked quickly and easily. (c) Manageability: The system can track the appropriate information about the student and content. (d) Accessibility: You can access the right content at the right time and at right way. The content repositories are developed and made available to the student based on common standards. (e) Durability: the content is produced once and inserted several times on different platforms and systems with a minimum of effort. (f) Scalability: learning technologies may have expanded its functionality to meet the different public and educational purposes. In addition to these features, a digital educational content should be freely and openly[9]. The content can be produced and subsequently transported to the virtual learning environment which will be used, with minimized efforts for adaptation and configuration of activities[10].

The authors believe that the digital educational content for Mathematics and Physics must have some specific requirements such as:

21 Strong content: full content, which corroborates student learning. Presented in a sequence from simple to more complex [11].

22Illustrated Content: Content is not limited to text, but is illustrated with figures (tables or graphs), videos or other tool that shows the student what is written in the text, facilitating learning.

23 Treatment and Conversion of equations: Equations are open sentences expressed by an equality involving mathematical expressions, which are used to solve problems. An equation consists of unknowns and coefficients, which are mathematical entities known. To apply this method of solving problem situations you must follow these steps: remove important data to solve the problem, identifying what is the unknown, or what the problem wants to find out, identifying the mathematical operations involved; mount equation, solve the equation found, obtaining the value of the unknown; verify the equation if the value found is correct and show the significance of this result.

According to [12] should pay attention to two types of transformations that are totally different, and that is fundamental to the process of teaching and learning of equations: the treatments and conversions. When a student is solving an equation and he writes equivalent equations to find the value of the unknown, he is performing a treatment. When a student becomes a problem situation, given in natural language to algebraic language, he is performing a conversion. For mathematical conversions are only important when choosing the best record, in which the treatments are made more efficient. As for the teaching and learning is much more important to consider the conversion of the treatments, because this is when the student needs to mobilize the necessary mechanisms for understanding the mathematical object in question.

24 Dynamic Simulations: are used to simulate and illustrate a theme. Simulations can give life to abstractions of the sciences. They can be a learning object built as applets, as in this article. Applets are interactive programs written in Java and can run on any browser or another Java application. They are able to simulate real life experiences, allowing the change of parameters and comparison and verification of results [13 and 14]. The use of applets provides a better representation for the explanation of a concept, when compared to static pictures or a textual description [15].

25 Studying varied to problem solving: A mathematical problem is any situation that requires a mathematical way of thinking of the individual and mathematical knowledge to solve it. There are software programs that solve specific problems such as geometry, CABRI, MAPLE, Mathematica, Cinderella, Curve Expert, Dr GEO; Euklid; Descriptive Geometry: Geoplan; ruler and compass; functions: GraphEquation; GraphMatica; MathGV; Modellus; RATS; VRUM-VRUM; Winplot; algebra: WinMate. Some systems, such as WebQuest, eXe Learning, NAVI, are used as authoring tool for creating any type of content.

3Virtual Environments Authoring

The expansion of the use of Virtual Environments Author (AVAut) provided more interaction and facilities for the teacher to create content and / or view applications made in proprietary or free. The Free Software Foundation defines free software when it can

be executed, copied, distributed, studied, or even modified and improved by the User. Already proprietary software is software that can not be redistributed or modified without permission from the company or person who did. Some of the best known proprietary software are Microsoft Windows, RealPlayer, Adobe Photoshop, Mac OS, WinZip, some versions of UNIX, and others.

The AVAut allow the inclusion of animations, simulations, images, formulas, among others, which helps in the process of teaching to facilitate learning. In a survey of teachers of Mathematics and Physics, and each teacher can work with more than one software, [16] claim that 71% use the software Cabri and Excel, 43% GraphMatica, 29% Tangram and Winplot, 14% Maple and Poly, and only 7% GeoGebra, WinMate and Shapari. The authors noted that the software Slogo and Tess, although available in schools, were not used by teachers who participated in the survey.

As in section four will be shown two activities using the software eXe Learning and GeoGebra, then they will be respected and shown the main tools used in this article.

3.1 The eXe Learning

The eXe (eLearning XHTML editor) is an authoring program, where teachers can develop and publish learning materials without the need for expertise in programming language [6]. This tool allows you to publish online content on several platforms, for example, in Moodle. The portability of this tool to the extreme of not requiring the installation of software, since it can take a portable version of eXe software on a USB (or other removable storage medium).

With eXe teacher can develop content or projects, in a structure of nodes. At the main node can be connected to several other nodes in the form of section and sub-section. Each part of a project may correspond to a iDevice, which must first be saved as a file .elp (elearning package). After finishing the project, the resources created using eXe can be exported in formats of IMS Content Package, IMS Common Cartridge format, single page web sites, web self-contained, SCORM 1.2, text file or group of notes to iPod. The IMS and SCORM formats can be inserted in virtual learning environments like Moodle, and need not be unpacked. The export of content in HTML format, requires that the resulting compressed file is decompressed after exportation that is on a server.

In software, the mathematical equations are written following some LaTeX commands, which is a set of macros for the word processor (PHP), widely used for the production of texts in mathematics and science because of its high quality printing.

3.2 The free software GeoGebra

GeoGebra is a free software that brings mathematics geometry, algebra and calculus, and the equations and coordinates can be introduced directly into the keyboard [5]. He works with variables linked to numbers, vectors and points to calculate derivatives and integrals of functions and provides a set of commands specific analysis of mathematics, to identify single points of a function, such as roots and ends. It was built in Java and its applets are available on the Internet and can run on Windows, Linux and Macintosh.

It offers three different perspectives of each mathematical object: graphical window, algebraic window and a window of the Spreadsheet. So you can see the mathematical object in three different representations: graphically (as in the case of points, graphs of functions), algebra (such as point coordinates, equations), and cells in a spreadsheet. Each representation of the object to bind the other in a dynamically adaptive to each other and, absorbing the changes produced in any one of them.

4 Activities of Physics and Mathematics using GeoGebra and eXe Learning

The authors chose to create learning objects (LO) using open source software in order to show the potential of eXe Learning combined with GeoGebra for building educational content and match it up with practically no cost, making it easier for both the teacher and for the institution. It created an LO using eXe Learning importing the graphics by Java applets, which was built using the GeoGebra, showing that content in Moodle is imported it to the SCORM standard.

4.1 Applications of successive derivatives

The successive derivatives are great tools for calculating points of maximum, minimum and inflection, especially in very complex equations, which makes the viewing geometry. They are also used to analyze the growth and concavity of a polynomial function.

4.1.1 Objectives: (1) Study the criteria under maximum, minimum and inflection of a polynomial function. (2) Review the criteria of growth and concavity of a polynomial function. (3) Show the graph of the polynomial and the derivatives of first and second order. (4) Show the graph points maximum, minimum and inflection.

4.1.2 Prerequisite: (a) basic mathematics. (b) Calculation: limits and derivatives.

4.1.3 Criteria points of maximum, minimum and inflection: In mathematics, the criteria for the points of maximum and minimum growth of a polynomial function are given a function f(x) and a point b such that

(a) if f'(x)>0 for all x belongs]a,b[,
(b)f'(x)<0 for all x belongs]b,c[and
(c)f(x) is continuous in b, then b is maximum point.
(a)If f'(x)<0 for all x belongs to]a,b[,
(b)f' (x)> 0 for all x belongs to]b,c[,
(c)f(x) is continuous at b, then b is the minimum point.
If f'(x)> 0 for all x belongs to]a,b[, then f is strictly increasing in]a,b[.

If f'(x)<0 for all x belongs]b,c[, then f is strictly decreasing in]b,c[.
The criteria for the point of inflection and concavity of a polynomial function are given a function f(x) and a point b such that
(a) if f''(x)>0 for all x belongs to]a,b[, then f is concave upward in that interval.
(b)If f''(x)<0 for all x belongs]b,c[, then f is concave side down in that range.
(c)If f''(x) has different signs in the intervals]a,b[and]b,c[, then b is a point of inflection (changes concavity).

41.4 Example: Check the growth of the function $y=x^3-3x^2+4$, showing the point of maximum or minimum. Analyze the concavity and the inflection point. No software GeoGebra, the following steps: the algebraic window, enter the function $y=x^3-3x^2+4$ and press Enter, which will free the object.

To calculate and show the derivatives: insert in the algebra window commands: Derivative [f] and Derivative [f,2], after press Enter. The derivatives depend on the function and therefore are dependent objects in GeoGebra, being represented by the graph of quadratic function (first derivative) and linear function (derived from second order).

GeoGebra to investigate roots, local extrema and inflection points of polynomial functions. For this to occur, insert in input field the following commands and press Enter after each command: E=Extreme [f], I=PontoDeInflexão [f], R=Root [f] .

These commands calculate the extreme points, that is, maximum, minimum, inflection point and the roots. Automatically appears in the window geometric points on the figures of the polynomial and its derivatives. All this activity for the application of successive derivatives described here was created in eXe Learning, and the graphics have been imported from GeoGebra, using Java applets, as appears of Figure 1.

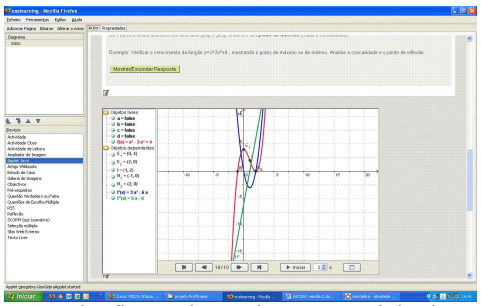

Figure 1 - The figure shows the same activity imported by eXe Learning, the use of Java applets.

41.5Analysis of results: The graph polynomial f(x) has the extreme points $E_1(0,4)$, the peak and $E_2(2,0)$, which is the minimum point. The function f(x) is increasing when x<0 or x>2 and decreasing when 0<x<2. You can do this study through the derivative of first order (quadratic function), where f'(x)>0 in the intervals x<0 or x>2 and f' (x)<0 in the range 0<x<2. The point where the function change of concavity, the inflection point is given by the point I(1,2). This condition can be seen the derivative of second order (linear function), which is positive in the range x>1 and is negative at x<1, and the concave up when x>1 and down, when x<1. The figure below also shows the points where the function f(x) cuts the x-axis, which are the roots of this function, in this case R1(-1,0) and R2(2,0), respectively.

This activity in eXe Learning was exported with the SCORM to Moodle, for it is there that the student will see this content. The student sees the activity as shown in Figure 2.

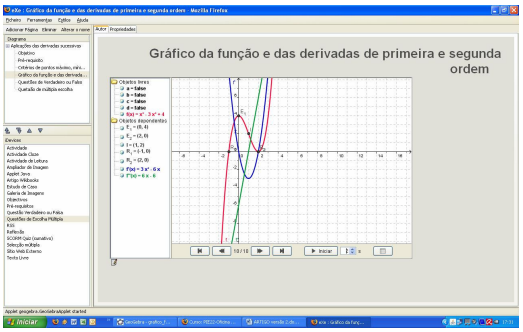

Figure 2 - Presentation of mathematical activity in Moodle.

42 Physical Activity - Implementation of uniform rectilinear motion (URM)
The uniform rectilinear motion (URM) is a movement whose speed is constant and whose graph is a straight line.

421 Objectives: (1)Identify the types of motion (progressive and retrograde). (2)Check graphically the types of movement. (3)Examine graphically the point and moment of encounter of two mobile.

422 Prerequisite: (a)Cartesian coordinates. (b)Straight ascending and descending.

423 Problematizing the URM: Constantly students have difficulties in solving problems that are of more than one speed, that is, appears more than one object to be analyzed. Given this, we elaborated a problem that involves two objects and uses the Geogebra to its resolution.

424 Example: Two cars travel in the same path and the distances are measured from a common origin. One of the cars start the position 3m with progressive movement whose speed is 2m/s, while the other start of the 6m position and its motion is retrograde speed 1m/s. Question is: what is the time of the meeting of the cars and their position?

425Answer: In the input algebraic software GeoGebra is part of the equations of motion of slot cars. Initially Geogebra presented as Cartesian coordinates x and y, need to be renamed to set, according to the nomenclature used in physics.

The scheduling functions used in this example were: S1: y=2x+3 and S2: y=- x+6, as depicted in Figure 3.

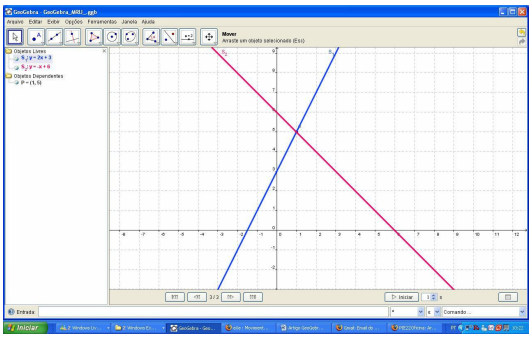

Figure 3-Presentation of the activity of Physics in software GeoGebra.

4.2.6 Analysis of results: Through the chart, one can see that the line that describes the trajectory of the progressive movement (S 1) is increasing and the line that describes the trajectory of the retrograde motion (S 2) is decreasing. Given this, they will intersect at the point x=1 (second) and y=5 (meters). This shows that the moment of meeting the cars are in the same position, regardless of how much each one passed. Therefore, the time of the meeting is the 1st and the second position of the meeting is 5 meters.

5 Teachers and digital content for Physics and Mathematics

The search for motivators that help arouse greater interest and understanding in their disciplines has led teachers to insert the digital content in their teaching.

The digital educational content (EDC) includes all the information necessary for achieving an objective previously proposed to learn a concept or skill. But the EDC does not guarantee the contextualization of the content and nor student learning. It takes planning and study of the object. Therefore, we suggest that teachers explore the materials in advance, consider whether they are compatible with the computer room of the school that serves, finally, plan their lessons, their educational strategy and the feedback activity and that it will ask the students.

When creating and / or reusing the content, the teacher can make use of free distribution of software and easy to use, as GeoGebra and eXe Learning. Thus, the technology can be used as an aid to enrich the lessons innovating didactic and pedagogical activities. According to [17], in the context of the area of logical reasoning and abstract, learning environments created by computer applications can streamline the curricula and enhancing the teaching and learning focused on "trial", with the possibility of the emergence of new concepts and new mathematical and physical theories in order to make it an important allied in the construction of knowledge.

One of the EDC used by teachers are the learning objects (LO). These are digital educational content involving collaborative activities and constructed in accordance with a need, following an object-oriented methodology to facilitate reuse [10]. For them to be reused some authors [10] and [18], suggest the adoption of a standard Sharable Content Object Reference Model (SCORM) making these educational materials available. Its use implies issues such as portability, use and reuse of these materials in different contexts, in person or remotely, and virtual environments.

6 Closing remarks

Today is no longer accepted that a student studies the laws and formulas decoupled from reality, but it should look updated content in context with their day to day. This article showed that the teacher can create educational content using the tools and GeoGebra eXe, which can simulate real phenomena, improving student learning.

It is obviously to replace the problem-solving using mathematical formulas, but also added a new technology that facilitates the learning process, which contributes to a better understanding of the concepts studied in physics and mathematics, making these subjects less exclusive and boring.

Using these tools, even simple for the Common User requires of teachers a minimum knowledge of programming language, allowing it to leverage its use and adapt the content for the student.

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Exploiting augmented reality based technology for contextualized experiential and authentic learning in mainstream schools - A dream or a reality?

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ABSTRACT

Contextualized experiential and authentic learning can be situated within augmented-reality (AR)-enhanced learning environments involving inter-disciplinary academic domains such as physical education, physics, mathematics and biology. However, AR technology-based learning tools are mainly exploited in tertiary institutions such as universities and polytechnics as they are costly and sometimes bulky. A national initiative funded by the National Research Foundation (Singapore) has made the development of such a tool affordable and mobile. This tool has the ability to automatically analyze physical scenes captured by video devices in terms of kinematic characteristics. Essentially, multiple segments/rigid bodies can be tracked automatically. Thus, mainstream schools now have the opportunity to exploit this AR technology-based scaffolding learning tool in an inquiry-based learning environment as it (the tool) potentially frees up more time (as compared to traditionally available frame-by-frame multiple-mouse-clicking video analysis tools for mainstream schools) for more questions to be asked and options to be explored during empowered self-directed learning sessions. Practical examples are highlighted in adapting these AR scaffold learning tools for activities in physics and physical education in the hope that the readers can perceive the potential pervasive exploitation of these tools in a multiple disciplinary learning space beyond the two mentioned subjects situated in mainstream school as well as tertiary education.

Keywords: Augmented reality, Authentic, Interdisciplinary, Experiential and Scaffolding.

1. INTRODUCTION

In traditional physics lessons, it is typical that problems be given to students in class, or as homework assignments, and again in tests that require students to calculate a precise quantitative solution (Briscoe & Prayaga, 2004). When solving these problems, students tend to focus on finding the right equations, manipulating them, and calculating an answer (Redish, Saul, & Steinberg, 1998). The focus on equations and calculations often results in students failing to understand the deeper conceptual relationships present in the problems, which encourages poor problem-solving strategies (e.g. Larkin, McDermott, Simon, & Simon, 1980).

Although various efforts have been successful in improving student motivation, problem solving, and achievement when compared to traditional physics instruction, many researchers feel that the context in such approaches remains implicit (see Finkelstein, 2005; Glynn & Koballa, 2005). Although students may become more reflective, active, and involved in what they are learning, they may still not have an understanding of how they can apply their newly learned skills and knowledge outside of the classroom, limiting the authenticity of instruction. For this reason, it is expected that contextualizing instruction so that it is applicable to students' everyday lives is a much more effective way to improve student motivation, understanding, and achievement (Glynn & Koballa, 2005).

2. A CASE FOR INTER-DISCIPLINARY AND EXPERIENTIAL LEARNING IN PHYSICS?

Additionally, the learning of academic subjects such as physics, mathematics, biology, physical education and the coaching of sports skills are usually taught predominantly within each discipline's domain. There are common inter-related concepts like mechanics in physics, mensuration in mathematics, kinesiology in biology and simple technique analysis in physical education or sports coaching which can be learnt within a common educational framework. The relevant connectedness between these academic and sports coaching domains are usually not perceived by the learner. To develop the holistic thinking student, one of the potential strategies is to have the connectedness between these domains, which forms a significant part of formal main stream school curriculum, located within the learner. The learning of interdisciplinary academic concepts, incorporating experiential physical activities in realistic conditions, provides a potential platform for establishing the connectedness. Traditional classroom or laboratory strategies have their limitations in that the concepts taught are usually not fully contextualized to real situations involving actual activities. Therefore, this may not facilitate deep learning. However, through interactive digital media (IDM) technology, we may now have a very attractive learning tool to address this problem by providing contextualized augmented feedback, infused with interdisciplinary information, in activities performed in real settings. Such situations and activities are best facilitated using imaging technologies. Objective and augmented feedback through interactive video-based approaches using augmented reality (AR) technologies, where virtual objects such as pictures, tables and graphs can be displayed and be interacted in a real environment, may be used to enhance the teaching and learning processes (see Kaufman, 2004). For example, a class of students may analyze their classmate performing a golf club swinging action where this performance, captured with video devices, is play-backed real-time on a display screen augmented with feedback on the musculoskeletal structures that are involved as well as speed of the golf club displayed in digital and graphical format on the screen. The action can be 'freezed', played forward and backwards in fast and

slow motion at the will of the students analyzing the context of golf, the anatomical structures (eg. prime movers and synergists) involved that control the movement (eg. speed and acceleration) of the club head as well as

3. SCAFFOLDS IN TECHNOLOGY-BASED CONTEXTUALIZED EXPERIENTIAL LEARNING

The importance of learning incorporating scaffolds has been emphasised by Bottge and colleagues (2009). In a technology-supported environment, students may potentially make use of four kinds of scaffolds: (a) conceptual, (b) metacognitive, (c) procedural, and (d) strategic (see Hannafin et al., 1999). Conceptual scaffolds help students determine what to consider when solving a problem, metacognitive scaffolds support students' self-regulation or self-management, procedural scaffolds assist students with learning how to use resources or tools built into an environment, and strategic scaffolds help make students aware of different approaches and techniques for solving problems (see Brush & Saye, 2001). Thus, using the above golf example again, the students may choose to use technology-based AR learning tools to look at the problem from a mathematical and/or physics perspective (conceptual). The learning tools available are just merely tools but the students will have to learn to use them in the right context and optimal combinations to solve the problem, say, 'How to improve the golf swing' (procedural). With the advancement in technology, the students can appreciate the various protocols available at their disposal for analysis in groups or as individuals and even deliberate on the equipment setup; indoors or outdoors (strategic). Throughout the analysis, they can reflect and examine on their learning processes and experiences at various intervals (metacognition) before proceeding further.

Taasoobshirazi and Martha Carr (2008) stated the need for contextualised learning in physics. Additionally, the reasoning process is another important element in inquiry-based learning. Learning in such an environment is no longer as simple as fact-collecting. Instead, inquiry-based learners have to engage in inquiry processes in which critical and creative thinking skills are the key for the learners to accomplish the problem solving tasks imposed upon them (Hung, 2009).

Using IDM in learning within a common theme may involve various inter-related academic disciplines. For example, in the example of the golf swing, the angles, speed, time concepts in mathematics can be explored together with physics principles like kinetic energy, potential energy and momentum under the domain of skills acquisition or physiology focusing on the musculoskeletal forces and moment arms. Also, these concepts can be taught experientially whilst the students actually perform the swing in actual realistic environment. Benefits of experiential and interdisciplinary learning environment using IDM has been described (Jarmon et al., 2009).

Additionally, as computing hardware—both wired and wireless—approaches ubiquity, new opportunities emerge to use technology to enrich individuals' experiences of objects and places. Because all areas of academic inquiry potentially benefit from background and context, AR has

performance. They will be able to investigate, in the evaluating the interplay between the different energy systems (eg. kinetic, potential energy and total energy).

the possibility of enhancing education across the curriculum. By holistically exposing students to an experiential, explorative, and authentic model of learning early in their education experience, AR has the potential to help shift modes of learning from students' simply being recipients of content to their taking an active role in gathering and processing information, thereby creating effective knowledge (Educause Learning Initiative, 2005).

Thus, there is a potential need for the use of a scaffolding learning tool in a contextualized inquiry-based learning that encourages experiential, realistic and interdisciplinary learning. Within the framework of a typical academic curriculum like in Singapore, the many activities within a physical education curriculum can present themselves as contextualized topics for learning. How can we improve our run or jump? How can we smash (in racket games) more effectively? Is energy conserved when we are performing a high jump? How can we field more effectively in fielding and batting games? How can we drive a golf club optimally? The activities can be performed by the students themselves and captured in video formatted scenes for immediate analysis and learning evoking, arguably, the experiential and authentic 'Kodak moment'. Potentially, these activities allow simultaneous learning opportunities in physics, mathematics, biology and physical education. The students can investigate the major muscle groups that control the physical movements which can be examined using mathematical concepts in time, distance, speed and angles using, say, motion tracking devices. Logical associations can be made with kinematics and energy systems in physics topics such as the velocity, potential and kinetic energy of the centre of mass. All these can be fused together to give a better understanding of executing fundamental movements such as jumping, running and smashing (in racket games) within the physical education curriculum. In fact, such learning opportunities are pervasive in learning sessions within the discipline of Sports Biomechanics (see Hamill & Knutzen, 2003) as the discipline is fundamentally underpinned by concepts from the mentioned core academic topics. Such lesson typically involves sophisticated equipment setups and arguably, predominantly students from tertiary or specialized institutions have the opportunity to experience such an innovative contextualized learning environment (Ong & Ho, 2006). The equipment used are costly and bulky rendering the deployment of such technological infrastructure in main stream school a challenge. A, seemingly far-fetched, suggestion may be to converge this equipment into something mobile and affordable so that main stream schools may have the opportunities to be immersed in such learning activities. In fact, a project has been initiated and funded by the National Research Foundation in Singapore where two neighborhood schools (one primary and one secondary) are being piloted. In this project, a learning tool is developed to effectively and automatically track any moving object/s in 2D space as well as computing and displaying the instantaneous time, distance, speed, displacement, velocity and angles in digital or graphical format augmented in real scenes as captured by video devices (see Figure 1).

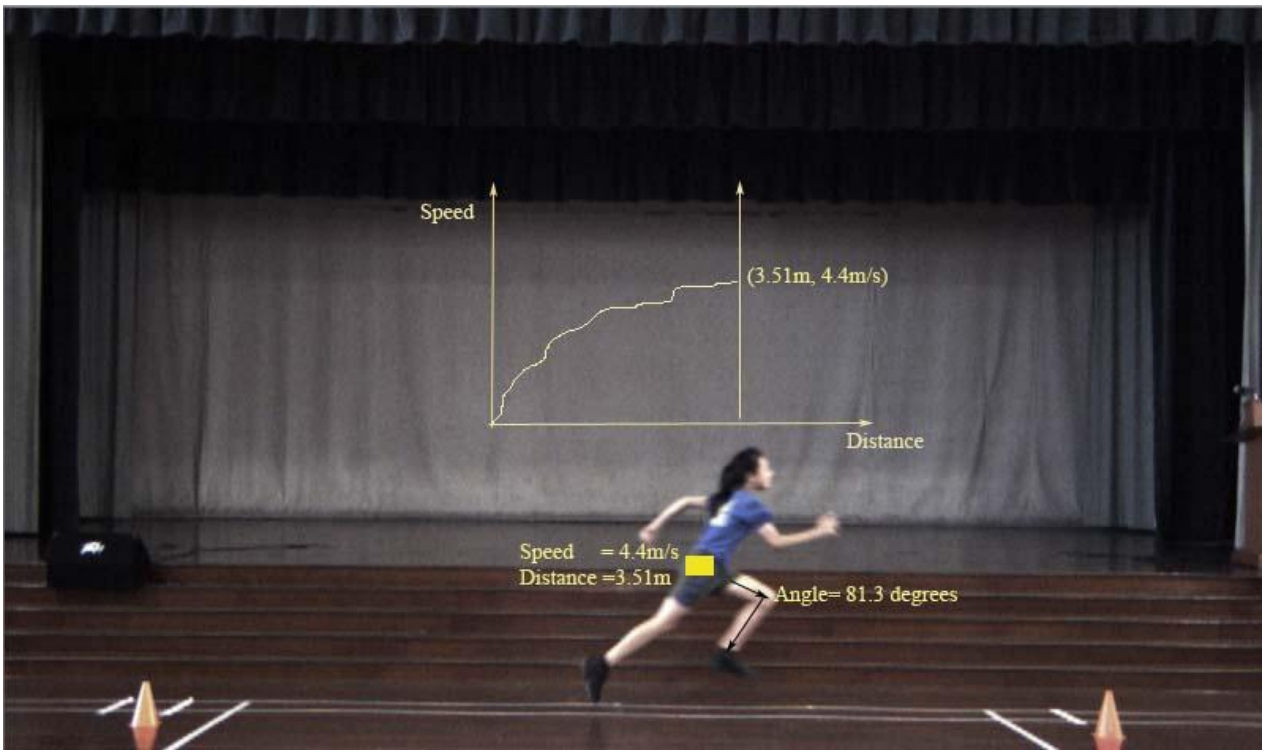

Figure 1. A student running across hall with speed, angle and time displayed digitally and graphically; automatically frame by frame. The scene can be captured by a video device. The kinematic tracking, is performed on the right hip (yellow box) and the angle tracking is focused on the left knee (intersection between the two black lines).

4. A SCAFFOLD LEARNING TOOL USING AUGMENTED REALITY TECHNOLOGIES - A REALITY OR A DREAM?

Although the abovementioned AR tool is limited to observable and measureable activities (as it tracks what is visible), there are numerous opportunities to exploit it. For instance, through a simple ball tossing and catching activity (in hand-eye coordination) where students, say, will not only get feedback on the vertical displacement and the velocity of the centre of mass of the ball but they will also have to calculate the potential energy and kinetic energy as well as the total energy by means of an MS EXCEL spreadsheet that incorporates the data that is derived from the video analysis. In so doing, they will be actively involved in the learning process (through calculation of the energy quantities) as well as receiving augmented feedback on selected information such as the displacement and the velocity. Through this, the students will potentially and simultaneously incorporate knowledge from mathematics, physics, information technology (IT) that is realistic and experiential in the context of a throw-and-catch activity. This is in contrast to a worked problem from a textbook or a flash-based simulated programme such as a trajectory of a missile (see http://www.math.tamu.edu/~dallen/physics/).

Consider another example, that of a physical education lesson. Through the AR technology, students will be able to track themselves running across a field or hall and derive their speeds, distances and times to be displayed automatically on the computer screen (see Figure 1) to enable comparisons to take place. With the given information, students may plot 'distance vs time' graphs, derive their speed of movement over various sections of the run and consider where they may improve on their performances. Additionally, the teacher may introduce concepts of angles of depressions/elevations for further analysis to consider the angular relationship with the projection of the takeoff in the run. Extending further from these learning opportunities, deep and inquiry-based learning can take place using the scaffolding educational tool to solve a simple contextualised problem such as "how can I run faster?" The experienced teacher will be able to suggest meaningful combinations of activities to facilitate deeper learning.

Thus far, the above-mentioned participating piloted primary and secondary schools are positive and have indicated their desire to integrate the AR tools into their curriculum in the following year. Throughout the piloting experience, we have learnt that the schools have indicated two key themes for discussion: Conceptual and Instrumental learning.

5. CONCEPTUAL AND INSTRUMENTAL LEARNING REVISITED IN PHYSICS

Conceptual understanding implies knowledge of the idea, how it relates to already acquired ideas, the contexts in which it is applicable and its limitations (McIntosh, 2002).

Skemp (1978) described it as 'relational understanding' in that one knows "both what to do and why" (p. 9). He differentiated between this and 'instrumental understanding' which he described as 'rules without reasons' (p. 9).

A perennial problem is that the end product for students (and a measure of their teacher's success) is often an externally set assessment which focuses on the doing, and less so on the conceptual understanding and broader perspective. These problems are often reinforced by typical assessment questions that ask students to 'solve, sketch, find, graph, evaluate, determine, differentiate, integrate', etc (see Ferrini-Mundy & Guether-Graham, 1991). With the availability of technology (graphical calculators, data logging equipment, computer algebra systems), there is the opportunity to free students from the drudgery of algebraic manipulation and calculation by supporting the learning of fundamental ideas. Koirala (1997) sets the teaching of calculus for students' conceptual understanding in the framework of Skemp's (1976) instrumental and relational understanding. Students can do well on traditional examinations and in an environment of international comparisons and short modular courses, such an approach appears successful to the teacher, learner, government and educational authorities. Teaching that develops relational understanding not only provides students with knowledge of what to do and how to do it, but they can also explain what they are doing and why. Students can demonstrate an understanding of the concepts underlying the rules. Koirala prefers to call this conceptual understanding. Schwalbach and Dosemagen (2000) reported on the practice of one high school teacher who provided students with concrete examples from their physics class to give them a contextually rich environment in which to explore the abstraction of calculus. They made use of data logging equipment and graphic calculators to provide an environment to explore displacement–time, velocity–time and acceleration–time graphs. The authors commented that many calculus students are gifted in mathematics yet rely on memorising formulas and applying them in rote manner. Their study suggests that making connections for students between disciplines, in this case mathematics and science, can develop richer understandings of semantic (knowing facts and concepts and how they connect) as well as procedural knowledge.

6. REAL-LIFE IMPLEMENTATION

The big question is always, "Will it work at the ground?" Here we will describe more specific applications using the scaffold learning tool within a school setting. In schools, arguably, the primary concern is to ascertain if such pedagogical scaffold tools do indeed improve academic results in addition, to enhancing higher levels of learning. We did a pilot study in a secondary school on two classes (1 experimental and 1 control), where the students were mainly mixed fifteen year olds, in physics. The experimental class essentially used the above-mentioned scaffold learning tool to facilitate the understanding of energy systems using a real person performing a vertical sargent jump as well as a tennis ball dropped from head height. A pre-test and post-test was conducted. In the main, no significant difference was found ($p>0.01$). The questions were a mixture of conceptual with predominantly instrumental-learning-based calculation-typed ones. However, there were 2 conceptual questions where one derived almost 1.6 times more correct responses from the experimental group. As this was just one question and the other did not show any marked difference, no statistical conclusion can be stated. However, it must be noted that contextualised studies in physics have mixed conclusions as mentioned earlier and the criticisms are mainly on the methodology such as non-standardised tests, small sample size and no control group being used (see Taasoobshirazi & Carr, 2008). These results can only be interpreted within their contextualised settings. To address such concerns requires significant resources and may not be practical. In fact, there are many practitioners who advocate interpreting learning experiences situated within contextualised environment.

The AR tool acts as a scaffold for learning by measuring authentic real-life physical performances, augmenting feedback in acceleration, velocity/speed angles, timings and distances/displacements. It therefore encourages inquiry as the students can now search and discuss for inter-connections of the relationships of known measured quantities and published knowledge. They can formulate their own conclusions, derive recommendations (and testing their recommendations) and rationalise future studies. Incidentally, scientific inquiry is explicitly defined and described in the Singapore's science curriculum (see http: //www.moe.edu.sg /education/syllabuses/sciences/). Thus, this experience in learning may be seen in the context of health and fitness lifestyle activities within physical education curriculum where the pedagogical framework is embraced within the Singapore science curriculum (see http://www.moe.edu.sg/education/syllabuses/sciences/).
Additionally, within the science inquiry-based learning, it encourages students to see activities as inter-connected. Similar, philosophy is stated in the mathematics and physical education curriculum (see http://www.moe.edu.sg/education/syllabuses/). The broad spectrum of activities essentially involve concepts found in Singapore national curriculum concepts such as time, distance, speed, angles, energy, kinematics, mechanics and moments from upper primary to 'A' levels as well as tertiary level. The problem can be 'How can I improve my performance in a meaningful activity'. Thus, at primary level, students may be involved in simple vertical jumping activities where the scaffolding tool facilitates learning activities that measures the maximum height jumped, speed at lift-off and angles at the knee joint. At secondary level, students may investigate the standing forward jump, where they may measure the trajectory variables such as velocity, height and elevation angle at take-off en-route to solving the problem. At tertiary level, the students may investigate the relationship between take-off and landing strategies such as the coordination of the hip, knee and ankle angles over time during the process to solve the research question. Such activities may be standalone to sum up a topical concept or they may allow progressive learning that is constructive and spiral such as the learning of time,

distance, speed and then acceleration concepts in a chronological sequence.

These possibilities are typically shared with teachers in the participating piloting schools. The breadth (as in the wide spectrum of activities within the physical education and beyond as well as the many concepts within the science and mathematics syllabus) as well as the depth (in terms of the concurrent inter-disciplinary learning opportunities using of physics, mathematics, and physical education concepts) will be impressed upon them. Ultimately, they are left to decide upon how they may want to proceed. These schools have shown great interest in wanting to implement this AR tool into their curriculum. They have requested for more features and have initiated meetings with the developers. However, there have been concerns in that there are similar software modules commercially available. In mainstream school education, there is java or flash-based simulation software but not real-life video based software. Non-video-based simulated software modules allow limited scenarios and it requires the developers to laboriously write the scripts to simulate the various new situations. Video-based ones potentially capture almost any observable situation to be analyzed authentically (not simulated) once downloaded to the laptop or computer.

Thus, based on my experience during the piloting process while interacting with the various stakeholders such as the students, teachers, principals and parents, to see a pervasive integration into main-stream schools, the breadth and depth as well as where in particular the national academic curriculum can be specifically situated, must be impressed, at a level relevant, upon them. However, the exact execution will have to be left to the customization of each school as the implementation must be contextualized and situated at each location. Only those at the ground will have the ability to adopt and adapt the pedagogical changes more effectively. Additionally, as the principals of each school is the gate-keeper of pedagogical policies and changes, they must first be convinced that this AR scaffold learning tool is beneficial and can value-add to the student's learning as compared to other time-tested traditional pedagogical methods. There are principals who explicitly state that they will like to hop on this bandwagon much later. For those who are keen to hop on immediately, the implementation and adaptation in the schools were swift and the results were positive. This, in my opinion, is due largely to the fact that the earlier-described AR learning tool was built from scratch to be user-friendly and contextualized to be situated within mainstream academic curriculum interacting with students who are novices as well as conversant with digital media technologies.

7. CONCLUSION

From the Singapore experience, AR is an ally to facilitate conceptual learning in physics and potentially in inter-disciplinary learning within in mathematics, physics and IT domains in contextualised situations derived from the PE curriculum. It goes beyond standardised testings (which are just tools to inform us). In reality, schools at the ground, arguably, see the value of such a scaffold and today's technology allows such affordable and mobile scaffold learning tools to be situated in main stream classroom from primary to tertiary levels. This is becoming a reality but more studies are needed to provide better in-depth insights to various contextualised learning environment using these AR learning scaffold tools in main stream education.

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Thinking About ALASKA Technology Leads to Thinking about Student Learning: A Professional Development for Algebra Teachers

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ABSTRACT

Teacher creativity is a untapped resource in K-12 education. In classrooms across the nation, teachers teach a curriculum designed by publishers of textbooks. With this current method, teachers lose their identity in a prescribed pedagogical framework. ALASKA, a classroom technology infrastructure and teacher-created digital content library allow teachers to create their own content, collaborate with colleagues, and have students engage in the digital media. This study details the implementation of ALASKA and the teacher professional development component of ALASKA called PREDICATE into an urban high school's Algebra I classes. This study provides insight into the curriculum planning teachers experience while implementing the ALASKA project. Learning engagement is also reported and provides insight into the potential ALASKA can bring into the K-12 schools.

INTRODUCTION

This paper describes the implementation of a technology program into three Algebra I classes. Included in the technology program is a professional development component for three novice high school algebra teachers entitled "Preparing Digital Libraries for Customized Access to Educational Experience" (PREDICATE). The professional development is part of the larger project, "Agent and Library Augmented Shared Knowledge Areas, or ALASKA.

ALASKA is an instructional support platform that integrates four distinct technologies: collaborative workspaces, pedagogical agents, learning object libraries, and Tablet computers that permit handwritten activity. ALASKA operates with the premise that ALASKA can a) provide students more fluid and realistic access to a greater array of instructional scaffolds; b) have faster access to the teacher when desired or when the other scaffolds are not effective; c) secure the learning benefits from helping peers; and d) secure the learning benefits of being helped by peers. The project is currently being implemented in a large urban Southern California high school.

Problem

Professional development emphasizing teacher creativity with digital media in mathematics education is new largely for two reasons. The first is that lay-person tools for production of sophisticated digital media have only recently emerged. Teacher authoring of digital content for classroom use has been an elusive goal for years. The notion of teachers creating content has encountered numerous obstacles related to the limitations of teachers' time and technical requirements (DiGiano, Chung, et al., 2002; DiGiano, Yarnall, et al., 2002). Second, such tools specifically entail producing supplementary curriculum content, in formal learning environments where teachers are not expected to be content producers but rather are content conveyors, disseminating knowledge and following pre-defined curriculum in preparation for accountability tests. Mathematics and science teachers simply are not expected to be creative.

At least, that message comes through loudly when examining state and federal funding programs involving research and innovation in teacher preparation and teacher professional development.

Creativity in education more broadly, of course, is the subject of a broad literature and specialized research journals. There is robust literature on ways to foster creativity in students (e.g., Kaufman & Sternberg, 2006). There is a strand of literature on school and school system administration that explores creativity and flexibility in school leadership (McCallum, 1999; Stoll & Temperley, 2009). And, of course, there is an extensive body of literature and research support (especially from NSF) designed to furnish teachers with creative or innovative instructional activities, materials, or full curricula.

Clearly, there appears to be little or no explicit guidance on helping teachers to function as active and creative agents in the complex enterprise of navigation of mathematical content and student cognition. The same observation holds true for the US Department of Education's professional development research programs (Institute for Education Sciences, 2009), where mention

of nurturing teachers' creativity or their generative abilities is conspicuously absent. An extensive survey of state education agency (SEA) professional development programs in New York, California, Michigan, and Illinois, produces the same finding. Innovation by professional development specialists is sought, as are sound implementation, and efforts to improve the quality of teaching. But we have not found a state educational agency (SEA) that expresses explicit interest in helping science or mathematics teachers function creatively.

Two just-published reports by the National Academy of Education (Kilpatrick, Quinn, Bass, Cobb, Daro, & Gomez, 2009; Wilson, Ball, Bryk, Figlio, Grossman, & Irvine., 2009) that highlight a national agenda in teacher quality and mathematics and science education similarly do not make the leap into identifying or suggesting we draw teachers, their imagination, or their creativity into upgrading mathematics or science education. Yet they do highlight the need for high-quality opportunities for professional growth, the early-career teacher dropout rates, teachers' dissatisfaction and alienation in their profession, and the lack of personal agency teachers cite in criticizing teaching in high-stakes testing environments.

SCOPE AND SEQUENCE OF THE ALASKA PROJECT

This project is supported by the Institute for Education Sciences (IES), emphasizing the development of a classroom communication and collaboration system with peer student tutoring, digital libraries and collaboration with colleagues (Hamilton & Harding, 2008).

ALASKA

ALASKA is the technology that the teachers and students use. It includes the technology hardware and software needed to create virtual collaborative workspaces. The hardware required is tablet computers, one for each student and teacher. This creates the infrastructure needed to create collaborative work groups, peer tutoring, and teacher assistance. The software required is synching software, which allows all of the students and teacher to be networked. Finally, ALASKA includes the digital library created by the teacher.

Technology

This project incorporates technology into public school classrooms to facilitate student learning and professional development for teachers. A goal is to increase students' state mandated test scores while encouraging teacher's creativity and individual pedagogy style. We aim to support teachers' creation of their own content that they can share with colleagues. This study implements technology for students that is teacher designed. The project has two main threads. The first thread is teacher created content. Teacher created content includes designing, developing, and fostering mathematics teachers to create personalized, cumulative digital toolkits of animations, diagrams, videos, and knowledge scaffolds for use in their own classrooms. The second thread looks solely at how that teacher creativity draws can impact learning and teaching. This thread explores the role that creativity can play in higher-level K-12 mathematics and science learning. The personal digital toolkit approach is unique, and provides one possible way to carry out investigations of teacher creativity. The personal digital toolkit allows teachers to have ownership of the content that they teach. The project, however, seeks to challenge mathematics and science educators to research and develop other ways to leverage their untapped potential.

Collaborative Workspaces: This project refers to collaborative spaces as computer screen images that are dynamically edited and shared on both computers simultaneously. In that case, the teacher's screen includes an image of each of the students' screens as thumbnails. The teacher can also isolate a single student's screen, and edit the student's screen or annotate it in real-time.

There are several software systems that can instantiate this shared screen form of collaborative workspaces. In this project, we use the SmartSync system by Smart Technologies, with modifications that we have developed in formulating the ALASKA platform. Additionally, instant messaging systems may be seen as a form of collaborative workspaces, and they play an important role in ALASKA. We originally used a variation of the Microsoft Live Messenger's Software Development Kit (SDK) system because it allows handwritten communication, essential to communicating mathematical ideas rapidly. While it proved effective in the crucial goal of transmitting data packets of handwritten notation necessary for mathematics, the off-the-shelf messaging system proved inadequate for most of the more complex interactional pathways, therefore part of this proposal involves development of a messaging system attuned to ALASKA's instructional processes.

Digital Library: ALASKA involves digital libraries or collections of small videos, diagrams, animations, or widget that are self-contained and can be invoked by a student or teacher (Lee, Prakash, Jaeger, & Wu 1996; Minenko 1998). These programs, or applets, explain, illustrate or simulate mathematical ideas much like concrete manipulatives do. For example, an applet may include a short animation of how to use the substitution methods to solve a system of linear equations. It may ask the user for linear coefficients and then sketch the system, or provide its own coefficients. For the purposes of this project, the library also includes answers to questions that students might ask about mathematical topics. These answers are formulated by a teacher or group of teachers in a school, and they can be any of modes that can be represented by a computing device. For example, they could simply be text answers that are stored either in extended and symbol ASCII form, or they could be symbols and sketches stored in graphics form. A teacher might choose to provide a short explanation to a question by creating a handwritten solution stored digitally that can be played back with audio narrative and timestamps, or a short video of less than a minute in length. The digital library features of ALASKA are client (teacher)-generated, to supplement curriculum materials the school uses and to correspond to the specific standards for which the teacher and school are accountable.

Tablet computers: ALASKA requires a fully functional notebook computer to handle screen sharing, high bandwidth internet access, and the computational demands of a digital library. In order to handle mathematical communication and notation, a pen-based input device is also required. The Microsoft Tablet PC Operating System features normal input methods (keyboard and mouse) but also accepts and processes handwritten input on tablet computers that have become quite reliable in classrooms.

In discussing these three features of the platform's logic model, provides teachers and students with benefits and can eliminate the guesswork for the teacher; to simplify work for the teacher but allow the teacher to function in more challenging ways; and to create usability through flexibility. Each of these is part of a design to nurture adaptive expertise by the teacher, while deepening learning and self-regulatory competence of students.

PREDICATE

The PREDICATE professional development was designed to incorporate current best practices in professional development with the practical experience of the research team. Ball (1996) and Carlson and Gadio (2002), suggest that professional development is effective when teachers' thinking is grounded in their own curriculum and improving the learning for their particular students. At the first PREDICATE meeting, the teachers chose a chapter from their Algebra textbook to use as a starting place for implementing the technology. Garet, Porter, Desimone, Birman, and Yoon (2001), report that professional development projects that use curricula as a starting point are effective in stimulating teachers thinking about learning mathematics. We found this to be true for the teachers in this project. They are under the pressures of high stakes testing and very committed to completing required curriculum material.

Part of the educational significance of ALASKA and the PREDICATE professional development, is to expand teacher's usable understanding the connections between content and student learning by helping to organize and create digital content to scaffold the student's learning in their classes. A second related dimension is in developing a system that promotes development of adaptive expertise by both teachers and students. By doing both of these, greater reflection is used by both subjects to make learning and teaching more personal. Creativity of the content allows teachers to not become stagnant in teaching the same content from a textbook year after year. Instead, they are provided the means to delve into a topic more deeply or teach something that they are passionate about.

The first step in the PREDICATE professional development was a week-long in-service for three novice teachers. The teachers were recommended for the project by the school's curriculum coordinator. The grant implementation takes place at a 4,000 student urban high school in Southern California. The PREDICATE professional development began in August 2008. The purpose of the weeklong in-service was to introduce Algebra I teachers to the grant, the technology and the types of digital media that they could create for their students. The three participating teachers teach Algebra I at least twice a day.

The broad goals of this August Workshop were to increase participants understanding of the grant, and introduce them to content building techniques via Camtasia Studio, Video production, and web-based content. Camtasia Studio is a screen capture software; for example, teachers can record themselves solving a math equation on the computer screen. The anticipated tasks included, choosing one Algebra Unit as a focus for starting this work and where they could incorporate the use of the tablets the content that they created.

Participants

There a three participants in the project. Teacher One, is just 22 years old. He has been teaching two years. He is very eager about the project and has an instinctive understanding of the technology. He has no problem visualizing how it will work. Teacher Two, has been teaching about 5 years. He is very confident about his skills. He is happy to be participating, but has a healthy skepticism about how all of this will work. Teacher 3, is a change of career teacher. This is his second year of teaching. He is eager to participate and to date, he seems most comfortable creating content, but is reluctant to give up class time unless he is certain students can learn using the program.

YEAR ONE IMPLEMENTATION: AUGUST WORKSHOP

Day one

First the teachers read the grant and we did a short question and answer session. Then we discussed creating the digital library. Teachers were asked to think about the type of mathematical scaffolds that their students need. Melville and Wallace (2007) suggest that professional development should be based on enhancing the in-depth content knowledge and instructional knowledge of teachers. Teachers used a chapter of their mathematics text to think about the instructional challenges that they face with their students. They also analyzed examples of student work from higher and lower achieving students to determine the types of scaffolds that they would want to develop (Putnam, and Borko, 2000).

It was clear from teacher conversation that many of their Algebra I students come to them with little prior knowledge about algebra. Some students lack basic skills in multiplication and fractions. Since the technology provides the opportunity for teachers to develop digital scaffolds, it appeared that this could serve the teachers' objective to meet the needs of a wider range of students. One of the teacher's first decisions was to create a glossary of mathematical terms because students need to understand the language of Algebra. This digital glossary could start with terms that they found in the textbook and grow according to students' needs. Another topic that surfaced when talking about the lower achieving students was motivation. Teachers wondered whether the digital scaffolds that they created would help to motivate students who were only taking the class because it is a state requirement for graduation. They discussed finding web-based content that might catch and sustain students' attention.

Day Two

Teachers were excited to begin to play with Camtasia and explore web-based content. They spent time in the morning creating a rubric for evaluating web-based content so that there would be a consistent standard in what was included in the digital library. Learning to use Camtasia proved to be harder than anticipated, and created digital media was a slow process. However, a significant piece of educational pedagogy arose out of this struggle. What is the connection between the speed that digital content runs and student understanding? When creating the Camtasia video teachers played with the timing of their *voice over* and the images that the students saw on the screen. Teachers talked about how much time some students need to understand what they hear. They explored ways to repeat crucial pieces of information and create playback opportunities for students. As Scrimshaw (2004), suggests, using technology can identify promote teachers' implementing a 'student-centered' approach to learning. While the three teachers were talking about time, it was clear that they had different philosophies and they seemed eager to talk with each other about this. One important goal for the in-service is teachers' cognitive development around mathematics

teaching. In this instance, the work produced the conversation that led to opportunities to think deeply about their students' reactions.

Day Three

The teachers came into Day Three with many questions. One advantage of meeting on consecutive days is that when the participants have "down time" they are able to process and reflect on professional development. Kabasakalian (2007) suggests that when teachers are guided to think about their own thinking, to assess student thinking, and to engage in discourse that emerges from work in the classroom they develop meaningful communities. The teachers wanted to talk about the amount of steps that one would include in one video for students, what are good ways to chunk content? Does chunking content affect students' understanding? Another strong thread of conversation focused on creating directions within the content that would be clear and simple- with vocabulary links, and some ESL support. This was a rich conversation and the teachers were excited. When the teachers started to create content, some of this enthusiasm was lost with the technical frustration due to the limits of Camtasia as a content builder. As the leader of this in-service this was a significant frustration for me. If we invite teachers to explore technology and how it affects their students' then we have to make sure that the technology is up to the task.

Day Four

This last day was devoted to creating video content of the three teachers teaching. We spent the morning working on this, perfecting timing and learning to write on the whiteboard with "camera awareness." After viewing the videos, all three teachers solidly rejected this method of creating content. They felt that it was a poor replication of their live teaching styles. They were more interested in finding web-based content that they could upload into their library. At the end of day four the teachers felt that the technology could provide support for meeting the needs of individual students and principally lower achieving students. They were enthusiastic about creating content.

The teachers' reaction to the in-service was collected through interviews and pre and post surveys. The professional development continued and the teachers met regularly to discuss each part of the implementation.

Monthly Meetings

The in-service was continued over the 2008-2009 school year, with monthly and bi-monthly meetings. In the first meetings during September and October, teachers were involved in creating content. After meeting, teachers began discussions about creating content to scaffold the higher performing students, as well as the lower performing students. The teachers discussed and explored creating content that would contain challenging problems and brainteasers. There was also conversation about unmotivated students. How does the teacher know if the students are using the content or just staring at the screen? As the roll out of the technology in their classroom approached (January 2009) there was a significant shift in the teachers' interests from creating to content to how the system would operate. They raised the following questions:

1. Can we see a demonstration to them with tablets so they can see how the communication between the teacher and the students?
2. What will the teachers see on their screens? What will the students see?
3. How are the computers networked together?
4. Since they don't have a wireless system at the school, how do we wire in 28 tablets?
5. What is the refresh rate for what students see on their screens, when they get feedback from the teacher?
6. What does the student toolbar look like?

This shift away from how students learn to how the technology work does seemed logical and reasonable as they prepared to incorporate the technology into their classes.

The teacher meetings throughout the rest of the year were consumed with operational and technical issues. Several technical obstacles were encountered during the implementation phase. Each teacher had different reactions to these challenges. One teacher was quite flexible about the technical issues and used the tablets in any way that he could with whatever parts of the system that were working. Another teacher tried to use the technology but only when he was confident that there would be technical support in his classroom for the entire class. The third teacher was reluctant to use the system even with support. From January to June, all three teachers used the technology to some extent. Teacher One began using it in all of his Algebra I classes on a daily basis.

RESULTS

For Year 1, data was collected from two of the three classes. Thirty-six students were surveyed and asked to choose how the technology helped their experience in Algebra from organization, fluidity of solving math problems, novelty, or did not help. 8 of the students reported that the ALASKA project helped with organization, 7 students reported that ALASKA helped with fluidity, 9 students found the project fun, and 3 said that it did not enhance their Algebra I experience at all.

Current Status

The program is currently in its second year. The same three teachers are still implementing the program into their classrooms. The teachers have changed classrooms over the summer to facilitate sharing the laptop cabinets for ease of mobility. The initial rollout for year two was this past week. Although the first day of year-two had several technical difficulties, two of the teachers are optimistic that those issues will be solved, while one teacher is waiting for the second semester to implement this program in his classroom.

CONCLUSION

Whenever a program is implemented into a public school, there are several aspects that contribute to the change process. Overall, the program has promise in personalizing education for students and tapping into an underused resource of teacher knowledge and collaboration. Overtime, teachers could become stagnant and bored as the years go on, and by developing their own instructional content, they can constantly grow in their professional practice. This idea does change how education is viewed in the United States. Teachers are perceived as the disseminator of knowledge, not the creator of it. As a result of that notion, teachers were reluctant to create their own instructional materials and content. This alongside the seen and unforeseen technical issues, the implementation process has been a long a difficult one. In forecasting the potential for this program, the question is posed under what conditions would this program provide optimal results?

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Virtualization as a tool to support the availability of computer networks in case of contingencies and disaster recovery

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Abstract

The IT challenge is to continue producing devices smaller, lighter and faster and at the same time, find better ways to manage the complexities of IT solutions involved. The IT industry drives a huge effort to security and information management for the production of more flexible systems to make them available to users anytime, anywhere. This need arises virtualization is an abstraction layer that separates the operating system hardware in order to provide mobility and optimize the utilization of information technology. The concept of this new platform paves the way for powerful devices, autonomous and reliable. The aim of this study is to analyze the benefits of this new technology and the impact of virtualization in the process of contingency and disaster recovery. To this end, we conducted a literature search - to understand the concepts underlying the areas of virtualization and security - conducted a survey with 25 companies to verify the possibility of implementing virtualization solutions as a contingency and the benefits this process can offer for companies, and a case study, which assessed the process for using this technology. Thus it was possible to analyze whether the advantages of this technique are really tangible in the current scenario, and also the benefits that has shown in the contingency and disaster recovery. The results of this study will serve as a basis for further field researches.

Keywords**:** Platform Virtualization; VMWare; Security; Contingency.

1. Introduction

Virtualization is a simple way to create systems that divide the sub-systems in devices more manageable. Thus, it tends to provide more security to the system, network and applications, because isolation of potentially vulnerable sub underlying systems and other virtual platforms.

Virtualization can be defined as "a technique that combines or divides computing resources to provide one or more operating environments for implementing "[NandaChiueh, 2005]. The environments created by this technique are called virtual machines.

Among the concepts involved in the study of virtual machines, a monitor (also called a hypervisor, VMM, or Virtual Machine Monitor) is a key.

The monitor is a software layer inserted between the system visitor (guest system) and hardware system where the visitor performs. This layer is an interface between the systems potential visitors (virtual) and the hardware that is shared by them. She is responsible for managing all hardware structures, such as MMU, device I/O, DMA controllers, creating a complete environment (virtual machine), where visitors systems run [XenSource, 2008].

Platforms virtualization can be defined as the creation of a computer system logically segmented, which runs on a real basis. The virtual platforms are seen by the User and act as if they were physical machines. Because they are abstract and divided from bases hidden, the virtual platforms are easily transportable and robust.

The virtualization allows you to create multiple virtual machines with heterogeneous operating systems running in isolation, side by side in the same physical machine. Each virtual machine has its own virtual hardware (e.g. RAM, CPU, etc), on which the operating system and applications are loaded.

With virtualization we can run multiple operating systems on an underutilized server or workstation. You can easily consolidate multiple platforms running on different operating systems and heterogeneous applications into a single, powerful and reliable platform.

The concept of virtualization includes all sections of the platform - from applications and operating systems - components, processors and interconnections of the platform.

2. Types of Virtual Machines

According to [King, 2003], VMMs can be classified in several ways. One refers to how close the interface they provide is the underlying hardware.

VMMs as VMware ESX Server and emulators such as Bochs have a hardware abstraction identical to the underlying hardware. To arrive at a level of abstraction so high, some monitors fall within the guest OS (host OS) device drivers that will be used by guest operating system (guest OS) by the VMM. Still others VMMs have a different interface from the underlying hardware. The Java virtual machine architecture is a fully independent of the hardware on which you run.

Another VMMs classification refers to the platform on which they run. According to this classification, virtual machines can be of two types [King, 2003]:

- **Type I** - The VMM is implemented directly on the underlying physical hardware. The VMMs Xen and VMware ESX Server are examples of such virtual machines.

- **Type II** - The VMM is implemented completely on the host operating system. Examples of such virtual machines are VMware Server VirtualPC.

3. Evolution of Virtualization

According to Nanda and Chiueh (2005), there are multiple storage virtualization technologies that have evolved, including solutions for internal and external bandwidth (in-band and out-band) based in storage and hosting. The first virtualization technologies that emerged were based solutions in storage. They allow multiple servers to share access to data in a single array variable that stores a set of values of the same type. The negative side, however, is that these servers can not access the data beyond its own array. In addition, users are in danger of being limited to solutions that rely on the manufacturers, based on the constraints of hardware compatibility wider array of servers or directly connected. Virtualization, based on storage, can then be more expensive than alternatives of lower priority.

In other hand, hosting based solutions enable the allocation of various disk arrays, from various manufacturers, present themselves as a virtual group to a single server host. This enables greater flexibility to enable them to be completely independent of manufacturers of storage solutions, but still enjoy the benefits of centralized storage management from a single console. Although the data are concentrated to access only through a single server, this can become highly available, ensuring the use of data. A potential disadvantage of this solution arises when multiple servers require shared access to the same data. Thus, we can consider the duplication of data or other methods of

storage virtualization. The architecture in-band inserts the device virtualization in the data network between the host and array. These devices offer volume management and other additional features such as data movement and copy service. He makes the replacement controllers for the storage devices that have being virtualized (Nanda and Chiueh, 2005).

The first advantage of this approach is simplicity. A new device itself can be developed to act as a central point of management for multiple systems connected. The recent appearance on a large scale, of monolithic arrays of high performance devices in-band virtualization, shows that advantage.

At one precise point, for large environments, even the strategy of scale may prove insufficient and will be need to develop a new in-band appliance. Each of these devices has responsibility for separate areas of virtualization, resulting in the need to manage independent pools of Virtualization. The consequence can leverage the original benefits of reducing complexity and simplifying of the management provided by virtualization.

4. Benefits of Virtualization

The bet in Virtualization solutions derives from the need of the Information Technology managers to give an effective response to the increasing number and range of computing environments within organizations. Moreover, the proper management of the TCO - Total Cost of Ownership is more than ever relevant, as well as the ability to resolve the growing difficulties of maintenance and management of those environments.

Virtualization infrastructure provides abstraction from the various methods of computation as processing, data storage, network and software. By implementing this concept, are eliminated physical constraints and resources are available as "logical groupings", which can be used anytime and anywhere.

The application of intelligent storage software virtualization layer provides a means of resolving functional challenges of storage, without compromising the need for data availability. It allows an unprecedented degree of flexibility in the use of storage resources to meet requirements relating to applications and end users,

The virtual storage devices are not restricted to the limitations of capacity, speed or reliability of the physical devices that include them. The Provisioning means to provide users or applications the amount and best type of storage, at the right time. Virtualization makes this process much easier. Combined with centralized administration, allows changes in the physical storage layer to be done without interrupting access to data in order to provide uninterrupted, high quality storage services in real time.

The Virtualization should revolution the way to manage applications, security and storage in the companies, converging systems to a single point, facilitating the maintenance and control of the network. Therefore, its benefits go through the centralized management of all storage, better access to users and applications, reducing training costs, easiness administration, reduced physical storage costs, eliminate downtime, greater scalability and capacity allocation on demand.

According to IDC, virtualization is in the way to become a standard practice among the thousand largest companies in the world, listed in the Fortune 1000. According to Forrester Research, more than 40% of U.S. companies have already embraced the technology.

The virtualization software allocates the hardware resources as processing, memory and storage, that will be assigned to each virtual station, and allows to reallocate these resources in accordance with the demand of each application in determined moment of the company.

With the virtualization it is possible to keep virtual stations running redundant applications, allowing that, in the case of environment fail, the other is used as contingency resource. With the support of appropriated software, it is still possible to

move different virtual stations to different hardware in case of a physical problem, thus preventing the loss of productivity.

In accordance with data given by VMware, the virtualization, combined with the consolidation of servers, reduces in up to 53% the costs with the hardware and 79% the operational costs, generating an average economy of up to 64% for the company who adopts the solution.

5. The process of virtualization as a contingency

To assess whether the process of virtualization can be used in small businesses, a survey was conducted with 25 SME - Small and Medium-Sized Enterprises, established in São Paulo.

The companies surveyed have between 1 and 6 servers and up to 120 computers in a network, in a total of 49 servers searched.

In the survey it was found that 72% of companies surveyed have 1 single server running users authentication services, file sharing, email and database management system (DBMS), also that 65% of server processors surveyed have the capacity to support the process of virtualization Type I, i.e., that supports the virtualization process implemented directly on the hardware, and that 30% of the servers support the process of Type II virtualization, implemented on the native operating system.

About the contingency, 52% of servers have mechanisms for fault tolerance in hard drives; in all cases, servers have backup routines of the data, and 60% of cases are being used tape drives, removable type DAT, LTO or removable cartridges and 40% in external hard drives. It was also found that 70% of the servers take up to 6 hours to carry out their daily backup routine. Only 10% of the companies keep a copy of your information stored outside of the main work environment.

We note also that the average utilization of processors installed on the servers tested, in 65% of cases did not exceed the average use of 30% of installed capacity.

In this scenario, the study was conducted to evaluate the process of virtualization can be used as a tool for contingency and disaster recovery, reducing downtime for network access of computers and their systems.

It was selected a company where all data were stored on a single server where we adopted the implementation of a process of converting physical to virtual server, known as P2V, using the VMWare Converter program, which creates a copy of the hard disk partitions to an external drive, transforming the content of hard disks in files.

This process took approximately 6 hours for a server with a 75GB hard drive. These files were transferred to a microcomputer equipped with the VMWare Player program, where tests were performed, noting the availability of the server entirely in a test environment.

In experimentally way, it was evaluated the recovery process of this same server, using the current procedures for data retrieval, i.e., installing the native system, the installation of their applications and the recovery of stored backup files. The duration of this process was 10 hours when, during this time, the network was unavailable.

It was performed the same procedure to recover the server using the server created by the process of virtualization and the data were recovered from the previous day in about 2 hours, i.e., it was found the reduction of the downtime of the system by 80%. Another advantage that was shown is that the server created by virtualization process could be removed from the company in an external disk, thus providing a new tool for contingencies outside the company.

6. Conclusion

The study, which was based on literature review and case study, has showed that virtualization has many advantages, despite a high initial cost, for the purchase of equipment

which generates for the company a charge bigger than a common system.

The need to reduce energy consumption and the search for technological innovations that make better use of existing IT resources, brought the process of virtualization for the current scenario of business.

The falling costs of virtualization programs, which are up to made available at no cost to users, presents new conditions for their use in large scale, including SME - Small and Medium-Sized Enterprises (businesses), previously excluded from this process by the high costs involved.

The use of virtualization as a contingency in the computer networks of small size, offers facilities for this environment to be endowed with the same conditions of security and high availability offered to large corporations.

The hiring of servers in data centers with lower values, offers facilities for that SME - Small and Medium-Sized Enterprises (companies) to review their investments in technology, reaching the conditions to maintain a copy of your computing environment in a out side environment and with security.

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Information Technology, Human Resources Management Systems and Firm Performance: An Empirical Analysis from Spain

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ABSTRACT

This research paper uses survey data on 1.518 Catalan firms (in Spain, with capital in Barcelona) to examine the relationship between IT use, innovative human resources management systems (IHRMS) and firm's performance. Using factor and cluster analysis, we find that only one-third of Catalan firms use IHRMS. Using association analysis we find that firms that adopt IHMRS are more internationalised; show grater ability to adapt to the change environment, to innovate and to collaborate; focuses product/service differentiation strategy enhancing quality; apply a greater degree of new forms of work organization; use IT more intensively; and invest more in training their employees Using regression analysis, we find that features which are structural, technological, strategic, organisational and result-related explain the adoption of IHRMS.

Keywords: Innovative Human Resources Management Systems (IHRMS), Information Technology (IT), New forms of work organization, Firm's performance.

1. INTRODUCTION

In the transition process towards a global knowledge economy human resources management (HRM) is shaping up as a determining element in the firms' competitiveness (Castells, 1996, Carnoy, 2000; Lindley, 2002; Pettigrew *et al*., 2003; Svetlik and Stavrou-Costea, 2007). Since the mid 90's, the consolidation and productive use of information technology (IT), improved human resources competences and organisational redesign have developed in parallel, and together require workers who are better trained and more highly motivated (Murphy, 2002). It has been demonstrated that the delegation of responsibility and decreased hierarchical levels, together with: a) intensive use of IT and the flow of information and knowledge; and b) HRM which increases workers' commitment, ultimately promote business process innovation (Lundvall and Nielsen, 2007) and improve the firm's productivity and competitiveness (Torrent-Sellens and Vilaseca-Requena, 2007). Thus, and considering the symbiotic relationship between IT, organisational change and HRM practices, this paper will analyse innovative human resources management systems (IHRMS) for the specific case of the Catalan firm. The aim of the paper is to find and characterize which types of HRM practices adopted by Catalan firms, and to establish determinants of implementation of IHRMS.

2. RESEARCH HYPOTHESES

The term HRM practices is defined as the pattern of planned human resource deployment and activities that help organisations attract, evaluate, motivate, and develop people with the appropriate behaviours and competencies to meet current and future needs (Huselid, 1995). Literature on HRM provides us with a noteworthy body of empirical evidence centring on the appearance of IHRM practices and their effects on the organisation's results (Ichniowski, 1990; Osterman, 1994). This empirical evidence suggests that firms able to transform their workers' basic competences, flexibly organise production and labour, and establish labour relations that increase the commitment of the workforce, have a greater competitive advantage at their disposal than do those firms with more traditional HRM (Carayannis and Sagi, 2001; Child and McGrath, 2001; Gant *et al*., 2002).

IHRM practices are often referred to as high involvement or high performance work system (Appelbaum and Kallerberg, 2000). The literature has identified a set of HRM practices in various ways that would assure the adoption of flexible work systems (Lawler *et al*., 1998), but generally they include three dimensions that are related to: 1) skills and competency requirements; 2) developmental approach to enhance continuous learning and performance as well as; and 3) innovative remuneration and labour relations programmes based on performance-related pay that drive motivation and commitment (Huselid, 1995; MacDuffie, 1995).

Within this context, we will begin with the premise that the results of an innovativeness HRM system do not depend, solely, on how each of the practices is managed separately. The final result also depends on how these practices interact with one other. There is no doubt that having more qualified workers who have been selected with greater care, and who work in a system that allows and encourages them to use their skills provides higher levels of organisational performance (Pfeffer, 1997). As the empirical literature shows, organisations gains from the internal consistency of their HRM, obtained through the suitable coordination between the different management practices and the high involvement of the workers (MacDuffie, 1995; Pil and MacDuffie, 1996;

Ichniowski *et al*., 1997). Empirical evidence also confirms the existence of important relationships of interdependence between certain internal and external aspects of structure of firms and the intensity with which IHRMS are adopted (Foss, 2005). As these practices become more sophisticated, they progressively form part of an overall system which, in turn, interrelates with other relevant aspects of business activity.

From a technological perspective, it has been demonstrated that digital investment is greater in those firms which delegate decision-making to their employees, more is invested in skills training, and organisational structures that are less vertical are adopted (Brynjolfsson and Hitt, 2000). Within this context, the complementary nature between IHRM practices and IT use determines: a) an important increase in the competences required from the workforce (Bresnahan *et al*., 2002; Bartel *et al*., 2004); and b) if combined with reorganisation of the organisational architecture, ultimately, an improvement of the firm's productivity (Black and Lynch, 2001, 2004; Brynjolfsson and Hitt, 2003; Arvanitis, 2005; Torrent-Sellens and Vilaseca-Requena, 2007) as are the workers' salaries (Caroli and Van Reenen, 2001; Shaw, 2002; Osterman, 2005).

By IHRMS we mean that group of practices which, acting as a complete system, is characterised by: a) a higher level of competence of their employees; b) the effort made in selecting and training them; c) a set of practices related to the transfer of power; d) the quality of labour relations; and e) remuneration which is managed through a system of setting objectives and performance review. In this sense, we formulate three research hypotheses:

- Hypothesis 1: *HRM practices operate as a system where they are mutually reinforcing.*
- Hypothesis 2: *The adoption of IHRMS is linked with firms that they: a) are more internationalised and show greater ability to adapt to the changing environment, to innovate and to collaborate; b) focuses product/service differentiation strategy enhancing quality c) apply a greater degree of new forms of work organization; d) have more technological equipment and use IT more intensively; and e) invest more in training their employees.*
- Hypothesis 3: *Firm structure, new forms of work organisation, IT use level, interaction with international suppliers, collaboration networks for innovation, and business efficiency, are determinants in the adoption of an innovative system of HRM.*

3. RESEARCH DESING AND DATA

The data used in the empirical analysis was collected in the course of the research *The Network Firm: ICTs, Productivity and Competitiveness in Catalan Firms* (Torrent-Sellens and Vilaseca-Requena, 2007) using a questionnaire which included questions on the incidence of IT use in the transformation of elements of value and business results in Catalan firms. The survey was based on a representative sample of 2,038 firms (confidence interval: 95%, p=q=0.5, and sampling error +/- 2.2 percent). Sample firms were contacted through telephone calls to confirm a contact person in each firm, followed by survey questionnaires that were answered by managers by means of a face-to-face, hour-long interview. The questionnaire consisted of 128 items. The study takes a cross-sectional approach. Follow-up data collection took place between January and May 2003. A careful examination of the data of these 2,038 firms led to the exclusion of 520 cases with contradictory or non-plausible answers; 1,518 valid answers remained which were used for this analysis. Therefore, we re-weighted the reduced sample of firms based on a factor which gives each company the real weight it should have according to its size. Table I illustrates the survey items and values which serve as the basis for collecting data pertaining to HRM practices.

Table I. Practices of HRM adopted by frequency in Catalan firms

		Frequency	Valid percentage
EDMAN	- Most frequently finished level of studies among managers: university level	845	55.7
	- Secondary/primary level/no studies among managers	673	44.3
EDNONMAN	- Most frequently finished level of studies among non-management employees: university level	325	21.4
	- Secondary/primary level/no studies in non-managerial workers	1,193	78.6
ATTMAN	- Most valued attributes for managers: Experience, leadership, and initiative and innovation ability	416	27,4
	- Previous attributes not mentioned in the first place	1,102	72.6
ATTNONMAN	- Most valued attributes for non-managerial employees: Initiative and innovation ability, work capacity, and technical knowledge	264	17.4
	- Previous attributes not mentioned in the first place	1,254	82.6
CTMAN	- Continuous and/or in company training for managers paid by the firm	599	39.5
	- No additional training for management	917	60.5
CTNONMAN	- Continuous and/or in company training for non-managerial employees paid by the firm	614	40.8
	- No additional training for non-management	890	59.2
REMMAN	- Type of remuneration: mixed, profit sharing, stock options, bonuses or deferred compensation for managers	966	63.6
	- Fixed remuneration	552	36.4
REMNONMAN	- Type of remuneration: mixed, profit sharing, stock options, bonuses or deferred compensation for non-managerial employees	326	21.5
	- Fixed remuneration	1,192	78.5
SALHR	- Amount of above-average remuneration	400	35.2
	- Salary less than or equal to the Catalan average	735	64.8
CONST	- Indefinite contract	1,034	68.1
	- Other types of contracting	484	31.9

4. FACTOR, CLUSTER AND ASSOCIATION ANALYSIS

Although the implementation of HRM practices is not equal in the Catalan firm, we observe several internal complementarities that suggest the existence of an overall system of IHRM practices. An analysis of the means for the components and their correlations, confirms that several elements in the matrix have a very positive (coefficients over 0.30) and significant correlation.

Factor analysis is used to assess item correlations and identify common relationships between similar items, allowing the items to be categorized into various themes or factors. Analysis of the correlation matrix: KMO (0.573) and Bartlett's test of sphericity (p=0.000) suggested that the correlation matrix was factorable. Data reduction was undertaken by principal components analysis using the Varimax option to identify possible underlying dimensions of HRM practices. From the analysis, five factors emerged that explained 66.9 per cent of total variance (table II). Five factors were labelled: 1) *Flexible remuneration*; 2) *Job training*; 3) *Qualifications*; 4) *Employment security*; and 5) *Managerial Competences*.

Non Hierarchical Cluster Analysis of K-means was applied to the five factors obtained in the Factor Analysis plus a new variable HRMSUM, that indicates the number of IHRM practices (from 0 to 10) that each firm fulfils. Two clusters or behavioural patterns were found in Catalan firms, according to the degree to which firms adopted IHRMS (table III).

Cluster 1 is comprised by the firms that display or favour greater importance towards (managerial and non-managerial) employees' qualifications and the non-managerial workers' skills (0.606), that provide more extensive professional and on-the-job training in terms of number of employees involved (0.532), and that have established mechanisms for flexible remuneration (0.518). Additionally, they are unlike the second group in terms of contractual stability (0.328) and the relevance given to new managerial competences (0.324). It is represented by firms that adopt IHRMS. Cluster 2 is characterised by HRM practices completely different from the previous ones and where all the factors identified are negative. It is represented by firms that adopt more traditional HRM practices or do not adopt any at all. Thus, and depending on the HRM systems adoption, we can characterise the Catalan firm in two clusters: 1) cluster 1, that uses all five of the HRM practices, can be considered to be the type of firm that uses the innovative system of HRM (37.6% of the firms); and 2) cluster 2 that contains groups of companies, most of Catalonia's private productive network (62.4% of the firms), that can be considered to use much more traditional practices or use none of the new HRM systems.

Table II. Varimax Rotated Factor Matrix of HRM practices

	Factor 1 Flexible remuneration	Factor 2 Job training	Factor 3 Qualifications	Factor 4 Employment security	Factor 5 Managerial competences	Commonalities
EDMAN	0.014	0.054	*0.791*	-0.193	-0.044	0.668
EDNONMAN	0.264	-0.062	*0.641*	0.246	-0.173	0.575
ATTMAN	-0.047	0.060	-0.131	-0.052	*0.911*	0.856
ATTNONMAN	-0.273	0.204	*0.450*	0.065	0.239	0.634
CTMAN	0.125	*0.794*	-0.068	0.032	0.030	0.653
CTNONMAN	0.084	*0.801*	0.101	0.028	0.031	0.661
REMMAN	*0.687*	0.194	0.231	-0.223	0.141	0.632
REMNONMAN	*0.676*	0.281	0.093	0.096	-0.107	0.565
CONST	-0.088	0.101	-0.046	*0.901*	-0.058	0.836
SALHR	*0.432*	-0.280	0.322	0.380	0.317	0.614
Autovalues	1.932	1.440	1.192	1.111	1.019	
% variance explained	19.316	14.400	11.917	11.106	10.195	

Notes: Rotated components matrix; Sampling method: factor analysis by main components; Rotation method: Varimax with Kaiser normalisation; convergence in 11 iterations.

Table III. IHRMS in Catalan firms. Results of k-means (quick cluster) analysis

	Clusters	
	1	2
	n=571	n=947
Flexible remuneration	0.518	-0.312
Job training	0.532	-0.321
Qualifications	0.606	-0.366
Employment security	0.328	-0.198
Managerial competences	0.324	-0.195
HRMSUM	5.87	2.71

Notes: Method of analysis: non-hierarchical cluster, final cluster centroids;

Finally, we carried out statistical analysis of the relationships between the IHRMS and several measurements of structure and firm results, as a first step towards the later formulation of a model that establishes the determinants for an innovative system of HRM practices. This analysis can be summarised on the basis of the following results (table IV):

- *Structure of the firm*. IHRMS is evidenced, in percentages that are higher than expected, in: a) the services sector; b) firms that form part of a business group; c) firms which have foreign capital, primarily from the European Union; d) the most internationalised firms; e) firms with a differential presence of clients and suppliers from outside Catalonia (Spain, the European Union, and the rest of the world); and f) firms with a high degree of collaboration with their competitors.
- *Competitive strategy*. IHRMS is demonstrated, in a greater percentage, in the firms that: a) opt for a strategy of product differentiation or specialised service; and b) have carried out improvements in their productive process through quality control of products or services.
- *Work organisation practices*. Firms with IHRMS opt, in a greater percentage, for: a) delegation of authority in decision making; b) using flexible and adaptable work teams; c) a greater flow of communication among workers; d) coordination systems based on work supervision by objectives; and e) a significantly greater percentage of externalised or subcontracted operations.
- *Technological and innovation perspective*. Catalan firms with IHRMS have at their disposal, in a greater percentage than those firms with traditional system: a) more digital technological equipment; b) a better level of internet equipment; c) more advanced IT use; d) a dynamic of greater innovation in the productive process through IT; and e) superior development of organisational innovation.

Table IV. IHRMS and structure of Catalan firms

	IHRMS	Traditional HRMS	Sign.		IHRMS	Traditional HRMS	Sign.
Sector of activity			0.000	*Work organisation practices*			
Information industry	5.0	9.0		- Organisational innovations in the last 2 years	46.4	32.5	0.000
Low tech industry	6.4	24.2		- Workers at operational level make decisions	37.8	33.1	0.076
Mid tech industry	1.2	4.4		- Existence of flexible and adaptable work teams	53.3	44.8	0.003
High tech industry	2.6	1.4		- Workers can share and exchange information	97.6	95.1	0.025
Low knowledge intensive services	60.0	41.2		-Supervision by objectives	71.6	62.9	0.002
Knowledge intensive services	24.9	19.7					
Property structure				*ICT equipments and uses*			
Forms part of a business group	19.2	7.5	0.000	Webpage	57.6	40.9	0.000
Internationalisation of sales and origin of capital				E-mail	96.7	85.0	0.000
Percentage of sales in Catalonia	73.3	79.9	0.001	Intranet (LAN/WAN)	67.6	52.3	0.000
Percentage of sales in the EU	6.7	4.2	0.006	Internet equipment:			0.000
Percentage of sales in the rest of the world	4.2	1.2	0.000	- Very low (no connection)	3.2	7.5	
% of Catalan capital	92.3	96.8	0.000	- Low: connection with narrowband	40.8	52.9	
% of capital from the rest of Spain	0.3	2.4	0.000	- Normal: connection with narrowband and webpage	52.1	37.4	
% of capital from the EU	6.9	0.7	0.000	- Advanced: connection with broadband and webpage	3.9	2.2	
% of capital from the rest of the world	0.5	0.0	0.070				
Agents immediately external to the firm				Payroll payment systems by means of IT	45.7	22.5	0.000
Suppliers from Spain	72.0	61.9	0.000	Internal communications systems	21.3	12.3	0.000
Suppliers from the EU	52.5	27.5	0.000	Information management systems	16.6	6.2	0.000
Suppliers from the rest of the world	29.5	15.5	0.000	Executive information systems (EIS)	11.6	4.0	0.000
The firm carries out activities with the competitors	40.4	19.6	0.000	Integrated management systems (ERP)	11.1	1.7	0.000
Competitive strategy				Utilisation of IT in the covering vacant positions	22.7	16.3	0.000
Competitive strategy of the firm based on:			0.000	Level of IT use:			0.000
- Differentiation of product/specialised service	40.7	24.0		- Low IT use	55.7	81.1	
- Flexibility and rapid response	4.5	15.9		- Medium IT use	39.3	16.7	
- Quality control of products and services	92.2	80.3		Advanced IT use	5.0	2.1	
Strategic redesigning of objectives				*Innovation in IT use*			
- Due to changes in demand	71.6	62.3	0.001	IT innovation in the last two years	59.7	49.1	0.000
- Due to improvements in the offer	63.6	54.0	0.001	Process innovation based on IT	47.4	34.9	0.000
- To adapt to changes in environment	58.2	46.2	0.000				

Notes: percentages of firms and chi-squared significance

5. ESTIMATION

With the aim of estimating the overall effect of individual variables on the adoption of IHRMS, we applied a binomial logit model. The parameters for the binary logistic regression model are described in equation:

$$IHRMS_i = \beta_0 + \beta_1 \cdot SIZE_i + \beta_2 \cdot STPROP_i + \beta_3 \cdot SECT_i + \beta_4 \cdot ADVIT_i + \beta_5 \cdot INTSUP_i + \beta_6 \cdot COOPNET_i + \beta_7 \cdot DECPROC_i + \beta_8 \cdot SALEWKR_i + \varepsilon_i$$

Where, IHRMS= a dichotomous dependent variable (1 if IHRMS adoption takes place, 0 otherwise); β = parameters to be estimated; and ε_i= error term of the model. The interpretation of standardized regression coefficients determines the probability that the independent variables represented in the model explain the adoption of IHRMS in the Catalan firms.

Regarding the independent variables, we contemplated a first group of business structure variables: a) size (SIZE); b) structure of the property (STPROP); and c) the sector of activity (SECT). We shall presume that large firms, which form part of a business group and whose activity is intensive in technology and knowledge use, are more likely to adopt IHRMS. The SIZE variable takes the value of 1 when the firm has more than 20 employees; and the value of 0 when it has fewer than 20 employees. The STPROP variable takes the value of 1 if the firm forms part of a group of companies; and the value of 0 if it does not belong to a business group. The SECT variable takes the value of 1 when the firm belongs to the sectors in the sample identified as intensive in the use of technology or knowledge: information industry, high tech industry and knowledge-intensive services; and the value of 0 when it is located in low or medium tech industry and in less knowledge-intensive services.

From the technological perspective, it has been proven that more intensive use of information technology is decisive in the adoption of more IHRMS. With the aim of measuring this effect, we considered the ADVIT variable, which takes the

value of 1 when IT use is advanced and the value of 0 when use is low or mid-level. To determine advanced IT use, we generated an indicator for IT use which gathers the sufficiency of use in five elements of value in business activity: 1) production; 2) supplies and distribution; 3) marketing; 4) organisation and basic human resources (accounting and invoicing, payroll payment and internal communication); and 5) organisation and complex human resources (data management and/or information exploitation, information systems for management and integrated management systems). This sufficiency, which is collected through the arrangement of digital technology systems in each of the five elements of value, determines the three levels of the indicator: a) low use of IT, when the firm does not have technological systems in any or has in just one, of the five defined elements of value; b) mid-level use of IT, when the firm has technological systems for two or three of the five defined elements of value; and c) advanced use of IT, when the firm has technological systems in four or five of the defined elements of value.

Another set of independent variables is determined by the firm's strategic and organisational resources. Regarding strategy, we considered a quality management variable. Quality management means greater sophistication in the utilisation of productive processes and a greater emphasis on employee's development. To measure this effect, we used a variable that measures the implementation of quality certification in the firm (QUAL), and which takes the value of 1, when the firm has an accredited system to guarantee quality; and 0 if it does not.

In terms of workplace practices, we incorporated autonomy and decision-making capacity when workers carrying out their labour tasks, as well as labour control and supervision systems. We shall presume that the movement of the decision-making process towards operational level is linked with HRM practices that involve workers more. The DECPROC variable, takes the value of 1 when the firm's workers at operational level make decisions at operational level, and the value of 0 when there is no delegation of responsibility towards them. Additionally, the management by objectives, instead of the traditional hierarchical structure, involves establishing mechanisms for arranging HRM activities. In this regard, we considered the variable of control and supervision by objectives and results (SUPOBJ), which takes its values depending on their application: yes, value of 1; and no, value of 0. HRM has also been involved in the nature of existing labour relations in the firm, and particularly in the role played by trade unions. Trade unions should be interested in those organisational changes which give the workers a greater presence and larger role in internal decision-making. Nonetheless, they can also consider the incorporation of more flexible systems of HRM as a threat to employment security. To measure the trade unions' capacity regarding the generation of innovation in HRM, the variable TRADUNI takes the value of 1 and indicates the presence of trade unions in the firm; and the value of 0 when there are not.

The literature also confirms that ties outside the company are very relevant for innovation. In this regard, businesses that have established cooperation networks with other companies or institutions should be more willing to facilitate internal innovation through more IHRMS. The COOPNET variable takes the value of 1 when the firm's cooperation (present or past) with other firms and/or institutions has led to innovation. If the firm does not or has not cooperated in innovation with other firms and institutions, this variable takes the value of 0. Additionally, we included a variable that measures the firm's interaction with international suppliers (INTSUP). This variable takes the value of 1 when the firm has suppliers that are from the European Union or the rest of the world; and the value of 0, in the opposite case (Catalonia and the rest of Spain).

Lastly, and as we have pointed out, other research finds a significant correlation between IHRMS and several business efficiency measures. We presuppose that efficient businesses are characterised by a greater concern for their competitive advantage in general and the innovative management of their human resources in particular. Based on the sales quotient per worker in the firm, we generate the SALEWKR variable, which takes the value of 1 when the average is greater than the Catalan average (135.6 thousand euros) and takes the value of 0 when it is less than or equal to the Catalan average. After running the model and applying the Wald Statistic and the Likelihood-Ratio Statistic, the TRADUNI, QUAL and SUPOBJ variables were not statistically significant (p values>0.10) and therefore they were disesteemed or rejected. To increase the goodness of fit and explanatory power, they were eliminated from the model. The estimated coefficients are presented in Table V.

Table V. Determinants for the adoption of IHRMS

	Estimated coefficient	Standard error	Wald	Significance	Marginal effects Exp (β)
SIZE	0.453	0.152	8.817	0.003	1.572
STPROP	0.758	0.168	20.241	0.000	2.134
SECT	0.839	0.140	35.768	0.000	2.314
ADVIT	0.692	0.205	11.369	0.001	1.999
INTSUP	0.387	0.144	7.191	0.000	1.472
COOPNET	0.556	0.140	15.788	0.000	1.743
DECPROC	0.579	0.155	13.909	0.000	1.785
SALEWKR	0.568	0.160	12.540	0.000	1.765
Constant	-1.715	0.152	127.552	0.000	0.180

Notes: Method of regression: binomial logit analysis; dependent variable: Advanced HRM Practices (value 1, adopted; value 0, not adopted); standardised coefficients. Statistics: - 2 Log-likelihood=1.245.113; R^2 Cox-Snell= 0.178; R^2 Nagelkerke= 0.238; Hosmer-Lemeshow test= 0.957; p=0.000.

The model correctly classified 69.1% of firms (75.8% of those that do not use IHRMS and 61.5% of those that use IHRMS). The Nagelkerke's R^2 equals to 0.238. The improvement in the likelihood function is significant (from 1381.9 to 1245.1). It accepts the goodness-of-fit of the predictive capacity and the variables as a whole have an outstanding explanatory power (Hosmer-Lemeshow test=0.957; p=0000). From the estimation of the model, it is found that all the variables included have a very significant explanatory power regarding the decision to incorporate IHRMS in the Catalan firm ($p<0.01$). The relationships of influence found have a plus sign. It is observed that the structural variables of the firm (size, technology and knowledge intensive sector, and membership in a business group), relationship with international suppliers and firms, networks for cooperation with other institutions and firms, decentralisation in decision making and business efficiency play a positive and significant role in the IHRMS adoption.

6. CONTRIBUTIONS

In this research paper, we have contemplated on IHRMS, its characteristics and determinants, for the specific case of the Catalan firms. On the basis of the four basic dimensions of HRM (selection, training, hiring and remuneration), we obtained five factors: flexible remuneration, job training, qualifications, employment security, and managerial competences, which have allowed us to identify a system of IHRM practices.

The empirical evidence that was obtained demonstrates that most of Catalan firms (about two thirds) have traditional forms of HRM, and that those firms incorporating innovative system of HRM practices (slightly more than a third of the total) have a considerably differentiated profile. Using association analysis we find that firms that adopt IHMRS are more internationalised; show grater ability to adapt to the change environment, to innovate and to collaborate; focuses product/service differentiation strategy enhancing quality; apply a greater degree of new forms of work organization; use IT more intensively; and invest more in training their employees.

Medium-sized and large firms (more than 20 workers), that form part of a business group, belong to a knowledge-intensive sector, with advanced IT use, establish collaboration networks with firms and institutions in order to innovate, whose suppliers are geographically international, that favour more decentralised decision-making and are efficient are the firms with greater probability of incorporating IHRMS.

Despite the limitations of the research, particularly the lack of a time series and the restrictions imposed by the indicators and the methodologies used, the results obtained are consistent with other studies carried out at firm level as well, in other regions and sectors (Foss, 2005; García-Olaverri *et al*., 2006). However, the specific characteristics of the overall productive system in Catalonia (very small firms, low intensity in technology and knowledge, with low levels of training and, and serious problems of productivity and competitiveness) allow the results obtained to be extrapolated to other regions and groups of firms.

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Mining Users Browsing Behavior for Product Promotion in a Multi-touch Display System

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ABSTRACT

Most product display systems are designed one-way only to broadcast the product information to customers by far. Those systems didn't provide any interaction function for users. Consequently, there is no way to analyze users' browsing behavior. Making profits from product sales is the golden rule for an enterprise's continuing operation. Conventional data mining models were used to discover the association rules from large databases that contain the transaction records. However, there is no way to realize how customers pick products before purchasing them. That is, the users browsing or comparing products behavior is not considered during the mining process. To enhance the product display systems, both RFID and multi-touch technologies are integrated to provide the interaction between customers and product display system in this paper. Each product is attached a RFID tag as a unique identifier. Whenever a customer intends to browse product information, he/she can take the product to a designated place that is within the antenna detection range of UHF RFID reader. Then, the product-related information can be automatically displayed on the screen. Every browsed product tag ID in this proposed display system is recorded in the back-end server for further information processing. A data mining model is proposed to extract the association rules from users' browsing behavior in the multi-touch system. The discovered association rules are then used to design a recommendation model to promote product sales to prospective customers. The detailed data mining model as well as simulation results is presented to verify the effectiveness of the proposed work.

Keywords: Data Mining, Spatio-Temporal Association Rules, Multi-Touch System, User Behavior, Neural Network, RFID.

1. INTRODUCTION

With the advent of Windows 7 new operating systems, users can experience a different user interface than before. Actually, there are already a variety of single- and multi-touch systems available in the market before the introduction of Windows 7. Unlike the Windows 7, the proposed multi-touch system is implemented by cheap hardware but maintains interactive touch functions for users. This display system is deployed with Radio Frequency Identification (RFID) to attract eyesight of customers for product promotion. Koch indicated if a company can find the important potential customers and design special marketing offers for keeping and establishing customers' loyalty, then it can improve company competitive advantage [1]. Therefore, customer oriented products and selling strategy become a major tendency of commercial affairs.

Analyzing users browsing behavior on products is important to make profits for companies. However, the transaction records grow larger as time goes by that makes the management of the databases a difficult issue for the company to face. In view of this aspect, data mining models are used to discover business information to help managers make decisions in profit making.

RFID is incorporated with the multi-touch display system in this paper that enables to record the customers' transactions for further analysis of customers' behavior. Fig. 1 is the structure of the proposed product display system. Fig. 2 is the proposed multi-touch system. Through data mining strategy, a company can analyze the consumption of major customers and predict consumer behavior in detail. The discovered association rules can be transformed to implement appropriate marketing strategies as well as to enhance personalized services accordingly.

The rest of this paper is structured as follows: Section 2 describes the problems at hand and introduces the related work. Section 3 presents the proposed system and section 4 provides experimental evidence. The conclusion and future work are made in section 5.

2. PROBLEM STATEMENT

Introducing data mining method in this study is to promote knowledge of understanding of customer needs and browsing behavior that in turn helps enterprises provide customized services to strengthen the links, communication and interaction with customers. Besides, the association rules can discover various customer characteristics and shopping patterns that can be used to plan the marketing strategy. This section discusses the challenges involved in preprocessing and analyzing the data. Necessary definitions are also provided.

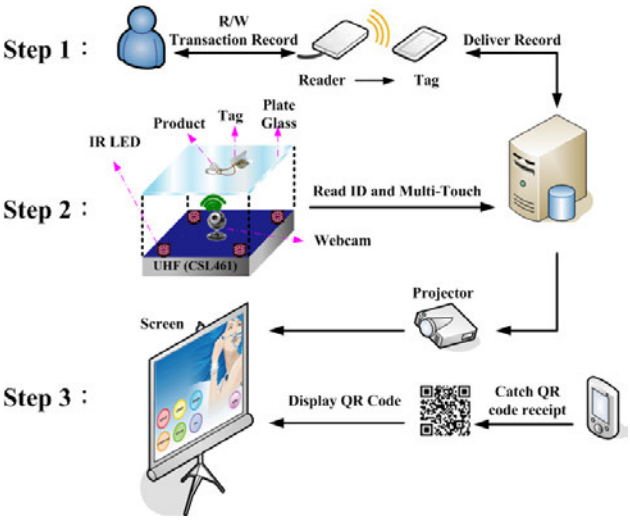

Fig. 1. Structure of the proposed product display system.

Fig. 2. The proposed multi-touch system.

2.1 RFID

RFID devices can be divided into two classes: active and passive [2]. According to the operating frequency, the readers can be divided into LF, HF and UHF RFID readers. Using the passive RFID tags and the UHF reader, the reader interrogates the tags 3m to 6m away [2].

Every product is attached a RFID tag to save the product information including a unique identifier. The identifier provides the multi-touch system for displaying the detail product information for the back-end server to record the users' browsing behavior in the database. The transaction database consists of users' browsing products with the time, the bill, etc., attributes.

2.2 Self-Organization Maps (SOM)

Using the self-organizing map (SOM) [3], a classification of unsupervised competitive learning, requires no target values for each data vector are known [4]. SOM is used to cluster users' browsing behavior that is recorded during their interactions with the multi-touch display system. The clustered data are beneficial to generate association rules in data mining faster and effective. In order to cluster the data, we need to transform the users' browsing behavior as an input vector $X_k = [x_{k1}, x_{k2}, \ldots, x_{km}]^T$ and define the neighborhood function $\zeta = \exp(-R/2\sigma^2)$ and the neighboring radius σ. SOM algorithm is given in Fig. 3 [5].

Begin
  Set neighborhood parameters
  Set learning rate parameters
  Initialize weights
  While
    For each input factor $X_k = [x_{k1}, x_{k2}, \ldots, x_{km}]^T$
    For each node, compute the distance:
      $d_j \leftarrow \|x_k - w_j\|, j = 1, 2, \ldots, n$
      Find index j such that d_j is a minimum
      For unit j and its neigborhoods, updates according to
        $\varsigma \leftarrow \exp(-R^2/2\sigma^2)$
        $w_j \leftarrow w_j + \varsigma \times \eta \times (x_k - w_j)$
        Reduce learning rate η and radius of R of neighborhood
  Until (Convergence or maximum no. of iterations is exceeded)
End

Fig. 3. SOM algorithm.

2.3 Data Mining

Spatio-temporal data mining is an integration of diverse fields, such as spatio-temporal databases, machine learning, statistics, geographic visualization, and information theory [6]. They can be used to extract spatial relationship among datasets, build spatial knowledge, optimize spatial queries, etc. However, spatio-temporal data mining presents a number of challenges due to the complexity of geographic domains, the mapping of all data values into a spatial and temporal framework, and the spatial and temporal autocorrelation exhibited in most spatio-temporal data sets [7].

Spatial data mining tasks and techniques can be roughly classified into five categories including segmentation, dependency analysis, deviation and outlier analysis, trend discovery, and generalization and characterization [6]. Consequently, any data mining task began with data collection and correlation analysis. In the data collection step it must confirm that all data are complete access and conform to the needs of analysis in order to avoid any unexpected error outcome.

2.4 Spatio-temporal Association Rules

In data mining, spatial association rules mining is a popular and active researched field for discovering interesting relations between attributes in large databases. The spatial association rules mining task aims to detect associations between reference objects and some task-relevant objects from spatial databases [8]. But, time is a significant factor which affects the correct ratio of spatial association rules. In the literature, there are also other studies that have focused on defining spatio-temporal patterns and algorithms [9-11]. Spatio-temporal association rules differ to traditional association rules where spatial and temporal factors considered in the former.

Given a dataset *T* of spatio-temporal data, define a symbol *L* that is able to express properties or groupings of the data (in time, space, and object attributes). A spatio-temporal process association rule can be expressed as follows.

Definition 2.1. A spatio-temporal association rule is defined: $A \Rightarrow B[t,s,c]$. If both the support and confidence of a rule overpass their respective thresholds, then the rule is claimed to be true.

In the above rule, A and B can be either data set of spatio-temporal or non- spatio-temporal data, t is the time step, s is the support value (namely, the items must appear in many baskets) and c is the confidence value (namely, the rule $A \Rightarrow B$ holds if the inter-transaction set that contains A also contains B). The following rules are examples of spatio-temporal association rules.

$$is(X,"every_year")\text{^}close_to(X,"Valentine's\ Day") \Rightarrow sales_of(X,"roses_increase")[\text{Feb.}, 0.5\%, 80\%]$$

This rule expresses that every year closes to the Valentine's Day, in February, the sales of roses will increase with confidence of 80%, and 0.5% of the data belong to this category. The definition of distance is "close" or "far" is subjective and may influence the mining results. For complex instance, the association rule in the above example is as follows:

$$is_a(X,"shopping_mall")\text{^}set_in(X,"prime_location")\text{^}in(X,"July") \Rightarrow sales_of(X,"ice_cream_increase")[\text{summer}, 0.2\%, 75\%]$$

This rule indicates that a shopping mall sits at a prime location, the sales of ice cream will increase in July with 75% chance of causing increasing sales, and 0.2% of the data belong to this category.

3. ANALYSIS OF USERS' BEHAVIOR

The mining of customer browsing behavior from a back-end sever database can be divided into three steps: data preprocessing, quantitative attribute transformation, the clustering of frequent itemsets using the SOM algorithm.

3.1 Data Preprocessing

The database in the back-end server side records the users' browsing behavior and the information of products. Three attributes of users' browsing behavior are considered, including browsing video time, click rate and scaling of interesting objects. Product information is categorized to five types, including the ring, necklace, pendant, bracelet and earring. Every transaction data contains the date of the transaction, the purchase quantity and product's price. The details of all property information are listed in Table 1.

In general, the training data of SOM network can be either normalized or non- normalized ones. The normalization is to remove the impact of one unit or scale over the others, if one data attribute is too dominating that makes SOM network ignore other attributes and converges to undesirable situation. MinMax method is used to normalize data for the SOM network as shown in Table 2.

3.2 SOM for Spatio-Temporal Data Mining

After preprocessing and normalizing the collected data, SOM is employed to cluster the data into categories of ring, necklace, pendant, bracelet and earring. Owing to the characteristics of "birds of a feather flock together", SOM can cluster similar users' behavior into the same category [12]. Fig. 4 illustrates the proposed SOM framework for clustering users browsing behavior.

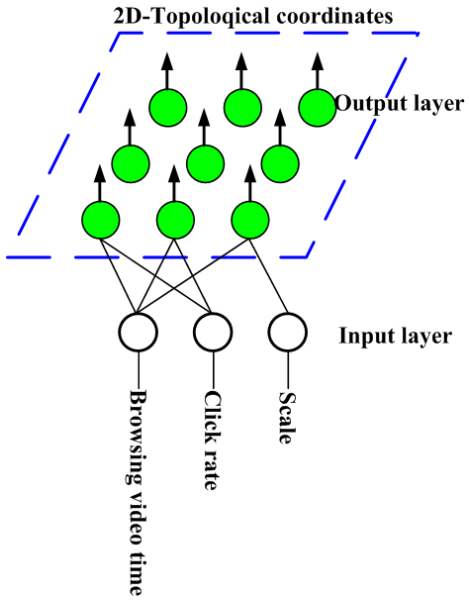

Fig. 4. The proposed SOM clustering framework.

Part of the clustering results from SOM is given in Table 3. Due to the large data set, only the properties of category "ring" are shown in Fig 5. In Fig. 5, TID represents the transaction identifier. The video browsing time, click rate and scaling are the attributes to form a transaction. GID is the output category from SOM.

4. EXPERIMENTAL RESULTS

The clustering results from SOM are used to generate association rules. Since an output node represents the clustering result from input patterns with similar characteristics, i.e., users' browsing behavior, those input patterns fallen in neighborhood of winner output node are treated as a transaction. The transaction database is then used to discover the interesting association rules.

An association rule is interesting if it satisfies the threshold of confidence value. For example, R1: IF scale=0.6, then GID=1. Based on the transaction database in Fig. 5, we can calculate the confidence value as follows:

$$\text{CF(R1)} = \frac{ID(1), ID(2), ID(7)}{ID(1), ID(2), ID(6), ID(7)} = 3/4$$

Given a confidence value of 0.5, if the confidence of R1 overpasses the threshold, then this rule is an interesting one. Table 4 shows some of the association rules. An interesting rule is added to the knowledge base to facilitate the subsequent speculation with similar browsing behavior of customers who

are likely to respond in order to develop new customer behavior base, and strengthen the relationship between company and customers.

5. CONCLUSION AND FUTURE WORK

From the analysis of users' browsing behavior, a new customer clustering model is proposed. The data mining model can discover the associations among all product information in the multi-touch display system, which could provide better customer service than the current models.

The proposed model can provide references for managers to make instant and strategic decision, such as releasing a promotion package or setting a new market promotion plan. The discovered association rules in the knowledge base are also useful to infer prospective products for promotion.

From the association rules, we can deploy the suitable display frame size for better promotion of the product. Till now, there is a limited study on users' behavior analysis in multi-touch display system, and not to mention that few of them were implemented in real business environment. The proposed system is not only good for analyzing users' behavior but also provides informative references for planning business market strategy and decision.

6. ACKNOWLEDGMENT

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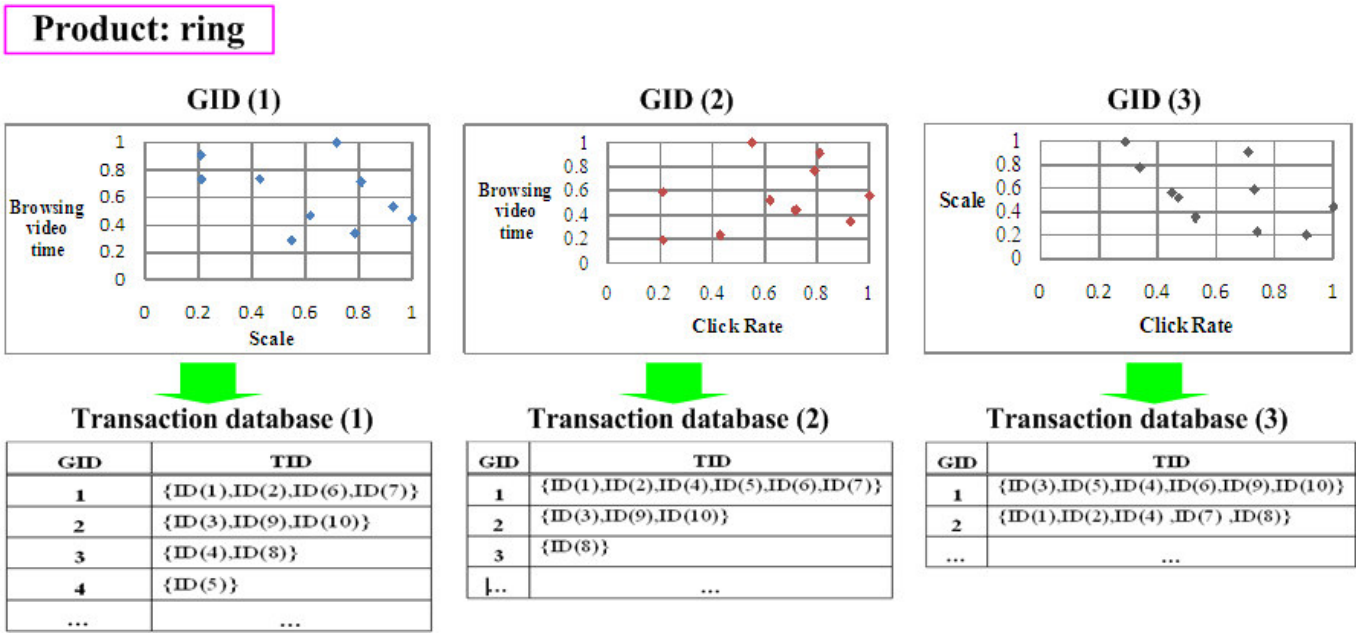

Fig. 5. The transaction database after grouping.

Table 1. Users' browsing behavior data.

Product	Browsing video time (second)	Scale (%)	Click Rate
Flirt Ring	58	156	156
Irina Bracelet	46	156	214
Pink Heart Lock Pendant	12	256	164
Gemma Bordaux Ring	36	164	144
Evening Necklace	42	350	144
Bordeaux Heart Pendant	47	250	254
Pink Heart Lock Bracelet	54	156	98
Bella Pierced Earrings	32	100	278
Hazel Pierced Earrings	12	260	64
Loop Clip Earrings	12	320	56
…	…	…	…

Table 2. The normalized data from Table 1.

Product	Browsing video time	Scale	Click Rate
Flirt Ring	1.00	0.45	0.56
Irina Bracelet	0.79	0.45	0.77
Pink Heart Lock Pendant	0.21	0.73	0.59
Gemma Bordaux Ring	0.62	0.47	0.52
Evening Necklace	0.72	1.00	0.52
Bordeaux Heart Pendant	0.81	0.71	0.91
Pink Heart Lock Bracelet	0.93	0.45	0.35
Bella Pierced Earrings	0.55	0.29	1.00

Hazel Pierced Earrings	0.21	0.74	0.23
Loop Clip Earrings	0.21	0.91	0.20
…	…	…	…

Table 3. SOM groups.

TID	Browsing video time	Scale	Click rate	GID (1)	GID (2)	GID (3)
1	1.00	0.45	0.56	1	1	2
2	0.79	0.45	0.77	1	1	2
3	0.21	0.73	0.59	2	2	1
4	0.62	0.47	0.52	3	1	2
5	0.72	1.00	0.52	4	1	1
6	0.81	0.71	0.91	1	1	1
7	0.93	0.45	0.35	1	1	2
8	0.55	0.29	1	3	3	2
9	0.21	0.74	0.23	2	2	1
10	0.21	0.91	0.2	2	2	1
…	…	…	…	…	…	…

Table 4. Partially discovered association rules.

	If	Then	CF(confidence)
R1	time=0.21	GID(1)=2	1
	ID(3),ID(9),ID(10)	ID(3),ID(9),ID(10)	
R2	time>=0.79	GID(2)=1	0.667
	ID(1),ID(2),ID(6),ID(7)	ID(1),ID(2),ID(4),ID(5),ID(6),ID(7)	
R3	click rate=0.52	GID(2)=1	0.333
	ID(4),ID(5)	ID(1),ID(2),ID(4),ID(5),ID(6),ID(7)	
R4	scale=0.45	GID(3)=2	0.6
	ID(1),ID(2),ID(7)	ID(1),ID(2),ID(4),ID(7),ID(8)	
R5	time>=0.79	GID(1)=1	1
	ID(1),ID(2),ID(6),ID(7)	ID(1),ID(2),ID(6),ID(7)	
R6	scale>0.75	GID (1)=4	1
	ID(5)	ID(5)	
R7	click rate<0.4	GID(3)=1	0.4
	ID(9),ID(10)	ID(3),ID(5),ID(6),ID(9),ID(10)	
…	…	…	…

A Study of Organizational and Cultural Factors Influencing User Satisfaction of ERP Systems in a Developing Country: Case Studies from Thailand

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ABSTRACT

This study guides organizational and cultural variables, which seem to play crucial roles in *user satisfaction* of ERP implementation projects in developing country such as Thailand. The literature review was based on a multi-disciplinary research approach by incorporating organizational factors, cultural dimensions, and *user satisfaction* in implementation of ERP for developing countries. The eight ERP software's customers in Thailand were chosen for eleven semi-structured interviews performed during the period of April 2007 to April 2008. The findings confirm that *management commitment, IT maturity, and computer culture* are important factors influencing *user satisfaction* of the ERP projects. A company with richer *Business Process Redesign (BPR) experience* is more likely to succeed with ERP. Interestingly, the *collectivism* of ERP teamwork and composition is also critical issue for ERP implementation's satisfactions. Dealing with *masculinity* of users may lead to more satisfactions toward ERP implementation. Solving high *uncertainty avoidance* tends to boost users confidence and familiarity of users. The findings and recommendations can be useful for developing countries with similar conditions.

Keywords: ERP, Organization, Culture, Developing Country, User Satisfaction, Hofstede

1. INTRODUCTION

Enterprise Resource Planning (ERP) software has been implemented by organizations in industrialized countries such as the United States, Greece, and Finland [26] [30] [23]. Currently, many organizations in developing countries such as China, Thailand, Egypt, and Jordan have also accelerated the implementation of ERP systems [12] [28] [33] [1] [40]. According to AMR Research (2005), the five biggest ERP vendors—SAP, Oracle (which bought PeopleSoft, J.D. Edwards), Sage Group, Microsoft's Business Solution Group, and SSA Global (which bought Baan)—accounted for 72 percent of a $23.6 billion business in 2004. Moreover, AMR has also predicted that the growth would rise from 2004 through 2011 around 11 percent compound annual growth rate [30]. The economic growth of developing countries in Asia, Latin America, and Eastern Europe has made these regions become major targets of ERP software vendors [33] [6] [32]. Nevertheless, the implementation of ERP systems in developed and developing countries are unlikely to follow the same implemented model since labor cost, skill base, research and development capacity, infrastructure, and government of the two groups are significantly different. For example, the Internet infrastructure of Thailand (as a developing country) is far different from that of the USA (which is a developed country) because 24.4% of Thai population in 2008 is Internet users [24], while 74.1% of the US population is Internet users [18] [19]. However, the industrial production growth rate of Thailand is much higher than that of the USA since the industrial production growth rate of Thailand is 5.4%, while that of the USA is 0.5% [19].

2. LITERATURE REVIEW

According to Kanthawongs & Kini (2003), Huang & Palvia' s (2001) framework model for examining ERP implementation issues in advanced and developing countries may need to be refined as only certain organizational factors may show connections with ERP implementation framework. To illustrate, *Management commitment, IT maturity, and computer culture* tend to

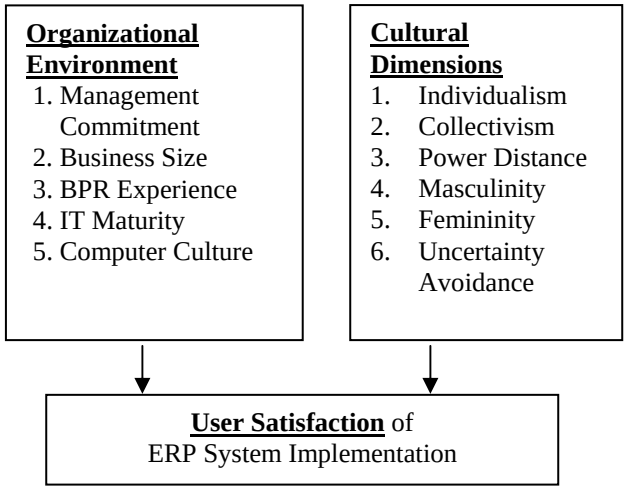
show positive connection with ERP systems [27] [28]. Nevertheless, *region*s of companies' locations are likely to be related to ERP system implementation framework. On one hand, *business size* is likely to show positive relationship with ERP systems implementation because medium and small sized enterprises claim to ally among themselves in order to increase the bargaining power as groups of customers with the software vendors. On the other hand, *business size* is likely to bring negative impact on ERP systems implementation since medium and small sized enterprises typically lack qualified team members in implementing the ERP projects. Additionally, *Business Process Redesign (BPR) Experience* factor is unlikely to produce identical and consistent patterns toward ERP implementation because firms address such issues differently, one firm views it positively: *"If a company is familiar with BPR, it is highly likely that it will be successful in ERP implementation."* However, some firms express a negative relationship, *"…Each unit should consider how their works affects work in other departments. Now, we have problems with the frame of our ERP. ERP system forces us to work in certain ways. But, our users do not follow ERP system and are trying to work around the system with their old & own ways of doing"* [28]. Therefore, organizational environment, including *management commitment, business size, BPR experience, IT maturity, and computer culture,* may related to ERP implementation framework.

Furthermore, many studies have pointed out that the popular ERP packages developed by Western countries, though based on good business models, may not fit the requirements of other organizations. For example, Soh et al. (2000) emphasizes that the "misfit" examples should be recognized in the unique Asian context when adopting ERP systems, especially when the business models originated from Western practices. Specifically, they suggest that the specific data, functional, and output issues are the basic categorization of misfits in the Asian context. Ngai et al. (2008) found empirical support for the impacts of CEO-IT distance on senior management support of IT of Western origin, while the relationship was not supported for the Asian firms operating in Hong Kong. The ERP implementation in China has not fully perceived as positively by Chinese managers and end-users as it is by their business counterparts in the USA [13].

Therefore, many studies provided evidence that national cultural issues are significantly related to ERP system implementation [2] [21] [27] [33] [1]. Hofstede [14] [15] [16] defined national culture as the collective programming of the mind which distinguished the inhabitants of one country from another. Fundamental values, beliefs, and norms in different countries are likely to affect the practices of professional activities, including ERP implementation. For instance, similar to many developing countries, Jordanian employees were threatened because they had a lot of uncertainty and anxiety (high *uncertainty avoidance)* toward the ERP projects. They resisted the project since they viewed that the projects would change their jobs. Also, Jordanians also accepted high *power distance* since the ERP project mangers stated that managers were unhappy with the idea of sharing information among the subordinates, the managers requested for restricted access to information for themselves [1]. Moreover, if managers in China could enthusiastically communicate with their subordinates the benefits and capabilities in implementing ERP systems (high *collectivism)*, the organizations should successfully adopt the systems [11]. Egyptian culture hindered the ERP implementation success such as "centralized decision making, hierarchical structure, loose lateral links, and ill-defined documentation cycle" [33]. Therefore, the beliefs and attitudes of *individualism, collectivism, power distance, masculinity, femininity, and uncertainty avoidance* may be related to the implementation of ERP systems.

User satisfaction with technology has been widely used indicators of success of information systems research [37] [33] [36] [8] [13]. If people have positive attitudes about a technological application, they are likely to behave in ways that enable them to get benefit from it. Recognizing the importance of people in ERP implementation, people related measure is user satisfaction [25]. Satisfaction with technology is viewed by the respondents' belief that the ERP system is able to provide integrated, accurate, timely, and reliable information to the respondents and whether they believe that the new system is better than the one it is replacing [13]. User Satisfaction is also concerned with the interaction between the information produced by the system and the recipients [1].

Therefore, the purpose of this study was to explore *organizational* and *cultural factors* relating to *user satisfaction* of ERP system implementation framework in a developing country such as Thailand. The proposed model for the study is as follows:



3. RESEARCH METHODOLOGY

Since the focus of this research study was an exploratory research, an in-depth case study approach was applied. Case research has been shown to be particularly appropriate for exploratory research of this nature [22]. Case analysis and cross-case analysis have proved to be particularly effective [17] [35]. The data collection was undertaken through interviews and reviews of secondary documents. The first author of this study' s teams conducted a set of interviews with key persons involved in ERP implementations in Thailand as parts of the major project assignment in the course, BA616: Information Technology, M.B.A. level, instructed by the researcher for

two semesters at Bangkok University [10] [29] [33] [20] [31] [5] [39] [3]. Every team was instructed, trained, and graded for class scores in order to thoroughly understand definitions and concepts of the past literature related to all domains of knowledge for this study. The eight ERP software's customers in Thailand were chosen as the case studies for this research. The eleven semi-structured interviews were performed to reveal information related to impact of ERP issues on *user satisfaction* of ERP system implementation. The interviews were performed during the period of April 2007 to April 2008. To maintain confidentiality, the names of the case sites were not included; the names of respondents were disguised; and the names of the software vendors and consultants were omitted.

4. FINDINGS

The results from the interviews obtaining through the analytical process described in the preceding section are presented in Table 1: Company Information.

Table 1: Company Information

Respondents' Titles	***Com-pany (ies)***
1. Director of the Port Operation and Product	1
2. Assistant Director of the Port Product	1
3. Human Resources Manager	1
4. Assistant Vice President of Information Services	1
5. Information Services Officer	1
6. System Engineer	1
7. Senior Staff IT Systems	1
8. Senior Staff System Section	1
9. Accounting and Finance Department Senior Manager	1
10. Accounting Officer	1
11. Assistant Director of Finance	1
Number of Employees for ERP Projects	
< = 99	1
> 99	4
Adopted ERP modules	
Financial and Managerial Accounting	3
Material or Warehouse Management	2
Human Resources	2
Maintenance or Repair	2
Management Information Systems	2
Operations and Logistics	1
Sale & Marketing	1
Procurement	1

Company Type/ Software Used/ Business Size

1. The Port Service Company/ Software No. 1 / Large Size Enterprise
2. The Automotive Component Company/ Software No. 3 / Medium Size Enterprise
3. The Retailer Company/ Software No. 1 / Large Size Enterprise
4. The Fashioned Dress Company/ Software No. 3 / Small Size Enterprise
5. The Electronic Equipment Parts Company/ Software No. 3 / Large Size Enterprise
6. The Car Company/ Software No. 1 / Large Size Enterprise
7. The Retail Agent Company/ Software No. 1 / Large Size Enterprise
8. The Public Industrialized Company/ Software No. 1 / Large Size Enterprise.

The important findings are:

1. Positive Relationship between *Management Commitment & User Satisfaction* [41] [28] [27] [12] [13] [25] [1]. The frequency of the comments in this category is eight. For example,

1.1 "The executives decided to purchase the expensive ERP system in order to help fasten the operation processes and increase efficiencies,"

1.2 "The executive were quite satisfied with the ERP consultant company,"

1.3 "Our executives highly support the use of ERP software and even play major roles in solving conflicts in departmental levels."

2. Negative Relationship between *Management Commitment & User Satisfaction* [41] [28] [27] [12] [13] [25] [1]. The frequency of the comment in this category is one; for example, "The executives were dissatisfied with the ERP vendor because slow progress and costly investment."

3. Positive Relationship between Small/ Medium *Business Sizes & User Satisfaction* [41] [28] [27] [12] [13] [25] [1]. The frequency of the comments in this category is four. For instance,

3.1 "Our organization has tried to reduce the number of employees by implementing more computer work, "

3.2 "Our small numbers of people in our organization use the ERP systems."

4. Positive Relationship between Large *Business Size & User Satisfaction* [41] [28] [27] [12] [13] [25] [1]. The frequency of the comments in this category is four. For instance,

4.1 "Since there is a lot of information involved in our operation now, so ERP will help create central database, "

4.2 "Business size affected the system selection stage because small size enterprises lacked sufficient investment fund for such expensive ERP software."

5. Positive Relationship between *BPR Experience & User Satisfaction* [41] [28] [27] [12] [13] [25] [1]. The frequency of the comments in this category is six. For instance,

5.1 "We used to change from an old system to a new ERP system once, then that experience helped us dealt with the new ERP system, "

5.2 "We had 2-3 major changes in our systems before, so adopting ERP system helped us shorten our work processes,

5.3 "Having experience from BPR for 2 times (due to software change) would allow employees to realize their needs to change the way they work,"

5.4 "If private companies can do better business

processes for our systems, we will outsource to the private companies to build the systems, "

5.5 At first, many key ERP systems' users did not like the system, and then change management team managed all departments to use it and listen to complains to improve work efficiencies."

6. **Negative Relationship between *BPR Experience & User Satisfaction*** [27] [28]. The frequency of the comments in this category is two; for example, "Our company is so big that we hardly make any change to our systems."
7. **Positive Relationship between *IT Maturity & User Satisfaction*** [41] [28] [27] [12] [13] [25] [1]. The frequency of the comments in this category is eight. To illustrate,
   7.1 "We have many state-of-art hardware, software, and network for our operations, "
   7.2 "We build our own infrastructure for our domestic and international locations with lease line network speed at 2Mbps."
8. **Positive Relationship between *Computer Culture & User Satisfaction*** [41] [28] [27] [12] [13] [25] [1]. The frequency of the comments in this category is eight. To illustrate,
   8.1 "Now, our new employees can easily adopt the use of computers, but some of our old employees may resist using computers,"
   8.2 "Our goal to have all employee do online self service,"
   8.3 "Our ERP users who can fully utilize computers are quite satisfied with the system especially it helps fasten their work processes."
9. **Negative Relationship between *Computer Culture & User Satisfaction*** [41] [28] [27]. The frequency of the comment in this category is four; for example, "Some of our ERP users do not like to use computers and have limited English language skills; they tend to resist using the system."
10. **Positive Relationship between *Individualism & User Satisfaction*** [33] [1]. The frequency of the comments in this category is two. To clarify,
    10.1 "Our company philosophy is that employee should rely on oneself in a certain level,"
    10.2 "During systems selection process, IT department was solely empowered to make decision in choosing ERP software for the company."
11. **Positive Relationship between *Collectivism & User Satisfaction*** [11] [12] [33] [1]. The frequency of the comments in this category is six. For example,
    11.1 "We tend to do work as a team more than individuals,"
    11.2 "Our work system supported teamwork because all business processes were linked."
12. **Negative Relationship between *Power Distance & User Satisfaction*** [12] [33] [1] [13] [1]. The frequency of the comments in this category is three; for example, "We have a long chain of commands, so this cause trouble in implementing ERP systems sometimes."
13. **Positive Relationship between *Power Distance & User Satisfaction*** [11] [12] [33] [1]. The frequency of the comments in this category is four. For example,
    13.1 "The executives pay close attention and help our ERP users to satisfactory work with the system,"
    13.2 "Top executives could exercise control of the ERP project directly to all divisional boundaries."
14. **Negative Relationship between *Masculinity & User Satisfaction*** [12] [25] [33] [1]. The frequency of the comments in this category is five. For instance,
    14.1 "Now our employees complained often how ERP have slowed their work processes,"
    14.2 "Dissatisfied ERP users were giving 6 months training program,"
    14.3 "With the previous system, we input our data once, with Software No. 1 was in place, we input our data 3 times for each of 20-items."
15. **Positive Relationship between Femininity & User Satisfaction** [12] [25] [33] [1]. The frequency of the comments in this category is four. For example,
    15.1 "Many departments who could adjust to the ERP system were quite satisfied with the efficiency and effectiveness of the system,"
    15.2 "If there are problems in using the system, we will talk in the committees' meetings."
16. **Negative Relationship between *Uncertainty Avoidance & User Satisfaction*** [25] [1]. The frequency of the comment in this category is five; for instance, "Our employee tend avoid uncertainty in a way that they do not want to deal with the new ERP systems, but rather want to go back and use the old system instead."

5. DISCUSSIONS AND RECOMMENDATIONS

The findings confirm the past literature that giving the complexity and resource requirements, **(1.1) *management commitment*** is considered a key to ERP implementation in developing countries. Moreover, top management must involve allocating valuable resources to the implementation effort because ERP projects span divisional boundaries and affect many stakeholders in an organization. Then, senior executives need to mediate between various interest groups to resolve political conflicts when necessary. The high level of **(1.2) *IT maturity*** can significantly influence an organization's strategic decision in acquiring and deploying IT/IS. A company with strong **(1.3) *computer culture*** would have better understanding of application functionality, data management, and more satisfactions with ERP systems. A company with richer experience in **(2.1) *BPR*** is more likely to succeed with ERP. The **(2.2) *collectivism*** of ERP teamwork and composition is another critical issue for ERP implementation's satisfaction. The project team should be composed of both IT and business experts from within the implementation company or from an external consultancy to have an effective and fast decision maker. Moreover, the key member of the project team must be empowered. The dissatisfactions from being **(3) masculinity** with the ERP software should be solved because the software slow down the regular work processes and create work redundancy. Parallel run between the old and the new ERP systems may be applied in order to solve negative reactions from high **(4)**

uncertainty avoidance of to boost developing country's users confidence and familiarity.

6. CONCLUSIONS

This study reveals variables, which seem to play crucial roles in ERP implementation projects in developing country such as Thailand. Like most other developing countries, the ERP projects must receive approval and support from *top management* before it can be implemented. The level of *IT maturity* and *computer culture* can significantly influence an organization's strategic decision in implementation of ERP. A company with richer experience in *business process redesign experience (BPR)* is more likely to succeed with ERP. More companies reveal *collectivism* in implementing ERP projects rather than individualism. Solving *masculinity* of users may lead to more satisfactions toward ERP implementation. Once implementing ERP projects, ERP users tend to make sure they familiar and have confidence in using the systems. Last but not least, implications for future researches are quantitative researches for ERP implementation and evaluation in Thai context. The findings from this study can be very useful in the ERP adoption decisions of other emerging countries such as Hungary, Poland, Czechoslovakia, and Bulgaria, as these countries move towards more networked economies. This research is subject to a possible threat of external validity since the total sample size of 8 companies may still be small. Future studies also include comparative studies of ERP implementation between developing and developed countries.

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A Block-Splitting Algorithm for Passive RFID Tags

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ABSTRACT

The design, implementation, and applications of Radio Frequency Identification (RFID) technologies are critiqued. Tradeoffs between costs and security of technologies for automatically recognizing and storing product items in databases are presented. A deterministic and efficient block-splitting algorithm for resolving tag collisions or passive tags in RFID technology is proposed. The algorithm divides and identifies tag IDs based on smaller blocks. The proposed algorithm requires no random number generation and it is deterministic unlike the slotted Aloha algorithm. The Block-splitting algorithm inherits the feature of fast resolution of empty slots without exhaustively searching the tree space. The design and implementation of RFID technologies are presented in details. Future directions for the realization of effective technological tools for commercial product identification are discussed.

Keywords: Radio Frequency Identification, Tag, Technology Security, Block-Splitting Algorithm.

1. INTRODUCTION

Radio Frequency Identification is the technology used to read physical tags on single products, cases, pallets, or re-usable containers that emit radio signals for signal reader devices. Implantable objects into products, animals, or humans for identification, localization, monitoring and tracking using radio waves all lend themselves to RFID technological applications. RFID is a part of refinement radar technology used over sixty years ago by the British army to identify friends from foes' aircraft in World War II. The initial applications of RFID for asset identification of commercial products began in the 1960s. The third era of RFID pioneered by the Massachusetts Institute of Technology's Auto-Identification Center (AIC) in 1998 focused on reducing costs, optimizing data network and developing open RFID standards. The MIT's AIC had over one hundred sponsors from four continents with large field RFID trial initiatives at ten US cities in 2003. The AIC officially closed its door on October 26, 2003 and transferred all its technology to EPC global [7].

Barcode readers are still in use today. Time-consuming barcode readers require a direct line of sight to read the printed barcodes on products. The line of sight requirements limit the ruggedness and reusability of barcodes because the printed barcodes exposed on the outside of products are subject to greater wear and tear. Moreover, unlike the RFID, the barcode technology has no read/write capability. Table 1 provides a comparative summary of the capability and technologies of RFID and barcodes [10]. On the other hand, the shortage of adopting RFID technology is still the cost of replacement. Currently a passive tag ID costs from a few cents to less than a dollar, a cost more expensive than the cost associated with the use of bar code. However, the cost of a passive tag ID is expected to be lower in the near future.

The advances and reduced costs of technology have incited new applications of the radio frequency identification (RFID) technology portrayed as "tech's official Next Big Thing."[2]. RFID was used to spot genial aircraft in World War II. Today the RFID is in use in private and public environments. Libraries around the world are tagging books. Chips are sometimes embedded in home pets to allow lost animals to be eagerly located and reunited with their possessors. In supermarkets, the color, style and size of each expensive cloth is often tagged for electronically recognition. An RFID-chipped label is sometimes attached to a prescription drug bottle at a pharmacy store to corroborate the genuineness of its contents, and to combat drug counterfeiting. Time and traffic congestions are often reduced at highways by having cars with RFID tags on their windshields go fast through tollbooths. The RFID technology offers great application advantages in supply chain management.

An RFID system consists of a tag (a tiny silicon chip in addition to an antenna) on an item that a mobile or stationary reader scans with radio waves. The chip is usually coded with a unique identifier to enable a reader to identify tagged items. The reader scans each tag for the data on it and transmits it to a database. The basic RFID system includes a central server, an interrogator and RFID tags. Thus, the capacity of RFID systems to transmit correct data of tagged items will continue to impact their benefits to businesses and consumers.

RFID tags can be passive or active. A passive tag does not have its own power supply and solely relies on receiving energy from the interrogator to backscatter its data, while the active tag possesses its own battery for computation and communication. Today, passive tags are in use in a variety of applications, including building-access cards, mass transit tickets, and tracking consumer products through the supply chain. The costs a passive tag still depends on the sophistication of the chip that includes its memory size and encryption capability. Passive tags are especially popular in supply chain management due to their low costs and efficient query interrogations with tags within regions. Akin to passive tags, semi-passive tags do not initiate communication with readers. Semi-passive tags have batteries for operating the circuitry on the chip and storing information, such as ambient temperature. Semi-passive tags can be combined with sensors to construct miniature wireless sensors (smart dusts) for tracking environmental features. A grocery chain might apply a smart dust to monitor track energy use, or a vineyard to assess incremental weather changes that could perilously impinge on grapes. The

vastly varying interrogation region is defined as the maximum transmission range within reach of tags. The communication range of an interrogator is limited to no more than tens of feet of passive tags. However, the interrogation region could be several hundred meters for active tags. At the end of tag-reader communication, the reader transmits the information retrieved from RFID tags to a central database server responsible for storing all updated information.

Capability \ Technology	Bar Code	RFID	RFID Benefit Example
Line of sight requirement	Required	Not required	No need to orientate scanned items
Number of items that can be scanned	One	Multiple	Very fast inventory scan
Automation & Accuracy	Manual read errors & prone to mis-scanning	Fully automated and highly accurate	Error free inventory count
Identification	Only series or type	Unique item level	Targeted Recall
Data storage	Limited codes	Up to several kB data	Real time data access in any location

Table 1 RFID versus Bar Codes

Tag arbitration used for identifying individual tags is a key step in RFID communication. The core problem of tag arbitration is the decision on how to minimize tag collisions due to concurrent tag responses and idle slots in which no tag responds. The existing approaches proposed for tag arbitration can be briefly classified into two categories: the Query-Tree protocol adopted in the EPC Class 1 Gen 1 (C1G1) RFID standard and the frame-slotted Aloha protocol adopted in the EPC Class 1 Gen 2 (C1G2) RFID standard [7]. In the arbitration process, the RFID tag could only be identified if there is one tag replying to the reader per time slot. An empty slot results when only one tag replies to the reader per time slot; a collision occurs when multiple tags reply concurrently. Both empty and collision slots should be minimized because they consume extra time and energy and provide invalid information to the reader. The probabilistic algorithm, Framed-Slotted Aloha, allows randomly selected tags at given frame slots to transmit signals. The Tree-Search algorithm recursively splits the group of colliding tags into several disjoint subsets until either one or no tag responds. This deterministic method guarantees the identification of all tags. In general, the tree algorithm resolves the empty subsets very fast, but it is inefficient in resolving collision slots.

Research work associated with the design of protocols for RFID tag arbitration can be categorized based on relevance: single reader and single arbitration, and multiple readers and single arbitration. A single reader cannot arbitrate all tags at one time in large RFID deployments. Several approaches that adopt multiple readers concurrently have been proposed to address this issue. However, the multi-reader solution raises other problems, such as the balancing of the communication load among different readers to achieve better performance and consume less energy [6], the resolution of the interference among multiple readers during the arbitration process [19], and the estimation of the tag cardinality given the results from multiple readers with overlapping interrogation regions in the tag counting problem [16]. The single reader and recurring arbitration protocol to facilitate single reader tag arbitration for previously identified tags also exist [15]. Similar to the Query-Tree protocol, every prefix with singleton reply is queried in the last round; if there is a collision, the protocol appends one bit to the prefix. This approach reduces the collision slots by remembering the singleton nodes in the last arbitration round; however, if the mobility of tags is high, the tags in the same interrogation region vary greatly by time.

This paper presents a Block-splitting algorithm for resolving tag collisions in favor of passive tags in RFID technology. The deterministic algorithm offers efficient tag identification solutions by dividing and identifying the tag IDs into smaller blocks. The proposed algorithm offers a deterministic way to identify all tags compared to the slotted Aloha algorithm. It does not require tags to generate random numbers. Moreover, Block-splitting inherits the feature of fast resolution on empty slots from the tree algorithm without searching the whole tree space.

2. RELATED WORK

Fast arbitration of massive tags is nontrivial to achieve in RFID systems due to the limited computation and communication capability of tags. Most of the proposed tag arbitration protocols were developed from the Query-Tree (QT) protocol or the frame-slotted Aloha (Aloha) protocol adopted in the Gen 1 and Gen 2 of Class 1 EPC RFID standards respectively [7]. The research work on the protocol design of RFID tag arbitration fall into two main categories based on their applications.

The Single reader arbitration focuses on a single reader and a single arbitration; it includes the Aloha-based and the Tree-based algorithms. The Aloha algorithm is a probabilistic approach in which the tags respond to the reader's query at random times. To achieve a better performance, the frame-slotted Aloha has been developed to restrict the tag responses in a given number of time slots [1, 17, 18].

Alternatively, the tree-based algorithms utilize the binary or n-ary tree structures to split tags into smaller subsets until the collision is resolved; it provides a bounded delay for tag arbitration [7]. However, similar to the Aloha-based approaches, the protocol also requires the tags to remember the state information. On the other hand, the Query Tree (QT) protocol adopts a memory-less scheme for tag identification by splitting the tags based on the binary structure of their IDs [13, 14]; a query with a tag prefix is assigned in each time slot. The responding tags are those with the matching prefix in their IDs. When collision occurs, the reader appends one bit to the prefix and continues to query until the collision is resolved. The schematic view of the search path of the Query-tree based algorithm is displayed in Figure 1. A smart-tree traversal (STT) has been proposed to help avoid collision and empty slots, and to achieve close-to-optimal search performance. The STT does not assume uniform distribution and the number of required tags.

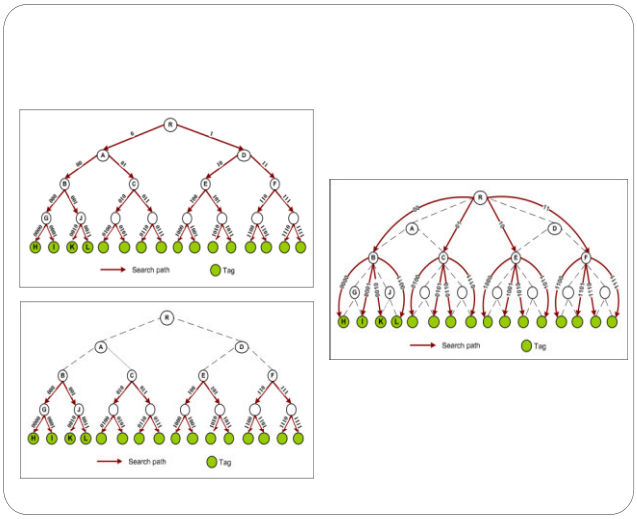

Figure 1 Query-Tree Based Search Process

The multiple readers arbitration are used in passive tags due to their low costs. Then again, the communication range between a reader and passive tags is limited. Without a doubt a single reader cannot arbitrate all tags at one time in large RFID deployments. Several approaches that adapt multiple readers concurrently have been proposed to address this issue. Nevertheless the multi-reader solutions have spawned other problems, such as the balancing of the communication load among different readers to achieve better performance and lessen the energy consumption [6], the resolution of the interference among multiple readers during the arbitration process [14], and the estimation of the tag cardinality in the results from multiple readers with overlapping interrogation regions in the tag counting problem [16]. Similar to the single-reader arbitration, the multi-reader approaches also focus on the single arbitration scenario. When tag reading is recurred to monitor and collect data, the existing protocols do not take advantage of the known tag information identified in the earlier rounds.

3. EPC C1G2 STANDARD

The emerging Electronic Product Code (EPC) Standard Class 1 Generation 2 (C1G2) [3] is the most popular currently available RFID standard. C1G2 combines the advantages of the existing EPC Class 1 Generation 1 (C1G1) and ISO 18000-6 protocols. It operates on the 860-930 Megahertz frequency range. The bit rates of Interrogator-to-tag (R=>T) and tag-to-interrogator (T=>R) are 26.7-128 kbps and 40-640 kbps, respectively.

Figure 2 depicts the tag memory of EPC C1G2. Tag memory in EPC C1G2 is logically separated into four distinct banks: reserved memory, EPC memory, TID memory and user memory. The EPC memory contains the information of CRC-16, protocol-control and an EPC code that uniquely identifies the object associated with a tag. The size of the required EPC memory is vendor-specific. The minimum 32 bits EPC memory contains 16-bits for Cyclic Redundancy Check and 16-bits for protocol control. The varying lengths of an EPC code could be extended depending on requirements of an application. There are eleven encoding schemes defined in the EPC C1G2 standard. Therefore, all EPC codes begin with an 8-bits header that defines the scheme in use. The TID memory contains a minimum 8-bits class identifier used by an interrogator to uniquely identify the customized commands, and other optional features. The minimum size of the TID is 8 bits. The other two optional types in the memory bank are the reserved memory containing passwords and the user memory for storing user-specific data. The encoding of the user memory is implemented using the EPC Tag Data Standards [8].

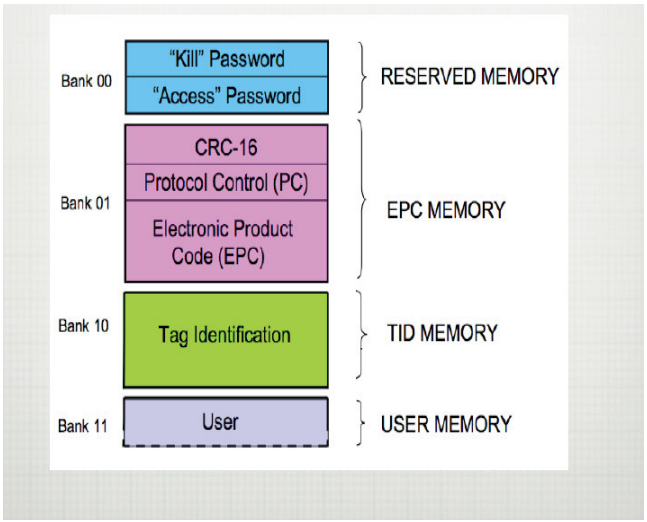

Figure 2 Tag Memory of EPC C1G2

The operations of tag arbitration are illustrated with a communication example in Figure 3. There are three operations involved in the tag arbitration: select, inventory and access. The operation, Select, allows the interrogator to activate a group of tags. The Inventory operation includes a set of commands such as Query, QueryRep, ACK and NAK for arbitrating tags and reading data from the memory blocks specified in the Select operation. A Frame-slotted Aloha algorithm is used in the Medium Access Control (MAC) for collision avoidance and resolution [1, 17, 18]. The Access operation allows the interrogator to write to and read from tags. The EPC tag states and operations are displayed in Figure 4.

In tag arbitration, the reader identifies and retrieves information from tags within its interrogation range. When multiple tags respond simultaneously, a collision occurs. Excessive delay overhead, impractical assumption about uniform distribution of tags and the estimate of tag count are major issues to resolve.

4. THE BLOCK-SPLITTING ALGORITHM

The Block-splitting algorithm combines the advantages of slotted Aloha and tree algorithms to optimally identify tags using a "divide and conquer" strategy. Consider a tag ID with K bits and n tags in the reader's range. The two steps involved in resolving the collision among tag IDs are block contention and block query.

The Block-splitting algorithm requires a tag to record its verification status. The verification status can be implemented in any tag because the verification record is simply one bit with 0 indicating fault and 1 indicating true. Initially, the verification bit is set to 0 for all tags.

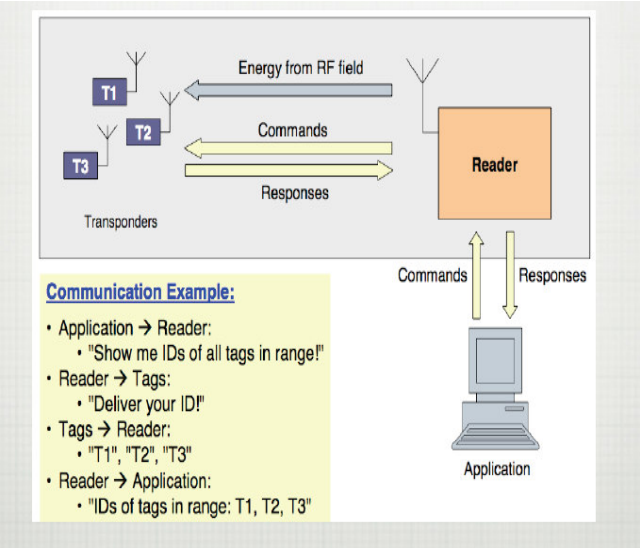

Figure 3 Tag Arbitration Protocol

In the block contention resolution, the tag reader divides the K-bit tag into several blocks. The size of the first block, L_1, is an integer less than $\log_2 n$. Block 1 is converted to a frame with 2^{L1} slots. Initially, the tag reader broadcasts {s_1 (the starting bit position), e_1 (the ending bit position)}. In the first block, $s_1 = 1$ and $e_1 = L_1$. To receive the message, a tag searches its ID from 1 to L_1 and obtains the slot number to which this tag will transmit in the current block. A short string, instead of the whole tag ID, is transmitted in a slot to improve efficiency. The contention result (empty, singleton or collision), is announced by the tag reader prior to beginning the next slot. A singleton tag transmits its long tag ID and sets its verification status as true. The verified tag will not respond to any broadcasting calls during the identification time. In a collision result, the tag reader saves the slot number in the binary and proceeds to the next slot. At the end of the frame, the tag reader establishes a table with s_1, e_1 and a set of bit patterns representing the collision. The number of the remaining unrecognized tags is then estimated using the contention result to decide the size of the next block. The tag reader repeats this same procedure in every block until either there is no more collision slots or all K bits are divided and heaved.

The tag reader has the clear bit patterns that caused a collision in each block after resolving a block contention. One straightforward way to query block would be to test the combination of all different patterns at once. Unfortunately, the number of unresolved tags is far less than the number of pattern combinations in many collision slots, making this method undesirable. Thus, we propose a method for building prefix query based on the existing collision patterns for quickly resolving the identification of colliding slots. The computation should be performed by a central server that transmits results to the tag reader because of the intensive processing power required to build the block query.

The prefix query table is constructed for each block using the standard tree-splitting algorithm. Each collided slot is a leaf in this table. The procedure begins from the root and continues to split the tree until the result is one or zero. In the tree search, when the result is one or collision, the search query is saved. A query with the result of zero is discarded. This method avoids unnecessary polling of the empty slots. The query table is further trimmed to reduce the collision slots using other techniques such as, implementing the search procedure to directly move to the immediate parent of two leaves. Again, the verified tags do not respond during the identification stage.

Any entry in the query table is a prefix of tag ID used by the reader to pull tags. Table I shows the prefix query table built for collision slots 1111, 1101, 0110, 0001, 0111 and 1010. The next query to broadcast when the result of the current query is singleton (or collision) is indicated as qSinglton and qCollision. When qSingleton is "end," the search is terminated because all tags have been recognized. When qCollision is "sav," the current prefix cannot be used to resolve the tag collisions. In this case, the query is saved for the next block and the current search is advanced to the pattern in qSinglton of this query. According to Table 2, there are a total of 10 slots required with the sample of six collision patterns. A regular tree-splitting query requires 12 slots to identify all the patterns.

When the collision cannot be resolved in block 2, a prefix query table similar to Table 1 is constructed in the next block for the tag reader. The tag reader broadcasts a query by fetching the query from the query table and used conjointly with the stored prefix in the previous block. The procedure runs recursively until there are no more collisions. In the worst case, the block query runs on all blocks.

Index	Query	qSinleton	qCollision
1	0	1	00
2	00	01	sav
3	01	1	0110
4	0110	0111	sav
5	0111	1	sav
6	1	end	10
7	10	11	sav
8	11	end	110
9	110	111	sav
10	111	end	sav

TABLE 2 Prefix Query

6. CONCLUSION

In this paper, a Block-splitting algorithm is presented for resolving tag collisions in support of passive tags in RFID technology. The algorithm is deterministic and offers efficient tag identification solutions, by dividing and identifying the tag IDs into smaller blocks. Unlike the slotted Aloha algorithm, the proposed algorithm offers a deterministic way to identify all tags. It does not require tags to generate random numbers. Moreover,

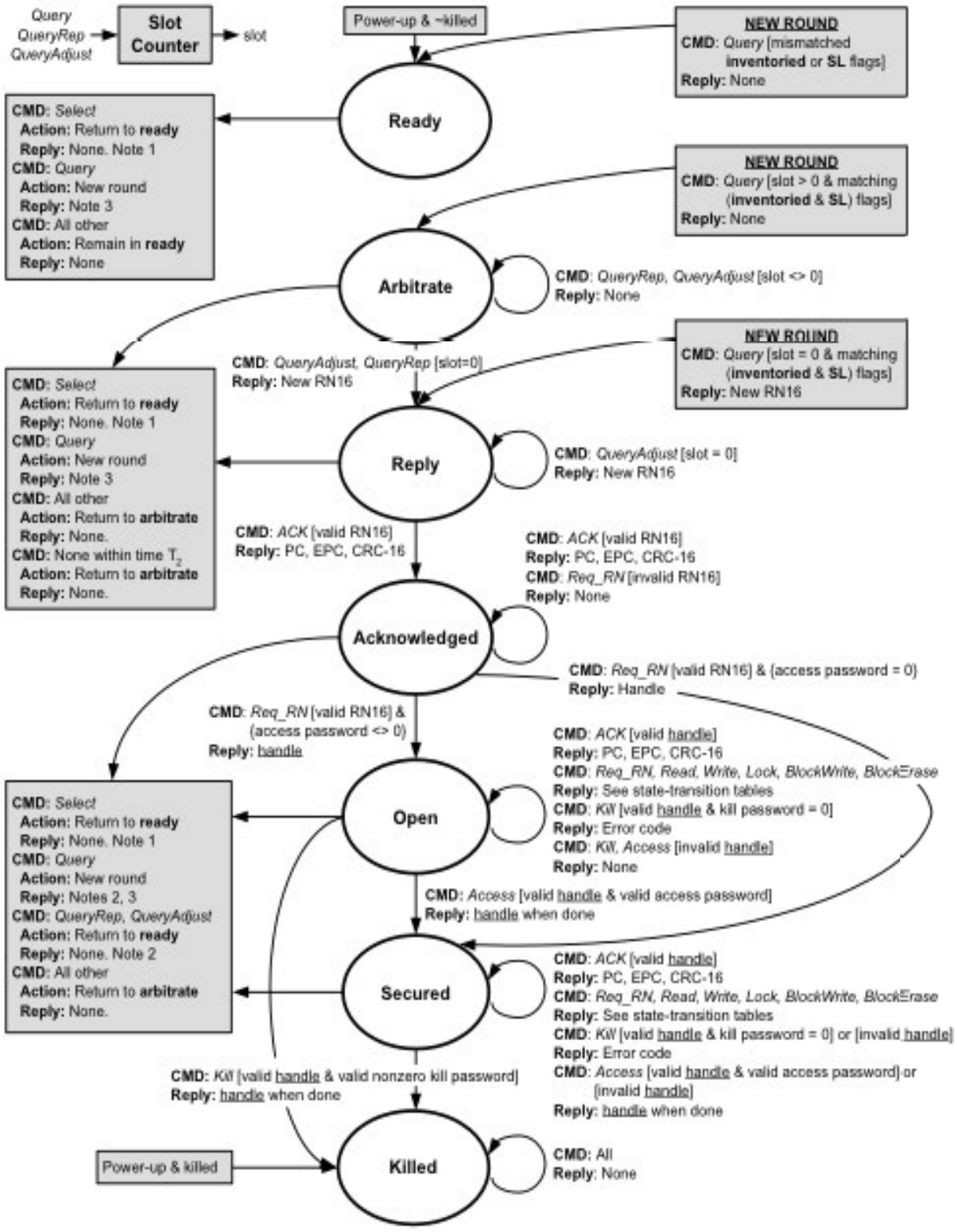

Figure 4 EPC Tag States

the Block-splitting technique inherits the feature of fast resolution on empty slots from the tree algorithm without exhaustively searching the tree space.

The developments of RFID offer considerable benefits for industry and consumers. However, some RFID applications have resulted in concerns about individual privacy. At issue is the fear that the RFID technology could be applied to monitor the behaviors of consumers via tagged products people buy. The concerns of consumers ought to be tackled to help avoid any obstacle on the expansion and exploitation of RFID in the marketplace. The RFID consumer education is an essential component of shielding consumer privacy. The industry, privacy advocates, and government ought to expand the educational tools for informing consumers about the choices in the use of RFID technology in specific real world applications. Moreover, technological protocols and products, such as encryption and blocker tags might be able to deal with the privacy concerns of the RFID devices.

Database security is a vital issue to resolve in the applications of the RFID technology in the manufacturing and retail settings. The security of the process for collecting information via RFID devices is an interesting area of research. The adequacy of the security of stored data is also important [4]. Database security is crucial in the investigation of privacy concerns of the use of RFID since the tags sometime include restricted data, such as a number in the case of EPC chips; the information associated with that number is usually stored on a trusted server for linkage to supplementary data [9].

There are also security issues with interoperable tags that can be read by different enterprises who share information about tags [5]; in particular, the databases supported by third parties might not be under direct control of the RFID owners. Thus, in such situations, security measures are crucial in databases that contain information from RFID tags tied to identifiable personal information of customers of tagged items.
The tags and readers of RFID often complicate the more central issues of general database security.

The need exists to establish secure protocols to protect communications between readers and tags; the effective use of encryption and/or passwords should be explored. The investigation should explore methods to restrict access to the tag itself via authentication on behalf of the scanning device. Blocker tags are tags positioned over or near the RFID tag to enable consumers to control items to block. With blocker tags that prevent RFID tags from communicating accurately with a reader, [12], consumers might benefit from any post-purchase applications of RFID that may evolve, such as smart refrigerators [11].

The security of the RFID technologies is an interesting area of research. Data transmitted to a computer system for storage, logging and processing by the reader is susceptible to hijacking and modification. The energy the transponder requires for transmitting signals is vulnerable to interruptions. Our research on the investigations of the security risks of RFID is still at the infancy stages. We are exploring the tradeoffs between security and the processing time required for encryption and decryption of RFID technologies.

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Towards a Conceptual Process-Oriented Framework for Patient-Centered E-health – An Exploratory Study of Current Projects in Sweden

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Abstract

This paper provides an overview of e-health and patient-centered care (PCC) from the perspective of one county council in Sweden, with a focus on chronic sickness. The aim is to suggest a framework for working with integrated IS/IT in support of PCC projects. Literature from several areas is reviewed, including PCC, chronic sickness and process-oriented health care. Experiences from a number of projects are presented, with a focus on the current use of IS/IT support. The experiences are clustered under a number of themes, providing outlines of a model for planning IS/IT in PCC. The paper ends with a discussion of challenges of using IS/IT for PCC in the area of chronic care, based on the proposed framework.

Keywords: Patient centered care, E-Health, IS/IT planning, chronic health care.

1. INTRODUCTION

Increasingly, health policy makers in Europe have acknowledged the potential benefits of e-health [1], one main political aim being to foster patient empowerment. There are a great number of studies of different initiatives and pilot projects, which, however, only focus on one side of the interaction between the healthcare system and patients, or on just one specific condition, illness or situation. In this article we will argue that there is a need for a framework that gives an overall picture of the field.

A focus on patients (i.e. patient-centered care, PCC) and their use of information technology (i.e. e-health) is a clear current trend in the field of health care. Both PCC and e-health areas have had problems that merit a further development of models and framework to guide the development and implementation of solutions. Dubé [2], for example, argues against a simplistic view of patients as rational information users, which is typical of PCC, indicating a more realistic understanding of how patients function when seeking, understanding and using information. Problems concerning the use of e-health are also discussed, for example by del Hoyo-Barolla et al. [3], where the authors also argue for a better understanding of the patient situation in order to get better results from e-health applications.

The basic approach here is to align IS/IT goals with general organizational goals (cf.[4]). It is getting the organization IS/IT connection right, which is the great challenge for success in using IT. This is also noted in the e-health area. Gartner [1] finds that many areas are common to every organization, as can be expected, the list including for example:

*Complexity, i.e. many factors and interrelated dependencies that influence the outcome of e-health projects, for example, the technical infrastructure or the information content.

*Governance, connecting e-health goals with general organizational goals.

*Stakeholder engagement, the involvement of different groups like users, managers, medical experts or IT personnel.

This paper aims to broaden the understanding about how to frame the integration of information systems and information technology (IS/IT) to accomplish and enable patient-centered care (PCC). To limit the scope of the problem area we focus on the field of chronic sickness, and the problems connected to the use of e-health and PCC ideas. The paper is outlined as follows: first a literature background covering the areas of PCC and chronic care. Then we look at a number of current cases, project descriptions in the PCC / e-health area. The paper concludes with a first outline of a PCC / e-health model for IS/IT planning.

2. BACKGROUND THEORY

As a starting point for this research, a number of existing works have been reviewed, including a chronic care model (CCM), a process-oriented care model, and patient centered care (PCC).

2.1 The chronic care model and IT

The paper focuses on patients with chronic conditions, because they have continued interaction with health care providers and need in many instances to handle their own care in their regular life situations. Typical examples of chronic conditions are hypertension, congestive heart failure, depression and diabetes. Wagner et al. [5] present a model for making chronic health care successful. Here, the driving force is identified as a need of a better match between the needs of patients and what the care systems deliver. Behind these problems there are those identified both in the delivery systems and among the patient groups. Troubles with the use of information systems and passive patients are examples of such problems. Suggestions for improving this problematic situation are formulated as the Chronic Care Model (CCM), see Figure 1. The framework has been used by more than a 100 health organizations as a guide for improving quality.

The framework is made up of 6 types of interventions:

1. Health care organizations involve changes on the higher organizational levels of health care. For example, higher-level leadership has proven to be an essential component in the CCM model. This could for example manifest itself in changes in high-level plans and goals.

2. Community support helps to activate and inform patients and families on how to better cope with the challenges of living with and treating chronic sickness. Traditional didactic approaches that provide more knowledge to patients have not proven effective in changing patient behavior. The family and other people close to the patient are important as motivators. Important aspects of behavioral management problems include goal-setting, identifying barriers, and planning for reaching the goals.

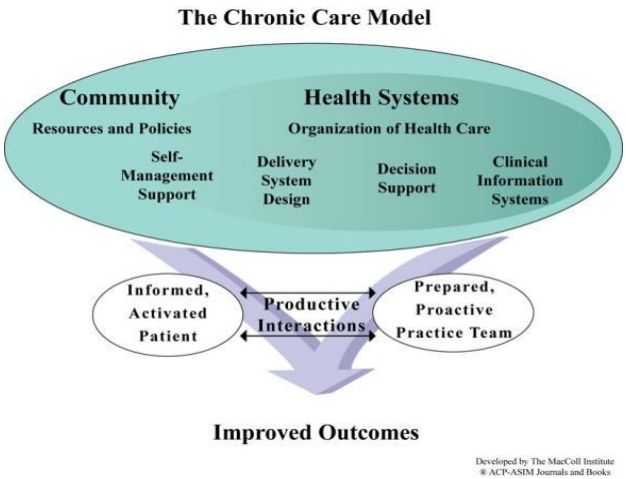

Figure 1. The chronic care model, [6]**.**

3. Self-management support. Guidelines are a common tool for supporting self-management. These are used for increasing the skills required of the patient for managing their condition. Guidelines must be accompanied by a number of other activities including education, reminders, specialist involvement and, as noted above, motivational support from the patient community.

4. Delivery system design involves changes in clinical personnel and patient flows, for example by creating coordination between different categories of caregivers.

5. Decision support includes activities aimed at providing the knowledge and skills of providers. Examples of support are guidelines and patient assessment tools that are combined with recommendations for treatment.

6. Clinical information systems regard the use of technology for collecting, summarizing and reviewing patient data in support of the care process. Here we find the traditional values of information systems, including timely, secure and relevant data about patients and groups of patients. This type of system could be used for calling in patients, planning and delivering care, receiving feedback and reminding patients.

2.2 Patient-centered care and e-health

Patient-centered care has been an emerging approach, in contrast to the 'biomedical model', and a great deal of hope has been attached to this approach when it comes to lower costs and delivering a better quality of care [7]. To empower patients or relatives and make them more active in their own care situation is the main focus in patient-centered care. Being emergent, no final definition has been laid down; it could rather be seen as a collection of ways of making patients and their relatives more active in the health care process. An attempt [8] to capture the area is to see it as a conceptual framework consisting of four dimensions: 'the patient-as-person'; sharing power and responsibility; therapeutic alliance; and 'the doctor-as-person'.

The approach has been criticized for focusing too narrowly on the relationship between the physician and the patient. Then the concept of self-management has been used to broaden the patient's activity level (cf. [9]). The focus turns from the communication skills of the physician towards targeting patient competence as a self-manager [10]. Supporting self-management [11] is one way of approaching this problem. Coleman and Newton [11] argue that self-management is a key component of effective chronic illness care. Self-management includes patient ability in problem-solving and the application of knowledge in real-life situations.

The focus is now on information technology, or more specifically e-health solutions for accomplishing patient-centered care, important characteristics of the development being that IT is designed and used with an emphasis on the patient and on making the patient empowered and active [12]. Patient focus means understanding the patients' needs and preferences in relation to a health care situation. There has to be a focus on the relationship and how to contribute to productive interactions between patients and their health care providers as a whole over time and on the need for patient changes. For e-health solutions this means that the patient and the relatives are seen as much as users and contributors to information provision in the decision-making process as the health care providers (cf. [12]).

This approach takes the view of the patient as a self-manager, but also points out the importance of focusing on the interaction between the patient and the caregivers. In order to understand how IT can provide good support for the interaction as well as for self-management, the caregivers' perspective, 'the other side', also needs to be incorporated in a model.

In a report made by the Gartner group on behalf of the Swedish government [1] a number of problems and possibilities with e-health are discussed. The report evaluates the connection between IS/IT applications and a number of political goals for health care. Of special interest for this study is the "Empowerment" goal, referring to the degree of patient involvement in the care process ([1], p. 23), which lies at the heart of any PCC project. Here we find a number of connections between IS/IT systems and documented benefits. The use of patient portals has given patients a better control of how to contact the caregiver, as measured by the increase of e-visits and decrease of in-person visits to the caregiver. Further, the uses of electronic medical records have contributed to increasing the number of patients with self-management goals. However, on the whole, relatively few connections between empowerment and e-health could be detected, and the evidence seems to be rather anecdotal. Only 2 of 11 types of IS/IT support investigated have had an impact on empowerment. Besides, only 2 measures out of the 37 that were measured were connected to empowerment. Clearly, there are possibilities to further the development and improvement of this area. From a chronic sickness perspective, Gartner ([1], p. 21) presented an interesting figure in the estimate that the use of telemedicine for monitoring could reduce admissions per year throughout Europe by 5.6 million. This is just one figure out of many that could be picked out, but it reminds us about the nature of the problems facing health care, and what potentials there are in IS/IT. But let us first use the knowledge existing in the health care about engaging patients and constructing a framework that tells us about the necessary requirement for making patients empowered to see what role IT can play in that.

3. PROJECT BACKGROUND

The case is based on experiences by one of the authors, who was employed from 2004 to 2007 as project leader at the Development Department at Jönköping County Council in the Southeast Health Care Region in Sweden. The council works in close connection with the Institute for Health Care Improvements in Boston (IHI), Dartmouth Medical School and Clinical Microsystem organization and other organizations working with improvements in health care and learning. The question of supporting and making the care more patient-friendly and patient-centered was always on the agenda in each improvement project. As project leader/evaluator the researcher was involved in health and environment issues for children, the improvement of care for adults with mental illness, tools for changing the life style for elderly healthy people, and different IT projects. The experiences made the shaping of a tentative model for patient-centered care possible with new IT solutions and with the aim to extend knowledge transfer and creation in the relationship between the caregiver organization and care-taking patients. In addition to the projects directly involved in this research, a number of current related projects have also been reviewed in order to broaden the scope of the investigation.

3.1 The strategic process view of the County Council

Process orientation is a solid trend in business development [13]. A number of typical features include cross-functional process connection, focus on the end consumer, how process adds value, as well as measuring and the use of IS/IT in support of these efforts. This has also been used in the health care area, as reported, for example [14]. A practical example of this can be found in [15], see Fig. 2, which reports a case study of a health care organization in Jönköping County in Sweden. Here it is reported that an overall process plan was created for the whole health care organization, and all activities that existed in the organization had to be fitted into this grand schema. The map defines the process roles and how these contribute to the overall mission of the organization.

Maps of this kind have been drawn from the macro level down to the smallest micro-system or front-end ward within the County Council, altogether constituting a rather complex organizational model. Thus, in order to empower patients there is a need for a different view of this health system – the view of the patient.

4. E-HEALTH PROJECTS

In this section we present a number of on-going projects, with a focus on how to create PCC in general and also on using IS/IT as support for that.

4.1 Growing people - supporting parents

The Growingpeople.se website is directed towards parents and contributes on a broad scale to knowledge about children in general, not only about sick children. The site is managed by medical experts in child medicine and is today financed by advertisements and contributions from some of the regions in Sweden. One feature that makes this service successful is its great effort to translate one language into an everyday language that every parent can understand and relate to. This language barrier is a problematic obstacle to helping the parent to understand the child's situation. The material is filtered and organized so that the most plausible understanding of a situation (possible sickness) is focused on, and the more extreme and serious problems are put in the background so as not to alarm people unnecessarily. It is also possible to ask direct questions, which has led to a substantial question database. Today it is estimated that half of Sweden's parents have visited the site. In child care at Jönköping County Council this website has served as a communication tool for physicians and nurses in explaining the evidence-based medicine or experience-based practice to parents. This development and the use of this kind of websites make it possible for patients and relatives to understand their conditions in an everyday language, enabling them be more aware and knowledgeable about the best practice in care right now. By the possibilities to ask questions the parent can also obtain a second opinion and connect to the expert's knowledge in between visits, whenever questions come up. But it is also necessary to offer knowledge about how to cope with a new situation both for the patients and for their relatives. This could be supported in the same way by supplying the connections to others in the same situation on a secure web-portal.

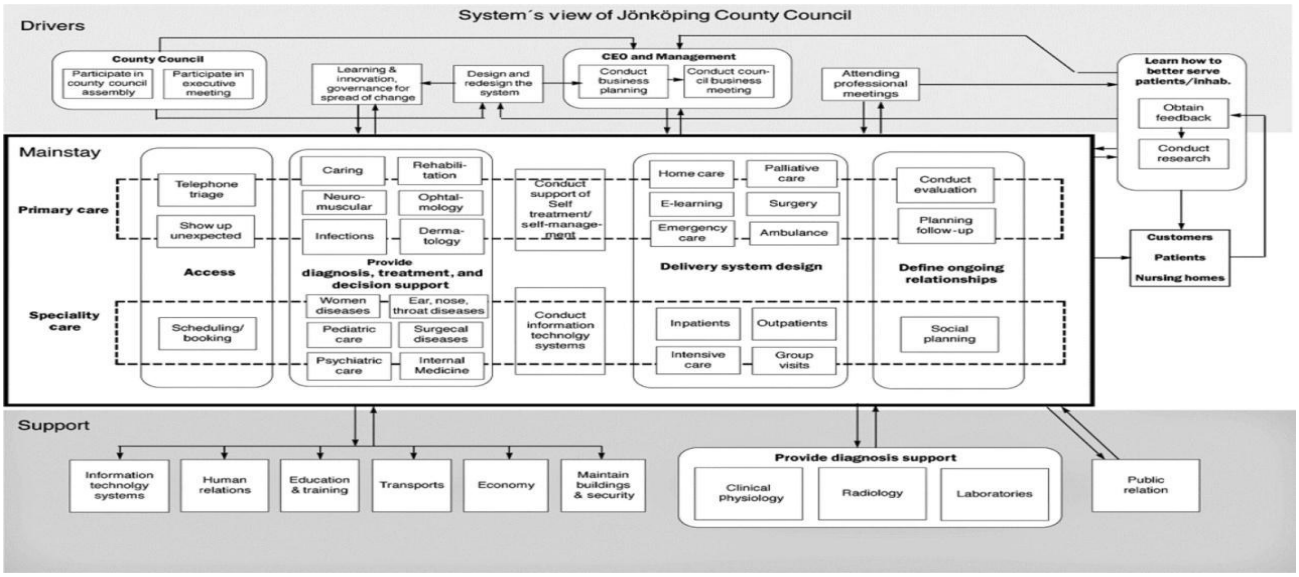

Figure 2. "Map of key processes-systems, Jönköping County Council" [15]

4.2 A support site for young diabetes patients

One site that focuses on the community around the diagnosis (diabetes) is www.diabit.se. The site is sponsored by a Swedish region and aims at helping patients, or rather parents to children with diabetes, to treat the sickness at home. The site contains a wide range of basic facts around diabetes as well as a question and answer section. A major part of the site focuses on the interaction between patients/parents that supports building a community, with a traditional forum for discussion, with rooms for different aspects of diabetes, and on different groups of patients. The forums make room for discussions among patients or parents, where questions or worries can be debated. Most answers come from the community rather than from medical experts. There are also movies that give an insight into the everyday life of diabetes patients. A special focus is on young people with the sickness, who can discuss their situation with other young people. The site also consists of support for registering their own measurements of blood glucose over time (with meters in the market this can also be done all digitally) and for discussing it with nurses or/and physicians to learn about the relationships of medicine, diet and physical activities. Here we can see that the site helps to understand the condition but also makes room for sharing patients' own experience of living with a chronic disease.

4.3 Preventive care for elderly people

One project focused on how elderly people can avoid problems and medical conditions that come with age. In the project, tools for improvement used mainly for organizational projects (cf. [16]) were tested at an individual level. The aim was to make people change their own behavior about home safety, nutrition, exercise and social networks. The project made them aware of the situation at hand, e.g. the risk of falling in the home environment and the well-known consequences of a fall such as a broken leg or arm. They measured near and actual falls and then made improvements like removing thick carpets or electric cords, or putting a towel in the bathtub, which resulted in fewer near and actual falls. Areas like food, exercise, and social life were discussed. With an extended IT support for this kind of projects we see that the approach can be used in other circumstances, helping people to overcome the obstacles in the way of a change in life style. The project ideas and program were spread all over Sweden and the original team members basically educated future advisors, for example in local courses The project is today supported by a website, http://www.lj.se/passionforlivet (meaning: passion for life). Preempting problems is always the best way, the question is how to motivate people to become engaged and want to learn. The project was focused on making this an appreciated event that stimulates and motivates life style changes.

4.4 Care on the web - IT applications for the patients

There has been great focus in the County Council on supporting the internal care processes with IT solutions, but there are still rather few solutions that offer support for the patients. Some small pilot and research projects have been conducted, but for the regular patient and care processes there is limited support. Today it is possible to get a picture of the organization and how to get into contact with it, and some overall regulations as well as some standard care plans are accessible through the website. As a patient you can also cancel your planned visit and get access to the national web pages (www.1177.se) that give general advice and information about symptoms, diseases and care.

The model proposed here is far from supported by applications available today, even though new projects that can support the need of better knowledge transfer and creation are running and starting on different levels in the Swedish health care sector. But there is a need to get an overall picture or model in order to see how the different IT solutions constitute a total delivery of patient-centered care processes. More advanced tools for measurements like digital scales, pedometers, blood pressure tools that transfer data to a web portal along with a diary of nutrition, exercise, self-reported feelings and social contacts are required, where the patient can learn about how different life style changes will improve the conditions caused by the illness.

5. TOWARDS A PROCESS-ORIENTED MODEL FOR IS/IT PLANNING FOR PCC

We can now sum up a number of key activities that might form a basis of an e-health process for patient-centered care. We focus on the different phases that a patient must go through on the path to a healthier life.

5.1 Understanding

In this phase the focus is on the process of how patients create an initial understanding of their illness. The care team can supply the output from evidence-based research in an everyday language and by various means (probably mainly through personal discussions with the patient or through written material). On the other hand, the patient will very probably come into contact with various public sources, typically magazines or www-based information resources – see the discussion about growing people above – like popular science. This phase is about creating a learning process, which in turn creates a foundation of understanding that will make the continued care process possible. This phase is also about making the caregiver understand about the patient understanding of the condition.

5.2 Measuring

Facts must be gathered as a first step towards taking effective action against the sickness or the symptoms of the condition. In a traditional world this usually means that the caregiver provides this within the health system organization. In a patient-centered world we would expect patients having (on loan maybe) their own instruments, and in the best case the information is captured, stored and made available to the caregiver, such as blood glucose testing for diabetes patients. This can also include screening, questionnaires where the patient enters answers to different questions, making observations and so forth. This is primarily used after the patient has gotten an evaluation and been diagnosed by the care team, to follow up or adjust treatments.

5.3 Decision-making

Traditionally, the caregiver decides and gives "orders" to the patient – the 'biomedical model'. In the patient-centered world of patient empowerment, the patient should be active and take responsibility for the choices of care. The idea of shared decision-making [17] is a key to engagement and compliance with care. At the same time the patient must have the right support and understanding, since, for example, the generation of options is not something the patient can achieve without proper support. The support lies in the compilation of facts and

measurements and the formulation of action plans that are in line with the patient's need.

5.4 Care planning

The planning is important for successful action, and in health care there are standard care plans for many different conditions. Here we find support like scheduling, instructions for how to act or reminder systems. Planning, as a process preparing for action, does not receive very much explicit attention. Transforming decisions made into action largely concerns understanding the patient life situation and removing barriers to action. An important step can be adjusting standard plans towards individual ones. In the end the "shared" part is the central one, i.e. the essential step in the interaction between patient and caregiver, whereas planning is unnecessary unless the patients and/or their relatives understand and agree to the plan when they are at home.

5.5 Action

Here the focus is on how to support patients in taking action in their own care plan. Many chronic conditions require life style changes for the patients in order to reduce symptoms – stopping smoking, diets, physical activities, security at home, etc. One problem is when activities that the patient wants to change are not carried out. A great deal of this relies on the motivation of the patient, since the action must be seen as important and meaningful and show quick results – self-improvement tools can be helpful to make the proper action happen, like in the case above with elderly people.

5.6 Writing records

The health care systems are largely concerned with gathering and storing facts that are generated throughout the care process. These systems are present during the entire process. Looking back at the Gartner report [1], we can see that many of the IS/IT systems are of this kind. The list includes for example: electronic medical records (EMR), computer-based patient records (CPR), and electronic health records. In the IS/IT tradition a great deal of data is gathered; however, the question that needs to be asked is to what extent a PPC approach to health care actually constitutes support. The lack of patients' own records of data in these systems makes it impossible for a care team to learn about the individual patient's care process. This will be essential and can contribute to better communication between patient and care team – where the actual care activities at home can be visible rather than the planned standard care provided by the team.

6. CONCLUSIONS

The aim of this paper has been to work towards a process-oriented PCC model for e-health. The work has been based on three theory areas: PCC, CCM, and process-oriented care, and has been further informed and directed by the use of several current e-health projects. As a concluding discussion we can make some final comparisons with the ideas from the background framework.

- Comparing with CCM. We have clearly seen the need of a holistic view of the care process, since it is complex and many aspects have to be put on the map. What has been added to this perspective is a clearer focus on the two sides of the process, i.e. the patient side and the care team side, and on the need to plan for how these interactions should be structured. The focus on IS/IT has been made more prominent.

- Looking back on the care process map that was reviewed, a clear change in perspective can be seen. The map [15] uses a process based on four major steps: assessment, diagnosis/decision-making, delivery system and ongoing relationship. The last stage refers to a long-term relationship, the follow-up to the care given. That process has more of a health care organization perspective, not one that has the patient in focus.

- The IS/IT planning perspective of the model is on a rather high or strategic level, following traditions of ends-means analyses based on normative descriptions of processes. The idea is that if we have an ideal view of how things should work and can describe the current situation, then we can make a gap analysis and suggest changes. In this case this means a list of IS/IT artifacts that should be implemented in order to create or support certain activities within the health care process.

There should also be room for some critical reflections on the proposed process model. The model might appear as a rather rational and linear view of the care process, and this might not always be the best way of understanding care in practice. The phases should be understood as the set of activities that should be tackled during the process, how they appear in time and how the interaction in time might become much more complicated. A future direction for research would be to further explore and give practical examples of how care processes can be guided and planned by the use of the model. In such examples it would be possible to go into the complexity of getting everything in place and how to resolve practical and time constraints between activities within and in between phases. The process orientation should in principle mean that all measures within the health process should relate to the increased value of the patient. This aspect is right now covered in the interaction dimension of the model. However, this is an aspect that would benefit from more work, especially on the measurement of patient values.

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Methodology for e-Government Readiness Assessment – Models, Instruments, Implementation

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ABSTRACT

e-Government Readiness Assessment is a vital step in developing effective e-Government strategies which provides important knowledge for policy- and decision-makers. Particularly for developing countries, it is imperative to analyse the conditions, opportunities and challenges of an existing environment to ensure that the resulting e-Government strategy is realistic and workable, whilst enabling public administration reform in support of a sustainable development agenda. While there are different approaches to e-Government Readiness Assessment, the review of existing literature reveals a general lack of focus on methodology and survey design for e-Government Readiness Assessment applicable to developing countries. In this paper, we present the key elements of a holistic e-Government Readiness Assessment methodology, considering national- and agency-level survey model and instrument design. In addition, we discuss implementation issues and present recommendations for future research including the validation of the proposed methodology.

Keywords: E-Government, Public Administration, Strategy Development, Readiness Assessment, Survey Design

1. INTRODUCTION

e-Government planning involves assessing e-Government readiness from different perspectives, elaborating a long-term vision, formulating strategic goals and objectives, aligning them with national development strategies and public administration reforms, and defining priorities and concrete implementation programmes. The assessment stage is particularly important as it provides inputs to the later stages, thus supporting both strategic and implementation planning. It can also provide a valuable exercise for assessing the motivations and capacity to commence and sustain e-Government programmes.

As a foundation for developing e-Government strategies, e-Government Readiness Assessment provides important knowledge for policy- and decision-makers. The developing country context makes it particularly important to analyse the conditions, opportunities and obstacles of an existing environment, to obtain a realistic and workable e-Government strategy that supports public administration reform and sustainable national development. It can also help identify the driving forces for government modernisation, and prioritise e-services that address essential needs of the stakeholders.

Given a short lifecycle of e-Government Readiness Assessment due to rapidly changing environments, the need for building national capacities for regular assessment as part of strategy development processes is emphasised [1]. In this context, the aim of e-Government Readiness Assessment for developing countries is to provide continued baseline data and all necessary information for e-Government strategy development that addresses national development needs, and to establish a sustainable implementation and monitoring system.

While there are different approaches to e-Government Readiness Assessment, each providing inputs to e-Government development, a review of the literature on the topic revealed lack of work on methodologies for e-Government Readiness Assessment applicable for different levels of government, and focused on the needs of developing countries. This paper aims to present a methodology for e-Government Readiness Assessment and the design of a survey to carry out the assessment for strategic planning in developing countries.

The rest of the paper is organized as follows. Section 2 presents the background, followed by e-Government Readiness Assessment methodology in Section 3. The survey model and the instruments for national- and agency-level assessment are presented in Section 4. The implementation issues are discussed in Section 5, and Section 6 provides conclusions.

2. BACKGROUND

A number of readiness assessments focused on electronic government development have been conducted over the last decade. These include the United Nations e-Government Survey reports by UNDESA [2], Global e-Government reports by the Centre for Public Policy, Brown University (CPP-BU) [3], the e-Government Leadership reports by Accenture [4], and e-Government Rankings by Waseda University [5]. A review of these assessments shows that the majority of the approaches to e-Government Readiness Assessment concentrate on ranking countries. The UNDESA series on e-Government [2] and the Brown University rankings [3] cover over 190 countries each. The UNDESA surveys use a composite index based on ICT infrastructure development, human development and maturity of online presence of governments, whilst CPP-BU focuses primarily on the development and maturity of online presence of governments in the ranked countries. On the other hand, Accenture [4] and Waseda University [5] focus on customer services, and e-Government promotion and management respectively, and assess a relatively few countries as compared to UNDESA or CPP-BU. In contrast to UNDESA, CPP-BU, Accenture or Waseda University, the eMacao e-Government Readiness Assessment [6] was designed to provide detailed information for strategic planning at the agency level. The survey, conducted by the UNU-IIST Center for Electronic Governance across the Macao SAR Government, provided

information about different aspects of individual agencies and the relationships between the agencies and the services they produce or receive to/from the environment or other agencies.

However, the comparative analysis of the measures, strengths and weaknesses of the five well known e-Government readiness assessment approaches revealed that existing frameworks do not scale up to cover different levels of government [8][9]. Furthermore, they are not sensitive to the overall country context. This however is crucial particularly for developing countries with weak public administrations, lack of resources and low human and institutional capacities. In addition, these frameworks do not cover various types of e-Government stakeholders at different levels of government.

Taking these issues and requirements for strategic planning for e-Government into consideration, a component-based e-Government readiness assessment framework was proposed as a basis for strategic e-Government planning [8]. This framework was adapted to satisfy the information requirements for demand and supply components of e-Government at different levels of government, and to assess technology, resources, online services, national and local contexts, and perceptions and challenges for e-Government development. In order to ascertain the enabling environment for e-Government development, the framework adapted the Waseda University e-Government readiness assessment which puts an emphasis on the existence of an enabling environment including back-office integration, IT management in the public sector, legal and regulatory environments, and public sector reform. The framework covers seven perspectives – stakeholders; demand; supply; technology; national, federal, local, community and international contexts; enabling environment; and perceptions, willingness and challenges. Within these, it supports the development of specific assessment instruments at different levels of government.

In this paper, we apply the component-based framework for e-Government Readiness Assessment as a basis for survey design and instrument development. The framework is applicable to developing countries due to its flexibility and adaptability to different government levels, and focus on national contexts, enabling environments and various stakeholders underpinning realistic and effective e-Government strategic planning.

3. E-GOVERNMENT READINESS ASSESSMENT METHODOLOGY

The methodology for e-Government Readiness Assessment proposed in this paper aims to address information requirements for strategic planning by assessing e-Government demand and capabilities within national and international contexts, as well as the enabling environment and ICT infrastructure. The proposed methodology has been developed based on the component-based e-Government Readiness Assessment framework, with assessment elements taken from the UNDESA approach. Key amongst e-Government readiness assessment factors are human, financial, technological, regulatory and organizational factors, all covered by the component-based model.

The methodology defines the model, scope and process for the survey and instrument design, as well as data collection and data analysis to address information requirements for e-Government strategic planning. It allows developing concrete national- and agency-level assessment instruments.

As shown in Figure 1, the methodology contains: Assessment Model, Assessment Scope, Assessment Process, Assessment Instruments, Sources, Stakeholders and the Assessment Team. They are described in detail in the following sections.

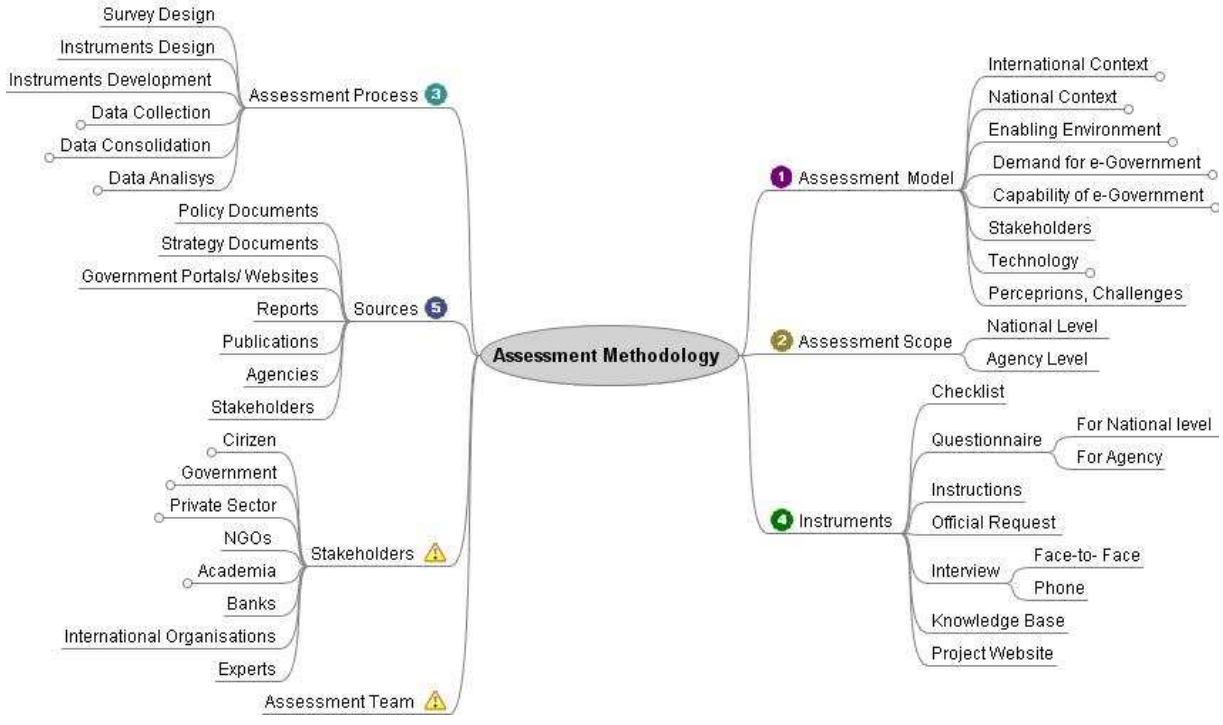

Figure 1: Key Elements of e-Government Readiness Assessment Methodology

3.1. Assessment Model

The proposed assessment model for e-Government Readiness Assessment has been designed by applying the component-based framework [8] with some assessment components partly obtained from the UN e-Government Readiness Assessment Survey [2], Brown University Global e-Government Survey [3], and Accenture e-Government Leadership Survey [4].

The component-based model provides significant flexibility in developing concrete assessment instruments from existing components and customizing these components to fulfil concrete requirements. It determines the information required for each component during survey design, and helps develop the instruments to gather data from different sources.

The model is organized into 8 perspectives, see Figure 2:

C1) *International Context* – to determine the relationships of a given country with its international development partners.

C2) *National Context* – to capture the main development features of the country at the national level.

C3) *Enabling Environment* - to assess environmental conditions for the development of e-Government in the country.

C4) *e-Government Demand* – to estimate the needs and interests, attitudes and perceptions, preferences of delivery channels, and ICT skills of different users in the country.

C5) *e-Government Capability* – to acquire information on the practices of using ICT by government for administrative and service delivery purposes; human, technical and financial recourses available for ICT; and on-going projects initiated by different stakeholders.

C6) *Stakeholders* - to understand and engage the stakeholders in e-Government planning for successful implementation. The stakeholders are required to participate in e-Government Readiness Assessment to supply critical information for strategy development including specific business requirements and drivers for IT, and expectations regarding e-services.

C7) *Technology* – to assess ICT penetration in the country, hardware, software platform, and network and security infrastructure, availability of public access to information and services, and ICT applications.

C8) *Perceptions and Challenges* - to identify the perceptions with respect to e-Government in the country and the challenges faced by different stakeholders.

Thus, the model provides a set of assessment perspectives including the strategic context for e-Government – national development, policy goals, supply, demand, perceptions, etc. Given specific assessment scenarios, different perspectives are selected and the corresponding components specialized to address the resulting information needs.

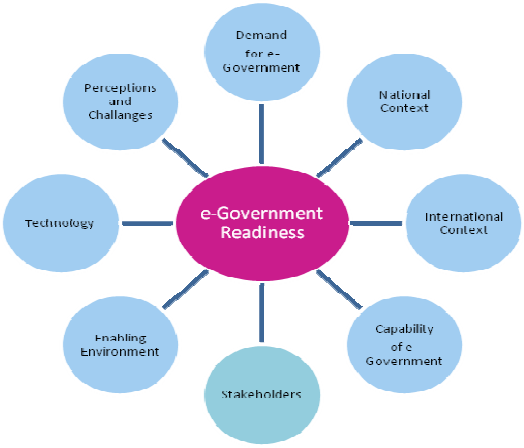

Figure 2: e-Readiness Assessment Model

3.2. Assessment Scope

The scope of e-Government Readiness Assessment defines the levels of government covered by the assessment, helping to estimate the human resources and the time-frame required for the survey exercise and to ensure proper survey and instruments design. Although this methodology can be adapted for different levels of government, national- and agency-level surveys are recommended for developing countries, taking into account lack of resources and low human and institutional capacity.

The National e-Government Readiness Survey is to determine the overall country development context from the national and international perspectives, the enabling environment, the ICT infrastructure capacity and access to information, on-going e-Government related initiatives of different actors within and outside the government, as well as ICT literacy in the country.

The Agency e-Government Readiness Survey is to determine the state of e-Government capability in key government agencies, and on this basis formulate the "big picture" of the state of e-Government for the government as a whole, taking into account the findings of the survey at the national level.

3.3. Assessment Process

The proposed e-Government Readiness Assessment process comprises six major steps:

S1) Survey Design
S2) Instrument Design
S3) Instrument Development
S4) Data Collection
S5) Data Consolidation
S6) Data Analysis

4. SURVEY AND INSTRUMENT DESIGN

4.1. Survey Design

Survey design is an important step in e-Government Readiness Assessment as it allows defining assessment implementation scenario from the component-based model. After determining

the categories of information to be collected within each component, the level of the survey and possible sources for gathering related data are identified.

As shown in Table 1, components C1 - International Context, C2 - National Context and C3 - Enabling Environment require gathering data at the national level only. The main sources for acquiring information are: policy documents (PD), reports (R), publications (P), and portals and websites (P/W). All other components: C4 - Demand, C5 - Capability, C6 - Stakeholders, C7 - Technology, and C8 - Perceptions and Expectations require gathering data at both national and agency levels from different sources including Stakeholders (S) and Agencies (A).

According to the component-based approach, the surveys at the national and agency levels can be carried out simultaneously by applying specific instruments for each level.

C1 - International Context	National Level	Agency Level	Source
C1-1 Millennium Development Goals	✓		P/W, P
C1-2 Development Partner Assistance Strategies	✓		PD, P
C1-3 International Treaties, Conventions, Agreements	✓		R/P
C2 - National Context	**National Level**	**Agency Level**	**Source**
C2-1 Political Development	✓		P/W, P, R
C2-2 Geographic, Demographic and Cultural requirements	✓		P/W, P, R
C2-3 Socio-Economic Trends	✓		P/W, P, R
C2-4 Environmental Factors	✓		P/W, P, R
C3 - Enabling Environment	**National Level**	**Agency Level**	**Source**
C3-1 Policy and Strategic Direction	✓		P/W, PD, P
C3-2 Public Sector Reform	✓		P/W, PD, R, P
C3-3 Legislation , Regulation	✓		P/W, PD, R
C3-4 Leadership and Coordination	✓		P/W, PD, R
C3-5 Financial Infrastructure	✓		P/W, PD, R
C3-6 Partnership	✓		P/W, PD, R, S
C4 - Demand for e-Government	**National Level**	**Agency Level**	**Source**
C4-1 Public Services	✓	✓	P/W, R,P, A
C4-2 ICT Usage	✓	✓	P/W, R,P, A
C4-3 ICT Literacy	✓	✓	P/W, R,P, A
C4-4 ICT Education	✓		P/W, R, P
C5 - Capability of e-Government	**National Level**	**Agency Level**	**Source**
C5-1 Front –Office Systems	✓	✓	P/W, PD,R, P,A
C5-2 Back-Office Systems	✓	✓	P/W, PD,R,P,A
C5-3 Databases	✓	✓	P/W, PD,R,A
C5-4 Data Sharing	✓	✓	P/W, PD,R, A
C5-5 Document Exchange	✓	✓	P/W, PD,R, A
C5-6 E- Document	✓	✓	P/W, PD,R, A
C5-7 Resources	✓	✓	P/W,PD, R, A
C5-8 On-Going Initiatives, Projects	✓	✓	P/W, PD,R,A,S
C6– Stakeholders	**National Level**	**Agency Level**	**Source**
C6-1 Government	✓	✓	P/W, PD,R,P,A,S
C6-2 Citizens	✓	✓	P/W, PD,R,P,A,S
C6-3 Private Sector	✓		P/W, PD,R,P,S
C6-4 NGOs	✓		P/W, PD,R,P,,S
C6-5 Academia	✓		P/W, PD,R,P, S
C6-7 Banks	✓		P/W, PD,R,P, S
C6-8 International Organization	✓	✓	P/W, PD,R,P,A,S
C6-9 Experts	✓	✓	P/W, PD,R,P,A,S
C7 – Technology	**National Level**	**Agency Level**	**Source**
C7-1 ICT Infrastructure	✓	✓	P/W, PD,R,P,A,S
C7-2 Access to Information and e- Services	✓	✓	P/W, PD,R,P,A,S
C7-3 ICT Applications	✓	✓	P/W, PD,R,P,A,S
C8 – Perceptions and Challenges	**National Level**	**Agency Level**	**Source**
C8-1 Perceptions with respect to e-Government	✓	✓	P/W, PD,R,P,A,S
C8-2 Challenges	✓	✓	P/W, PD,R,P,A,S

Table 1: Components Implementation

4.2. Instruments Design

e-Government Readiness Assessment requires various types of instruments for specific purposes at different assessment stages. We suggest the following list of instruments:

I1) Stakeholder Analysis Tool – to support identification of major stakeholders, documentation of their roles, profiles and interests, and development of communication plans.

I2) Survey Instruments – to collect information required for strategic e-Government planning at the national and agency levels. Several types of instruments are required to collect specific information for different components:

- ✓ Questionnaires
- ✓ Instructions
- ✓ Official Requests
- ✓ Interviews – face-to- face or phone

I3) Knowledge Base – to capture collected data and use it for data consolidation and analysis.

I4) Project Website – to disseminate the assessment findings.

4.3. Survey Instruments

The survey and instrument design provide a basis for the development of specific survey instruments for strategic e-Government planning in a country. The component-based model allows developing instruments by re-using existing tools following e.g. eMacao, UNDESA or Waseda approaches. As eMacao e-Government Readiness Assessment framework covers e-Government demand and capabilities at the organizational level, the instruments for Demand and Capability components have been chosen from this tool for adaptation and extension. They can be also extended to support the information requirements for the Technology, National Context and Challenges perspectives of the proposed model. As the UNDESA and Waseda University rankings pay particular attention to the existence of an Enabling Environment and e-Government Capabilities including back-office integration, IT management in the public sector, the legal environment and the public sector reform, the UNDESA and Waseda University instruments are adapted for the national-level survey.

Thus, we recommend the following survey instruments to be developed for e-Government Readiness Assessment taking into account the governance structure and public administration:

SI1) Questionnaires for National-Level Survey – questions related to information requirements to ascertain National and International Contexts, Enabling Environment, and Demand and Capability Components, aimed at the central government departments and key external stakeholders including NGOs, academia, the private sector and international organizations.

SI2) Questionnaire for Agency-Level Survey – questions related to public services including supply and capability sides.

SI3) Interview Questions - questions for e-Government stakeholders related to their profiles, interests, capacities, perceptions, willingness to participate in e-Government strategic planning, and challenges.

SI4) Official Requests – official requests to the Agencies and Stakeholders used for collecting information not available from other sources.

SI5) Instructions – guiding materials for the Assessment Team with detailed process on data gathering to ensure completeness, integrity and accuracy.

Questionnaire for the National Survey - The main requirement of the survey at the national level is to ascertain perceptions, national drivers, persistent inhibitors, overall attitudes, and technological and human capacity development at the national level. The questionnaires are aimed at different stakeholders including central government, non-governmental organizations, academia and international development partners. The demand and capability perceptions and what are believed to be the key drivers and expectations of the public sector reform and e-Government are assessed. This gives a clear picture of the stakeholder perspective at the national level and can be compared and contrasted against the information gathered through the agency-level assessments in order to: determine the gaps and alignment issues, help identify key strategies to be developed, and define key thrust areas aligned with the national perceptions, expectations and development demands.

Questionnaire for the Agency Survey - The approach for the Agency Survey is based on the provision of services by the agencies. Since the agencies participating in the survey are different from one another, we recommend a service-oriented perspective, as opposed to the organizational structure. The questions should collect information on public services; on-going projects; back-office and front-office IT systems; technical, human and financial resources; and determine the perceptions and challenges faced by agencies. They should not be limited to the provision of electronic information/services or even to the technical aspects of the agencies, but focus instead on three kinds of services: (1) services provided by the agency to other entities; (2) services received by the agency from other entities; and (3) services provided and received within the agency. In addition, questions related to the function, structure, operations, services and resources of the agencies should be captured, including technical (software, hardware, networking and telecommunication), human and financial resources, as well as capacity, perceptions and expectations of the agencies.

5. IMPLEMENTATION ISSUES

The proposed methodology and survey design are currently applied for the development of the national strategy for e-Government in Afghanistan within a joint project between the Afghan Ministry of Communication and Information Technologies (MCIT) and the UNU-IIST Center for Electronic Governance. The implementation process and the issues and challenges arising during implementation are discussed below.

5.1. Assessment Process

As the first step, an assessment team was established. The leader of the team from the MCIT e-Government department was engaged in the process of adapting the proposed assessment model for the conditions in Afghanistan, and developing concrete survey instruments applicable for the country. The number and profiles of the members of assessment team were defined according to the scope of the exercise, to ensure simultaneous conduct of national- and agency-level surveys. The team was established from MCIT e-Government specialists and representatives of the Kabul University, by assigning concrete roles to the team members in order to facilitate concurrent surveys at the national and agency levels.

The training for the team was provided by the UNU-IIST Center for Electronic Governance to explain the methodology, objectives, expected results and outcomes, framework, scope, model, sources and survey instruments for Afghanistan, and to present best practices. The training also included the process for administering the surveys and highlighted the important role of the stakeholders. In addition, practical exercises were conducted with assessment team in applying the instruments.

The main responsibilities of the assessment team were:

1) Questionnaire distribution to identified organizations
2) Gathering data from identified sources by administering prepared instruments
3) Interviewing officials and other stakeholders
4) Reviewing related documents and reports
5) Collecting missing data or information
6) Capturing data into the knowledge base

The data collection process included the following steps:

1) Collect required data from official publications, reports and other documents related to e-Government and Public Administration in Afghanistan;

2) Review official portals and web-sites related to e-Government and Public Administration in Afghanistan;
3) Meet the key stakeholders to learn their interests, concerns and capacity related to e-Government in Afghanistan;
4) Send questionnaires specially designed to find out and document the agency's missions, structures, services, resources and e-Government efforts;
5) Review agencies' websites by the assessment team; and
6) Visit agencies to meet and discuss the issues arising from the questionnaires such as the missing or inconsistent information, and the follow-up discussing the concerns of the agencies as regards e-Government projects.

In order to facilitate data collection, every agency assigned the Primary Coordinator – Director or Deputy Director, and the Secondary Coordinator – Head of Information Technology Division or the individual responsible for e-Government development in the agency. With such senior management and technical staff involved, it should be possible to coordinate through various units of the agency the work required to fill and revise the questionnaire, organize onsite visits, and review and approve the findings and reports.

The data collected during the survey is currently being captured in a Knowledge Base developed as an instrument for data consolidation and analysis for strategic planning: statistical analysis of the variables collected and social network analysis of the agencies' service provision. At the same time, the process includes concrete measures to ensure quality, integrity and confidentiality of information gathered. A help desk is also established for the assessment team to reply to questions and make the necessary changes in the process, ensuring a degree of flexibility when facing the realities of the environment in Afghanistan.

5.2. Issues and Challenges

A number of issues and challenges are being faced in applying the proposed methodology for assessing e-Government readiness in Afghanistan. These include:

1) Lack of understanding of the importance of e-Government in general and particularly readiness assessment by the public sector agencies;
2) Lack of capacity in the agencies to fill the assessment questionnaires;
3) Lack of resources for the assessment team;
4) Translation of the survey instruments from English to two local languages and translation of data collected from the agencies from two local languages to English;
5) Lack of available statistical data related to Afghanistan;
6) Lack of research capacity in e-Government domain in Afghanistan; and
7) Political instability including presidential elections, renewing the Cabinet of Ministers, etc.

6. CONCLUSIONS

This paper presented a comprehensive assessment methodology for e-Government, applicable for developing countries, and discussed implementation issues. The methodology comprises a component-based model and national- and agency-level survey instruments that address information requirements underpinning strategic e-Government planning. Key amongst e-Government readiness assessment are human, financial, technological, regulatory and organizational factors, all covered by the component-based model. The model allows systematic adaptation of the methodology to the local needs and its application to different levels of government. The components are derived from existing e-Government readiness assessment frameworks and are designed to allow re-use in developing specific instruments for particular purposes. The proposed methodology is currently applied in Afghanistan and will be revised and updated in view of this experience.

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Rethinking the E-government Theories: the Rise of Social Media during Typhoon Morakot

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ABSTRACT

Even since the catch on of information and communication technologies, they have been seen as the leading edge for solving all sorts of communication problems, henceforth, creating a brand new hope for realizing the full potential of good governance through social media. This paper reviewed bottlenecks of communication and negotiation both between government organizations and between government and society at large in Taiwan, particularly during the record breaking disaster caused by .typhoon Morakot in Aug 2009. This paper also examined how the social media, the first of its kind ever witnessed in Taiwan, had played critical roles in helping government agencies and civilians getting over with their bottlenecks in managing information related to disasters caused by typhoon Morakot. Finally, to go to the bottom line of information management by public organizations, the authors conducted some probing reflections on the relationship between the nature of bureaucratic tasks and their incentives to communicate and share information.

Keywords: Social Media, Micro Blogs, Disaster Mitigation, Communication and Negotiation.

1. INTRODUCTION

The internet penetration rate in Taiwan has grown threefold over the last ten years, from the low of 17.4% in 1999 to a high of 74% in 2009. People have become more and more reliant on internet. Reinforced by the quite recently developed information technology such as Web2.0, internet communities in Taiwan have witnessed a highly rampant and diversified development over the last ten years. All sorts of blogs, web service systems, and micro blogging systems have also evolved to take over the dominant roles of traditional print and screen media. Communication through cyberspace possesses special features such as speediness, prompt streaming, horizontal-ness, and etc. that have generated brand new ways of supply and demand for communication in many countries all over the world.

At times of major disasters when traditional media fail to meet the urgent information needs of the general populace, web users tend to develop information anxieties. Against such a backdrop, web users also tend to turn to all sorts of web communication systems for gathering and broadcasting information, which also bear significant weights for public policy activities. All these can be succinctly caught in the idea of 'social media,' a concept promoting interactions between government and non-government sectors for better governance, emphasizing communication through updated web information management systems.

However, communication through ICT between the society at large (web communities in particular) and the government may be more complicated than originally expected by early E-government proponents (Layne and Lee, 2001; Moon, 2002).

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The joint efforts in information management by the Disaster Reduction Centers (hereafter DRCs) of various levels of governments and the Association of Digital Culture, Taiwan (a NGO, hereafter ADCT) during typhoon Morakot that had caused severe damages and casualties in Taiwan in August, 2009, is a case to the point.

2. THE MORAKOT INCIDENCE

Typhoon Morakot hit Taiwan at 23:50 in the night of Aug 7 (Fri), 2009. It had rained more than 2000mm over that weekend and brought along large-scale mudflows and landslides that had caused sever damages to many localities in southern Taiwan. In that morning, the Central Weather Bureau has already released an unprecedented 1100mm forecast in the mountainous areas of Kaohsiung and Pindong area. After that, it kept revising its forecasts upward. In that morning, the Central Weather Bureau in Taipei had already released an unprecedented 1100mm forecast in the mountainous areas of Kaohsiung and Pindong. After that, it kept revising its forecasts upward. At that night, a record high of 1400 mm was forecasted. Yet, the sobering meaning of these figures escaped the attention of the central and local authorities, not to mention the general public.

The heavy rain carried by Morakot moved slowly from southern to central Taiwan at a speed around 12 mph from Aug 8th to 9th. In the midnight of Aug 8, while central government in Taipei were still not aware of the severity of the typhoon, some disaster information had already broken through to the public by web users in Kaohsiung and Pindong. As individual web users started to spread the information they acquired through their mobile phone messages, plurks, twitters, MSN, or PPT (the largest social group on the web in Taiwan), massive information started to be transmitted in a spontaneous and speedy fashion. However, the upsurge of emergent requests on the web was quite chaotic and did not draw the attention of the authorities. As information asking for help poured into the official disaster information system, i.e. the 119 emergency call centers housed in all DRCs, it collapsed, even though it was already digitized many years ago.

Approximately the same moment, executive members of the ADCT happened to see TV news reports and made checkup phone calls to their members stationed in central and southern Taiwan. They were astonished to find that the disaster was much more serious than expected and decided to volunteer to do whatever they could to help. They also learned that there were problems associated with the information rushing out on the web. Henceforth, after a Skype conference with members of ADCT around the island, they made a few decisions. First, the ADCT set up a couple of web sites for disaster relief based on Twitter and made them synchronized with other micro blogs that had already been constructed by individual bloggers who provided disaster information services on personal basis. On top of that, the ADCT also established a canopy web site encompassing all the other more specifically designated sub web sites, i.e. the Disaster Information Center for Morakot on the Web (hereafter DICMW). Secondly, the ADCT persuaded successfully some local authorities to let them integrate disaster mitigation information from all sources. According to staffs of the ADCT, the existing collaborative relationships between the ADCT and some local governments, e.g. the Pefecture of Tainan, working on government contracts bridging the digital gap in rural areas, had been critical for the aforesaid success. Consequently, executives of the ADCT were well trusted by the leadership of the aforesaid local authorities. As a result, the director of the Bureau of Social Affairs of the County of Tainan asked the ADCT to station two of their members (the disaster center members, hereafter the DCM) on a 24 hour basis in their NDRC, which also housed the local 119 emergency call centers. As such, web users from the ADCT were able to engage in direct and face-to-face communication with all levels of officials working on disaster mitigation.

The DCM had to search, classify, and verify all the information they collected from web media, phone calls, and yellow sticky notes on message boards within DRCs and transform them into formats acceptable to the 119 information system. After that, other related public agencies were notified by the DCM had to take appropriate follow-ups. The canopy web site, the DICMW, had been connected to all plurks and other web sites by the DCM through searching keywords related to disaster conditions of typhoon Morakot. However, the volume of information need to be processed was just beyond the capacity of the DCM stationed in southern Taiwan. In no time, the ADCT called in help from other members of the ADCT all over the island. Later, the call was even extended to non-ADCT volunteering netizens, utilizing intensively the group functions of the Skype service.

Web tools and services such as Wiki, YouTube, Twitter, Flickr, Google Maps, Google Doc, and Skype, were all utilized.

As a result, many non-ADCT netizens were able to join and divided the huge workload of information management for disaster relief, including screening, verifying, classifying, updating, and transferring messages on the web and passed them onto the DICMW. Through DICMW, they also helped releasing the information generated within the DRCs to the outside web world. Together, the ADCT, governments, and the netizens invented a new pattern of cooperation for highly effective information management between government and non-government organizations, which can also be labeled as 'social media.' As the severity of the disaster eventually dawned on residents of northern Taiwan, donated supplies and volunteers started to flood into inflicted areas in the south. The ADCT also augmented a Center of Supplies to their DICMW, which was specifically responsible for managing information related to both the demand and supply of donations, logistics, and volunteers. Meanwhile, authorities of both the central and local government of many southern prefectures, particularly the former, found their leadership started to be harshly criticized as cable TV news bombarded the national audience with all sorts of reports about damages and casualties caused by the typhoon. On Aug 11, the County of Pindong also asked the ADCT to station their members in Pindong county's DRC. On Aug 13, the central government followed suit.

In all, more than fifty members of the ADCT were stationed to various DRCs, not counting the non-ADCT volunteering netters. Through the DICMW, urgent and large-scale information transactions of all sorts had been mediated through the aforesaid social media. Such an information management system has been the first of its kind in Taiwan. Not only social panics were effectively avoided, ineffectiveness and inefficiencies of resources mobilization, including rescuing missions, food donations, volunteer activities, and etc., were also significantly reduced.

3. SOME REFLECTIONS ON THE CASE

Both the scope and the severity of damages caused by typhoon Morakot were extraordinary in the history of Taiwan, which was the main reason caused the communication breakdown, as alleged by staffs of the ADCT. The logic goes like the following. Ever since the initiation of democratization after the abolishment of marshal laws in Taiwan, higher level civil servants have been increasingly politicized due to the multi-centered political competition. Excellent performance has become secondary than personal connection with chief executives of public agencies or politicians in the promotion and career development of civil servants. Inferior performance on the other hand would turn surely into real drags on promotions for civil servants without such political connections. To protect themselves against negative impacts on their performance and career development, civil servants resort to observing rigorously standard operating procedures or rules when implementing their tasks. In other words, public servants have developed a highly conservative attitude toward excising discretionary power and taking appropriate level of risks. Such attitudes have resulted in general bottlenecks of communication and negotiation between administrative units since doing so always required making discretionary decisions and taking significant level of risks.

To make it worse, under the current disaster mitigation laws and political regimes, public agencies are solely responsible for their designated functions. E.g. Fire Departments do not have to answer to requests for social services if someone's house was razed and have serious problems sustaining their livelihoods, since that is the major job for Bureaus of Social Affairs. Consequently, whenever it comes to critical events or large-scale disasters that tend to tie everything together, almost all discretion are left to chief executives. Civil servants also become highly conservatives in releasing the information they have. This has been the main reason why even though the central government of Taiwan has spent significant amounts of money and taken significant steps in implementing e-government policies since 1997, communication bottlenecks within the bureaucratic system have not been effectively removed so far.[1] There is no doubt that the e-government policies have facilitated the processing of huge amount of government documents and forms, the installment of all sorts of databases and web pages, the disclosure of some government information, and to a certain degree, enhanced the transparency and accountability of government activities. However, as clearly pointed out by experts, including executives of the ADCT, the majority of such web services have been scattered all over the fragmented

[1] See (Research, Development and Evaluation Commission, 2007).

government information systems. Even worse, the management of such information services has been rather inflexible. Therefore, such information services are hardly accessible by the general public. This was the reason why the ADCT had to mine out whatever useful information embedded in the sea of official databases by themselves and released them to the public through the web. [2] Furthermore, different public agencies seem to adopt very different philosophies in constructing their own web services. To cope with that, the ADCT had to develop painstakingly different operating procedures of information management corresponding to different public agencies so that the information conveyed by their web sites, including the DICMW and others, could be synchronized with public agencies.

In conclusion, it is beyond any doubt that social media, as can be told from the ADCT experience during typhoon Morakot, have great potentials to contribute to public governance through improving the communication and coordination among public agencies and between the government and non-government sectors. Still, public organizations have to deal with their bottom line problem, i.e. why advanced ICTs available have not been adopted in appropriate ways such that the ideal of 'social media' and their impacts on good public governance can be sufficiently realized?

4. A BRIEF REVIEW WEB 2.0 AND THE E-GOVERNMENT IN TAIWAN

In a nutshell, E-government policies in Taiwan over the past decade have biased heavily toward technicalities and instrumentalism. Consequently, social media in Taiwan has not witnessed any healthy head start yet, except the aforesaid case. [3] Many heavy weight politicians join the bandwagon of using personal plurks, twitters, facebooks, and blogs. However, the majority of these interactions are one-on-one based. No policy discussion groups or communities take shape as a result, not to mention generating any real impacts on policy processes. So far, the most interactive types of web services provided by administrative entities in Taiwan are 'Citizens' Forums,' or 'Mayor's Mailbox.' However, again, these web sites are either rarely visited or even visited but are, at best, based on one-on-one communications between individual citizens filing certain complaints and specific public agencies (Wang, 2002). As for the rest of public information services accessible on the web, the majority of them are based on one directional communication, which should be classified as web 1.0, instead of Web 2.0. Not only so, the most common experience shared by netters mining data or information from public web sites is that almost all sources of public information are highly incomplete, not readily updated, and no explanation attached when definitions of data or methods of data collection changed.

5. FURTHER REFLECTIONS ON BUREAUCRATIC BEHAVIOR AND INFORMATION MANAGEMENT

Summarizing from the above discussion, if public agencies are really serious about e-government, they have to deal with one most fundamental problem. That is 'Why information services on the web provided by public agencies (including 119 and all sorts of E-government projects) tend to fail their designated functions, except in terms of document processing?' Traditional information management theories tend to see vertical communication and control prevailing in public bureaucracies as the culprit that strangles the development of social media. However, ample evidences of the prevalence and development of social media in advanced democratic countries are available. Take CDC and FEMA in the federal government of the U.S. for example. These public agencies have developed mature web services based on the concept of 'social media.' Therefore, public bureaucracy *per se* is not the problem. Adopting the approached developed by James Q. Wilson, what the bureaucracies do may be the key to the question (Wilson, 1991).

According to (Aoki, 1988), the ideal American firm (A firm hereafter), even though quite bureaucratic and hierarchical in terms of their decision making, does not forbid information exchange within and across organization boundaries. This is because the A firm, in the process of technical change, tends to aim at the frontier type of systematic and large scale innovations. Such types of innovation require the collaboration of partners within and across boundaries. Also, it would be hard for anyone to engage in instant appropriations by free ride on information acquired from others in such an early

[2] E.g. red alert areas of highly dangers mud flow and landslide (National Science Commission), delivery schedule of water by regions (public water companies), the 24 hours rainfall forecasts (Central Weather Bureau), the progress schedule of disaster condition management, and etc.

[3] See (Wang, 2002/05/23; Tsai, 2002/10/07).

phase of technical change. As a result, professionals within the A firm engage frequently in boundary spanning activities by attending conferences, symposia, and forums conducted by related professional communities. The same rationale also applies to public bureaucracies in the U.S., even though some modifications are required due to the fact that public bureaucracies are not that innovative. There has been a tradition among professions that are concerned with public interests to resort to communities or the society at large and competed for their support and recognition since the Progressive Era (Carpenter, 2001; Shefter, 1984:76; Chandler, 1977:464-468).

In contrast, both public and private bureaucracies in Taiwan have accustomed to highly incremental type of innovations. The majority of such innovations are copies of practices well established in advanced countries. Since such innovations can be applied to instant appropriations and can be easily copied or surpassed, individuals and groups within Taiwanese organizational hierarchies have a strong tendency to protect and reinforce their privileges through existing social ties and form rather closed type of informal factions. This is particularly the case with public bureaucracies. Consequently, there has been very little need to communicate with the society at large. The bureaucratic mindsets of incrementalism also result in conservative and closed personal ties between civil servants of public organizations. Such personal ties within and across public agencies tend to be the pivotal mechanism based on which strategic decisions were made. Consequently, information transaction within and without public organizations in Taiwan tend to be non-transparent and not fully disclosed, as long as not among insiders. Furthermore, whenever it comes to occasions where the exercise of discretion is required, e.g. large-scale disasters or critical events, without personal ties with and support from top ranking executives, public servants tend to shy away from taking risks to initiate effective communication and coordination within and without their units.[4] As a result, decisions were usually pushed back to higher level supervisors. In critical times, such a tendency to relay decisions to top executives will lead to general breakdowns in communication and coordination.

[4] This was exactly what happened as the leadership of central government was not fully aware of the severity of the damages caused by typhoon Morakot and public agencies and local governments were left alone to deal with disaster relief in the initial phase.

Against the aforementioned backdrop, the success of joint efforts between the ADCT and the NDRC in the later phase of typhoon Morakot is a special case. First of all, typhoon Morakot was a very large-scale natural disaster. Without such a miserable encounter, it would be highly dubious that public agencies were willing to cooperate with civilian entities and reveal the information they had. Secondly, the supports from top executives in local and central governments were also critical. Thirdly, the strong sense of mission among members of the ADCT should never be discounted either. Still, this case has significant implications for the development of social media in Taiwan. Since the fundamental overhaul of tasks civil servants perform is a huge project that can hardly accomplished in the near future, public agencies should be urged to try out social media with respect to their normal policy processes, based on the Morakot experience.

However, the harsh realty of the timidity of public servants in exercising their discretionary power and their tendency to be locked in superficial rule by law and incremental policy innovations can not be overlooked either. The bottom line is that Taiwan still awaits politicians to form a common vision about her future role in the upcoming international political economy. Based on this vision, private sectors and local communities should also be asked to invest heavily and play critical roles in large-scale and systematic type of economic and infrastructure developments. Once this transformation can be accomplished, members of public agencies and society at large will naturally nurture a very high propensity to dialogue with each other. However, even then, social media will be powerful instruments for the forging of common visions and the deliberation of such grand scale projects. However, there is a big difference from traditional e-government allegations, i.e. e-government itself will not trigger the trick. Political mobilization has to go hand-in-hand with the development of social media. Only then the ideal of social media can be fully developed. The conclusion of bottom-up social governance suggests the E-government theories to be reconsidered.

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GNU Library in Python Language applied to Education in Information Security

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Abstract. This work develops an open source library in Python with applications in academic settings, for educational purposes. It can also be used for general software development. It allows users to implement Number Theory applications commonly employed in Cryptography and Information System Security. Improvements in teaching quality, user software readability, and time savings at the encoding stage could be expected.

Keywords. Library, Python, Education, Cryptography, Number Theory.

1 INTRODUCTION.

Information Security (IS) is the field focusing on granting integrity, confidentiality and availability of information in processing and communications systems. Its requirements increase over time. Hence, a greater number of applications are required as well as the need for their study in academic settings [01].

A significant number of its techniques and procedures are drawn from other fields, such as Number Theory. Therefore, teaching Cryptography, a fundamental component in information confidentiality, requires the study of particular mathematical functions and procedures.

The NumTheoryPy library was created with a twofold purpose: education and software development. In other words, its primary targets are the academic community and software developers.

Developed in Python, this tool provides applications for educational settings, achieving a positive synergy between theory and practice while fostering the learning process [02] [03] [04].

In the software development sector, developers can add this tool to their professional portfolio to save time at the encoding stage, achieving improved readability in their software.

2 GENERAL CRITERIA FOR LIBRARY DESING

Three strategic criteria prevailed in the development of this project:

2.1- The library must be open source.

Greater accessibility at no cost.

2.2- User control must be safeguarded.

They use the software for their own objectives, methods, and styles. The library is a code cluster to be employed whenever called upon and not a final product.

2.3- Code lines must be kept at a minimum

No superfluous code lines. Users define catch tasks and validate required input data for each function, as well as data screen displays.

3 WHY DO WE USE NUMBER THEORY?

We focus on Number Theory (NT) because, along with other disciplines, it constitutes the theoretical foundation of Cryptography and System Security. Increasingly, academic courses in the applied sciences have incorporated Number Theory in their subject matter [05], considered until relatively recently in the history of science as one of the "purest" disciplines. With its use, a greater and better understanding of the information and communications protection techniques can be achieved.

Some authors, such as Neal Koblitz [06], have suggested an inverse path: to use Cryptography and its applications to Information Systems and Communications (internet, e-mail confidentiality, digital certification, home banking, and others) as a teaching resource for Number Theory. Similarly, other authors encourage its use as a requirement in the subject matter for teacher education at the secondary level [06].

Another well-known problem, *the discrete logarithm problem* originated the Diffie and Hellman method to exchange keys, operating efficiently since its discovery to present times.

4 LANGUAGE SELECTION.

4.1 Requirements.

The selection of the appropriate language was of utmost importance considering its impact on the library and its goals for the Project

Considering the library was conceived as an open resource, the chosen language had to be aligned to the general philosophy and objectives. The requirements were:

- Clarity in writing and reading the code. Considering its use in education, the code had to be easy to read, so students can rapidly grasp its contents.
- Capability to work with large integers. Cryptography uses integers with a large amount of binary digits (e.g., 2^{1024} o 2^{2048} bits). Consequently, the language had to be able to handle these values.
- Simplicity in the creation and implementation of functions, libraries, and modules.
- Free of charge accessibility. In addition, preference was given to GNU-GNP -General Public License- languages. In this manner, installation and user costs could be avoided.
- Background and long term lifespan. Mature languages were considered with widespread use among the software community and not reserved only for experts. A long lifespan was significant to ensure its suitability over time.

4.2 Python Language.

The language chosen for the code was Python, created in 1991 by Guido Van Rossum, as it complies with the detailed requirements [08].

In addition, it provides:

- Multi-paradigm: allows the programmer to choose among the "structured," "object-oriented," or "functional programming" modes. It can also add "extensions."
- Memory use through dynamic data types and reference counting.
- Dynamic name resolution, linking a method and a variable name during software execution.
- Expansion capabilities by accepting modules written in C and C++

5 NUMTHEORYPY LIBRARY.

5.1 Issues addressed.

Along with language choice, library functions were selected. For this version 1.5, certain mathematical procedures with application to Number Theory and Cryptography were included. Later, the procedures were encoded to create the software of the library. Multiple tests were carried out on each segment to detect and correct errors. After depurating all errors found, the final library was obtained, ready for implementation.

5.2 Library general concepts.

Version 1.5 of the library consists of 15 functions -- the latter term used in the computer science and not mathematical sense; i.e., a piece of software which can be executed when called upon by other software, avoiding code redundancy.

Each function has, in addition to its specific output, related output displays for educational use. One of them indicates the number of iterations used in the procedure, and execution time measured in seconds. Both results allow users to compare and carry out benchmark studies on procedure behavior. It also admits verification when contrasting theoretical and implementation results. Although these functions were not designed to be called upon from the command line, as the output does not display information clearly to the user, it can be achieved as Pyhon has such features, and it can also be used as a powerful calculator.

The user calls upon these functions from software with validation capabilities for the input data and conveniently presents the output values. Functions do not validate. Whenever a function requires the input of a prime number and a compound number is entered, the output could be compromised and incorrect. Validation needs to be performed at a previous stage.

6 LIBRARY FUNCTIONS.

Functions, valid input and output values are detailed:

6.1 Function *NTGCD(a,b)* "Greatest Common Divisor".

Calculates the Greatest Common Divisor (GCD) between two positive integers *a* and *b*, using Euclid's algorithm. The output displays the GCD, number of iterations and execution time.

```
def NTGCD(a,b):
     r=0, ti=0, i=0, tf=0
     if a<b:
         s=a, a=b, b=s
     ti=clock()
     while b<>0:
         r=a%b, a=b, b=r, i+=1
     tf=clock()
     return (a,i,tf-ti)
```

6.2 Function *NTLCM(a,b)* "Least Common Multiple".

Calculates the least common multiple (lcm) between two positive integers *a* and *b*. GCD properties are used: the quotient between the product *a* and *b* and their GDC.

The output displays the lcm, number of iterations and execution time. The latter is calculated as a function of the GCD process.

```
def NTLCM(a,b):
    D=NTGCD(a,b)
    m=(a*b)/D[0]
    return (m,D[1],D[2])
```

6.3 Function *NTINVERMOD(b,n)* "Modular Inverse".

Calculates the inverse of a number *b* (mod n), using *Euclid's Extended Algorithm*; i.e., finds *b* such that:

$$bd \equiv 1(n) \qquad (01)$$

The condition for *d* to exist is *mcd(b,n) =1* and needs to be validated by the user.
The output displays the integer *d*, the number of iterations in the process and execution time

```
def NTINVERMOD(b,n):
   a=n, f=0, g=1L , A=0L , B=1L , C=0L ,
D=1L, q=0L , r=0L
   x=0L, y=0L, t=0, ti=0 , tf=0 , i=0 ,
ti=clock()
   while b>0:
       q=a/b, r=a-q*b, x=B-q*A
       y=C-q*D, a=b, b=r, B=A
       A=x, C=D, D=y, i+=1
    d=a, x=B, y=C
    if y<0:
        y=(y+n)%n
    tf=clock()
    return(y,i,tf-ti)
```

6.4 Functions *NTRHOPOLLARD(n) and NTMONTECARLO(n).*

Given that this factoring method is known by both names, two input forms were defined for the same function. They find a non trivial compound factor of *n*.
The polynomial Z[x] is used, starting at x_0=2:

$$P(x) = x^2 + 1 \qquad (02)$$

The output displays a factor of *n* (not necessarily prime), number of iterations and execution time.
Note: it is possible that the algorithm may yield factor 1 as output. In such case, the number entered is prime or P(x) and x_0=2 are not appropriate to find the factors of n.

```
def NTRHOPOLLARD(n):
    t=0, ti=0, tf=0, i=0, x=2L , y=2L ,
d=1L , r=0L
    ti=clock()
    while d==1:
        x=(x**2+1)%n
        y=((y**2+1)**2+1)%n
        r=abs(x-y)
        i+=1
        d=NTGCD(r,n)
    tf=clock()
    if d==n:
        return(-1,i,tf-ti)
    else:
        return(d,i,tf-ti)

def NTMONTECARLO(n):
     return NTRHOPOLLARD(n)
```

6.5 Function *NTPI(n) "Function PHI".*

Finds the approximate quantity of primes less or equal to a positive integer *n,* using the Theorem of Tchebycheff and evaluating the function Phi(x).

```
def NTPI(n):
     from math import log
     z=n/log(n)
     return(z)
```

6.6 Function *NTFERMATFACT(n). "Fermat´s Factorization".*

It finds a non trivial factor of *n,* if it is a compound number, using Fermat's factoring method. In the case the output are the trivial factors, *n* is prime.

```
def NTFERMATFACT(n):
    from math import floor
    a=0, b=2, p=0, q=0, i=0, ti=0, tf=0
    ti=clock()
    a=long(floor(n**0.5))
    while (b**0.5-long(b**0.5))<>0:
        a+=1
        b=long(a*a%n)
        i+=1
    p=long(a+(b**0.5))
    q=n/p
    tf=clock()
    return(p,q,i,tf-ti)
```

6.7 Function *NTLEGENDRE(a,p) "Legendre´s Symbol".*

This functions yields 1 if the positive integer *a* is a quadratic residue (mod *p*) and -1 if it is not.
The function could give a wrong answer if p is not prime. The method used is the traditional formula:

```
def NTLEGENDRE(a,p):
    if a%p==0:
        return(0,0,0)
    k=(p-1)/2
    L=NTEXPMOD(a,k,p)
    if L[0]==1:
        return(1,L[1],L[2])
    if L[0]==p-1:
        return(-1,L[1],L[2])
```

6.8 Function *NTBINARYCONV(a)* "Binary conversion".

It yields the binary conversion of a positive integer *a*. It accelerates the procedure for the exponential functions in modular form of paragraph (6.9)

```
def NTBINARYCONV(a):
```

```
D=[0]
w=0
while w<>1:
    r=a%2
    w=long(int(a/2))
    D.append(r)
    a=w
    D.append(w)
 return(D)
```

6.9 Function *NTEXPMOD(b,e,n)) "Modular Exponential"*

Finds the value of the modular exponential with base *b*, power *e,* and module *n*; i.e.:

$$b^e \bmod(n) \qquad (03)$$

It uses the accelerated process for modular exponentiation, employing the binary expression of the exponent to increase its effectiveness. The output displays the value of the modular exponential, number of iterations, and execution time.

```
def NTEXPMOD(b,e,n):
      p=1, ti=0, tf=0, i=0
    if e==0:
        return(1)
     E=NTBINARYCONV(e)
     A=b
     ti=clock()
     if E[0]==1:
         p=b
     for t in range(1,len(E)):
         A=(A*A)%n
         if E[t]==1:
             p=(A*p)%n
             i+=1
     tf=clock()
     return(p,i,tf-ti)
```

6.10 Function *NTQR(a,n) "Quadratic Residues".*

Finds whether the positive integer *a* is a quadratic residue module *n* or not. As opposed to the case of the function *NTLEGENDRE*, it is not necessary for *n* to be a positive prime as it tracks all possible squares mod *n*, through sums of odd numbers. It should be noted that it could be solved by the use of the *Jacobi* process, but it requires the factoring of *n* for all to be prime and applying the product of Legendre symbols for each prime factor. However, if *n* needs no factoring, this function is more convenient.

```
def NTQR(a,n):
   i=0, ti=0, tf=0, r=0
   if a%n==0:
       return(0,0)
   ti=clock()
   if a<0:
       a=a+n
   while i<(n-1)/2 and r<>a:
       i+=1
       r=(r+2*i-1)%n
       if r==a:
           tf=clock()
           return(1,i,tf-ti)
           break
   if r<>a:
       tf=clock()
       return(-1,i,tf-ti)
```

6.11 Functions *NTCTR(a1,m1,a2,m2)* "Chinese Theorem Residues".

Finds number *s* and number *m* (the product of m_1 and m_2) such that it complies with the two linear equations of congruence: *s* is congruent to a_1 module m_1 and congruent to a_2 module m_2 .
It should be noted that the Chinese Remainder Theorem can solve a quantity r of equations as long as m_r are co primes among each other. In order not to determine beforehand a number *r* to apply in the library, though less efficient, the system of equations is solved in pairs. The user should perform repeated calls to this function to complete the full system of modular linear equations, hence finding *s* and *m*.

```
def NTCTR(a1,m1,a2,m2):
    m=0,M1=0, M2=0, N1=0, N2=0, s=0
    ti=clock()
    m=m1*m2
    M1=m/m1
    M2=m/m2
    N1=NTINVERMOD(M1,m1)
    N2=NTINVERMOD(M2,m2)
    s=(a1*M1*N1[0]+a2*M2*N2[0])%m
    tf=clock()
    return(s,m,tf-ti)
```

6.12 Function *NTPRIMETO(n)* "Prime of n".

Finds integer i where (0<i<n) such that GDC(i,n) = 1.

```
def NTPRIMETO(n):
    z=[1], b=1
    ti=clock()
    while b<n:
        b=b+1
        if NTGCD(b,n)[0]==1:
        z.append(b)
     tf=clock()
     return(z,tf-ti)
```

6.13 Function *NTEULERFUNCTION(n) "Euler´s Function φ(n)".*

Finds the Euler´s function of n with *cardinal ({i integer, 0<i<n, GCD(i,n)=1}).*

```
def NTEULERFUNCTION(n):
  return(len(NTPRIMETO(n)[0])
```

6.14 Function *NTSEUDOPRIMETEST(b,n)* "Test for pseudoprime n of base b".

Runs a test. It displays 1 if GCD(b,n) = 1 and b^(n-1) = 1 (mod n).

```
def NTSEUDOPRIMETEST(b,n):
    if NTGCD(b,n)[0]==1 and
NTEXPMOD(b,n-1,n)[0]==1:
        return(1)
    else:
    return(0)
```

6.15 Function *NTSEUDOPRIME(n)*: "Pseudoprimes to base n".

Finds integer b (0<b<n) such that GDC(b,n) =1 and b^(n-1) =1(mod n) and counts it.

```
def NTSEUDOPRIME(n):
    z=[1]
    ti=clock()
    for i in range(2,n):
        if NTSEUDOPRIMETEST(i,n)==1:
        z.append(i)
    tf=clock()
    return(len(z),z,tf-ti)
```

7 CONCLUSIONS.

Information security (IS) protects information in storage and processing systems, as well as in communications. It offers confidentiality, availability, and integrity. Hence, the academic field is focusing increasingly on this discipline. Progressively, graduate programs have included courses dealing with this subject matter.

NUMTHEORYPY library is intended for educational settings and software development. It offers educators, students, and developers the ability to run functions commonly used in Number Theory with direct application to cryptographic techniques.

Regarding educational applications, each function provides, besides its resulting value, additional information; for example, number of iterations and execution times used in finding the value. Such information provides the means for efficiency comparisons among different methods and algorithms, fostering improved teaching techniques.

Software developers can benefit from this library by saving time and gaining program readability.

The library was developed completely in PYTHON language and within GNU license of open source software, thus providing free access. In addition, due to this open source nature, users can read and verify content as well as change the code if desired. Similarly, it can be evaluated by software developers in the creation of new IS software and later include the additional functions they may require.

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ECO DESIGN, COLLABORATIVE LEARNING AND PCs IN AN ENGINEERING PROJECT

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ABSTRACT

Many innovations in recent years are interconnected and reflect the demand of a globalised knowledge society, which also requires a heightened respect for the environment. These demands imply a need for students to become more autonomous in their learning attitudes and in our particular case; the system offers the possibility to exchange information among people with different points of view and knowledge. The swift penetration of Internet in the domestic and professional fields is a spearheading innovation of all areas related to accessing information. A part of this work takes place in a collaborative environment among students which have different knowledge and skills, and the rest is carried out in traditional classrooms. To obtain the best results it is necessary to apply the principles of respect for the environment where being more effective. This takes place in the design criteria and bases, especially to minimize the problem at source, life cycles of products, etc.. (sustainability and respect for the environment). This teaching method focuses on the need to educate people so that they are capable of learning to learn and can continue to learn throughout their lifetimes.

Keywords: Eco Design, Environmental Solutions, Information Exchange, Engineering Project, Moodle.

1. INTRODUCTION

Presently, a series of efforts are being carried out in the Area of Projects of the Advanced Engineering School of the University of Cádiz to introduce new traverse capacities in the subject.

The amount of nature that is needed to maintain current lifestyles has recently increased to an unsustainable level. If this trend continues, we will exceed nature's capacity for self-regeneration and end up by exhausting natural reserves. Initiatives for sustainable consumption are established as the only solution, but it is necessary to create a design of sustainability at the beginning of the process and not at the end, because in the early stages of design is where the impacts are minimized.

Many innovations in recent years are interconnected and reflect the demand for a globalise knowledge society, which also requires a heightened respect for the environment.

These demands imply a need for students to become more autonomous in their learning attitudes.

A part of our experience is based on a virtual learning environment called Moodle.

Moodle platform also generally offer students and teachers interactive mechanisms, such as discussion forums, chats and instant messaging services, etc..

To obtain the best results it is necessary to apply the principles of respect for the environment where being more effective. This takes place in the design criteria and bases, especially to minimize the problem at source, recovery of materials, etc.. (sustainability and respect for the environment) [1].

References of actual projects related with the problem are presented during the course, to the students, for example Masdar [2] (an ecological city located in the middle of desert of the United Arab Emirates, design of Norman Foster whose objectives are 0 emissions of carbon, minimum generation of residuals, and obtaining of the whole energy that needs from renewable energy, the city is expected that it is finished in the year 2016 and this city has begun to build in 2009). The information is obtained directly from his web.

The main target for the student is to be able to learn and use the correct and necessary information on the activities undertaken.

2. METHODOLOGY

Climate change and increasing energy prices threaten the planet and the economy.

The European Union has promised to take the lead, through a reduction in greenhouse gases by 20 to 30% and a 20% energy savings by 2020.

Maybe the quickest, and cheapest way to decrease the emissions of CO_2, is to lower the energy consumption changing the domestic lighting habits (the expense for lighting is approximately 15% off the total), of the industry, and in the streets (they depend on the administrations), etc., being this an important step to implement in the consumption topics.

For example, the incandescent lamps are cheap but they consume a lot of energy (they dissipate approximately the 90% of the energy that consume in form of heat) and they are responsible of great quantity of emissions of CO_2.

On the other hand, the available alternatives to this type of lamps are: the halogenous lamps that are not very efficient either; the compact fluorescent lamps (CFL) that are 80% more efficient than the incandescent ones and they last longer, but they contain mercury, and the issue of diodes of light (LED), a very efficient technology that doesn't contain toxic substances, and that begins to compete with other lamps in the more powerful lighting.

From data like these, the student begins to make decisions and undertake various studies.

The main goal in the followed methodology is to increase the decision making process along with the search of the information and the collaborative work, introducing the respect for the environment like main axis of the work to be carried out.

Once this has been achieved, the student obtains a value added in his education, when carrying out team-work and observing how to solve a problem from the beginning starting from different points, and how they defend their ideas and propose others to change.

From the 2006-2007 to 2009-2010 academic years, this experience was implemented among Chemical Engineering, Electronic Engineering, Electrical Engineering and Environmental Science degree students to solve a specific problem.

The Moodle platform is used by different degree areas to exchange information and consult the theories underpinning each degree in a specific area.

Students work in groups in each specialty, and one student is appointed in each group to use the Moodle platform to exchange information.

Thus, it is possible to verify the different points of view on different training.

The main change in the course 2009-2010 is to work on an old traditional project to seek environmental solutions.

After students exchange information, the proposals for each degree must be studied and discussed to select the most environmentally responsible suggestion; the difference in cost for the potentially least expensive solution then needs to be examined alongside a more expensive, yet more environmentally-friendly one, since it may be possible to recover the extra expense within a certain period of time.

A part of this work takes place in a collaborative virtual environment and the rest is carried out in traditional classrooms to steer students towards the most appropriate solution.

The standard theory and specific exercises can be consulted in the subject's virtual space. Final solutions must be proposed by the students.

European universities are currently undergoing a convergence process to build and promote the European Higher Education Area. The guidelines for this process are being followed in our area.

This teaching method focuses on the need to educate people so that they are able to learn and can continue learnig throughout their lifetimes.

The methodology used during the realization of this project [3] is as follow:

- Moodle platform is used like a tool of integration of all the activities of the subject, including the administration of the visits to field, reception of works, communication, etc...

-Visits to a similar construction place for the study of the impact in the area of the project and how to minimize it.

- Learning of specific computer tools to carry out the work is essential for the student. Therefore, specific seminars are set for the handling of these media.

- Visits to several facilities, similar to those visited during the execution of the project in order to understand similar subjects to those taking place during the project, in each visit the reason of the adopted solution is explained.

- Specific seminars of the topics to be addressed by specialists from the University, public and private companies. These seminars are offered before and after each visit carried out, in order to show the pupils the different points of view from each one of the parts implied in a project of these characteristics (property, administration, etc..).

- Every year we visit an eco hotel (Fuerte Conil). The Hotel Fuerte Conil has been strengthening its position as one of the top 10 environmentally managed hotels in the International Ranking since the 2000-2001 seasons. The determining factors that allowed the Hotel Fuerte Conil to achieve eight place in this International competition were the numerous energy saving measures that they have put in place, and they are leaders in putting effective management measures in place to minimise ecological impact, their strict waste management, activities to raise the consciousness of client and employees and, in general, their elaborate environment management system. Fuerte Group created a department that carry out projects based on economical, social and environmental sustainability, they select durable materials, recyclable raw materials and they investigate manufacturing process

to guarantee respect for workers rights and the environment, now is a company called EID & WE-Equip. Every year the quality manager of this hotel explains to the students the new strategies adopted and the old ones.

- If during the training period, a congress is celebrated with an interesting material for the project, we try to assist.

It is important to introduce the student in the parameters that are desirable to reach beginning at a basic level with publications like the practical guide of the energy that the IDAE publishes, to arrive in later phases to the new normative on Echo-design [4].

It is very interesting in the part that is devoted in the subject to the exhibition and defence of the preliminary design on the part of each group, and the method of selection of the final solution.

In most of the cases it has been positive and they have helped to get better results in the final approach to the solution

3. RESULTS AND DISCUSSION

The philosophy of the process is to teach to the students how to look for information and specialists in very specific topics for the resolution of problems.

The results obtained with this technique are, in a high percentage, quite satisfactory. Starting from different examples, and waking up the student's curiosity in complementary topics with their standard formation, it has led them to work in group developing new ideas and alternative solutions to the most common ones.

During the last 3 years the students of the groups Engineering that worked with the proposals presented by the students of Environmental Sciences, didn't find any better option in particular to the part of the specific project that they had to make constructive.

The students of Environmental Sciences contributed with very little technology used in Spain, as it is the system of geothermal heat pump for the air conditioning of a house, and the students of Engineering looked for the elements to install, analysing how the system works and what would be necessary to do to install it and the way to obtain the maximum yield with the minimum consumption.

It was also part of the study the supply of energy in the most sustainable way for their first floor electric consumption. This technology was a problem for them due to their lack of knowledge about this material.

When finishing with their studies about geothermal heat pump they were very satisfied for the advantages of this technology, although they recognized the big advantages of the system and the ignorance that they had of it.

For many reasons (for example the previously exposed air conditioning), in our opinion it was an enriching experience for all the degrees.

Some of the sustainability solutions adopted in these works by the students are perfectly carried out to the reality, but with an increment in the budget compared with a classic solution of among 20% to 40% in cases like that of the air conditioning. In this case in particular, evidently it is necessary to make them stress that half of the life of these elements is much bigger than those of the classic solution and in the energy saving.

This envelope expense was reasoned for a paying-off of this investment to half term. In the case of the air conditioning that we are trying, the recovery of the envelope invested in comparison with a good traditional system was carried out approximately in 6 years.

4. CONCLUSIONS

Our universities are on their way to becoming European institutions, at which students, teachers, and researchers from across Europe and from overseas study and work. It is our duty to reflect on and make provision for the ecological implications of this process of integration in the higher education sector.

Our proposal is research and scholarly activities to prepare students to be critical thinkers, innovators, future leaders, creative scientists and researchers in a variety of engineering and scientific disciplines.

One of the key finding is the need to educate people so that they are capable of learning to learn and can continue to learn throughout their lifetimes, because one same problem in a different context may have a different solution.

A combination of classroom learning and investigation driven interdisciplinary research will provide students with the knowledge and skills necessary to address some of the world's most challenging problems.

The part of Echo-design was carried out with good results and the election among the different available options was carried out correctly.

The students need to do a simulation in order to develop an interdisciplinary and collaborative research and development infrastructure and are working to develop and promote the human capital.

We got a strong tendency from students to use an already known and cheap technology instead of seeking a more creative solution.

Some of the echo-design solutions adopted in the papers exposed by the students are easily exported to the reality, and they have had the opportunity to see the cost parameters like maintenance, to check the price difference with other solutions, and to be able to in that way to reason in a detailed period of paying-off of the initial investment.

Each year a different project is proposed.

The proposed objectives of environmental understanding are: traverse knowledge, own learning and search of the information by the students.

This experience allows students to obtain a better vision of the real world, and that they understand the need to stay upgraded for the correct development of their functions.

An important part of the students end the subject with big restlessness on the topic, even ending up proposing Final Project Degree.

The aim is to develop a pool of professionals, engineers, managers and technicians capable of accelerating the development of technology and also trying to find the best solution to a problem using the new technologies.

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The Use of Information Technology in Early Childhood Education – Examining the Cultural Barriers with Theory of Information Technology Culture Conflict

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ABSTRACT

The purpose of the research was to explore the readiness of the day-care industry to adopt information technology to support its activities. We conducted a survey as a part of a larger research project on the potential applications of IT in early childhood education. We wanted to know why especially early childhood education is behind other industries in utilizing information technology in its activities by exploring the impact of cultural barriers This paper uses Theory of IT culture conflict as a background for operationalizing and exploring how conflict between group values and values associated with IT can create problems in working environment. Results of a survey of 274 early childhood education professionals are presented together with future suggestions for measuring IT values.

Keywords: Culture, Information technology, IT values.

1 INTRODUCTION

The effect of culture on work behaviour has become apparent (Erez & Earley 1993) and the information system (IS) research discipline has noticed the potential of cultural differences in explaining IT-related issues. However, even though the first IS culture studies appeared in the early 1980s and numerous studies have since been conducted, the field has been relatively scattered. This is likely due to the fact that culture is a challenging variable to research with its divergent definitions and measurements (Leidner & Kayworth 2006).

In this paper culture is by definition *shared values*, as suggested in earlier studies (Leidner & Kayworth 2006). This study uses the *Theory of information technology culture conflict* (Leidner & Kayworth 2006) as the theoretical background to explain how the conflict between group member values associated with the work and values associated with the IT can create a conflict. The proposition is that such a conflict has a negative effect on the attitudes towards using IT.

2 TRENDS AND PROBLEMS IN MEASURING CULTURE IN IS RESEARCH

Several problems in the current IS culture research has been acknowledged by a number of authors (e.g. Gallivan & Srite 2005; Karahanna, Evaristo & Srite 2005; Myers & Tan 2002; Straub, Loch, Evaristo, Karahanna & Srite 2002). The main criticisms have arisen from the weak conceptualizing of culture, which has led to obscurity in the evaluation and comparisons of the results. In order for the field of IS culture research to mature and establish itself as an IS research discipline, there is a need for a more rigorous, theory-based conceptualizing of culture that, furthermore, is explicitly measured in empirical studies.

Several solutions have been suggested to overcome these problems in the current conceptualizing of culture in IS research. One solution have been seen to be the use individual level measures of culture (S. McCoy et al. 2005; S. McCoy et al. 2005; Myers & Tan 2002; Straub et al. 2002). Measuring culture at an individual's level would help to avoid too wide generalizations within groups (e.g. nation-states, races etc.). According to Straub et al. (2002, p.19) '*culture must be measured at an individual level even thought it is assumed that it is a group level phenomenon'*.. Straub (2002, p.19) argues this is because culture can only manifest itself thought the individual and therefore it is not possible to access '*the collective unconscious of the entire culture '* but instead it is appropriate to use individual unit of analysis when measuring culture. In the domain of healthcare, for instance, age, organization unit, gender and ethnic background were found to have an influence on organization culture perceptions (Helms & Stern 2001), thus suggesting that perceiving culture is an individual process. Moreover, in order to develop more rigorous ways for measuring culture the use of theory-based measurement has been recommended (Straub et al. 2002). Previous cultural studies in the IS field have recommended structuration theory (Walsham 2002), Social Identity Theory (Straub et al. 2002) and value-based approach (Leidner & Kayworth 2006) as a suitable theoretical back ground for cultural studies.

3 VALUE-BASED APPROACH FOR MEASURING CULTURE

Theory of IT-culture conflict is originally developed by Leidner et al. (2006) based on their extensive literature review on culture in information systems. In these reviewed articles three types of values were identified: Group member values, IT values and Values embedded in a specific IT. Group member values are those representing the values held by individual members of a certain group. IT values refer to "values that a group ascribes in general to IT" (Leidner & Kayworth 2006, pp. 374).Values embedded in a specific IT refers to "values that are assumed in the work behaviours that the IT is designed to enable" (Leidner & Kayworth 2006, pp. 374). **Error! Reference source not found.** presents the framework of IT-culture conflict.

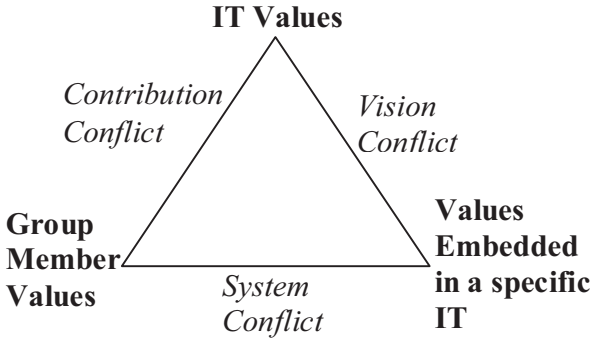

Figure 1 IT-Culture Conflict (Leidner & Kayworth 2006)

System conflict occurs when the values of a user group are contradicted by the values assumed in a specific IT. This conflict occurs when an organization implements certain IT without customizing it and that creates a gap between the values of the user group and the values of this particular IT. This can be the case, for example, when buying software which is designed in another country. Vision conflict occurs when the values of a group regarding IT in general conflict with the values embedded in a specific IT. In short this means that if the user group does not held the same values as IT values of the management for instance, the user group may not invest their time in using a system that is a part of another group's (e.g. management) values system.

In this article we concentrate on the *contribution conflict* which is caused by the mismatch of the values of the group members and the values embedded in IT. Contribution conflict describes instances when the values of members of a group conflict with the values the group associates with IT in general. Thus, as Leidner et al. (Leidner & Kayworth 2006, pp. 377) give an example: "*if individuals highly value financial capital and IT is perceived as a means of obtaining financial capital, then individuals will experience low contribution conflict (their perception of IT is consistent with their dominant value).*

4 RESEARCH DESIGN AND CONTEXT

Finnish early childhood education

The purpose of the research was to explore the readiness of the day-care industry to adopt information technology to support its activities. We conducted a survey as a part of a larger research project on the potential applications of IT in Early Childhood Education (ECE). In Finland the concept Early Childhood Education refers both to the education and care of children under compulsory school age (seven years). Municipal authorities are in charge at local level of how to organize services. Like in other Nordic countries the share of the private day-care in Finland is very low; most children are put in public day-care centres. The main objective in day-care is to promote child's healthy growth and social and learning skills.

According to Andersen, Grönlund, Moe, & Sein (2005) Finland has been ranked quite well (2nd to 9th) in five different international e-government rankings published in 2004-2005. Finnish government has succeeded in many cases to deploy information technology in many of public sector's processes and services. However, in ECE services the use of IT has so far limited to some administrative procedures. The users of ECE services are typically young parents, who are familiar with information and Internet technology. So, most resistance of change in adopting new technological innovations into ECE would most likely take place among the personnel of day-cares. By legislation the ratio of day-care educators (=teachers and nurses) to children is 1:7, when children need whole day-care services. The maximum group size should be 21 with 3 adults (Day Care Degree 806/1992), but unfortunately this is not always the case. Group size can vary from 18 to 38 children in whole day-care groups (Pihlaja & Junttila 2001). Simultaneously, as the number of children per educator has risen, the quality of the pedagogical context has declined. The proportion of teachers in day-care among all employees has decreased, which is one reason for why the pedagogical competence has lost its value (Kauppinen 1995; Kinos & Laakkonen 2006; Pihlaja & Junttila 2001). The day-care educators have had hard times for a number of years, and some municipalities complain that "saving money" seems to have come to stay. Work-related stress, emotional pressures, and the pace and intensity of work increase with the growing demands of efficiency. This is apparent in the case of day-care personnel as well (Pihlaja & Junttila 2001).

To answer these demands, a project called VARPE was launched in 2005, financed by the Ministry of Social Affairs. The project was a joint effort of academic IS researchers and ECE researchers as well as ECE professionals of four different cities in South-west Finland. The project took two years producing an initiative of how to apply IT in ECE.

Several tentative ideas of IT deployment were planned in workshops. The researchers and ECE professionals refined the ideas using the value adding model by Amit & Zott (2001) as an underlying theoretical backbone. Amit & Zott (2001) presented four possible sources of value creation, specifically efficiency, complementarities, lock-in, and novelty. Without going into details in this paper, some examples of potential applications could be as follows:

- Efficiency: Gathering of billing information using RFID transponders.
- Complementarities: An e-portfolio for supporting the growth of a child.
- Lock-in: Electronic notebook for communication between home and day-care.
- Novelty: A virtual community for parents.

More than twenty different applications were planned, some of them fairly imaginative. When anticipating the consequences of implementation of new kind of applications in a field like ECE it's quite obvious that resistance of change will occur. One important factor causing resistance is the lack of skills or knowledge. In ECE field it is presumable that the general level of computing skills is quite low. The average age is fairly high and the average level of education is fairly low.ECE professionals were chosen to be the target group of this research because of their novelty to IT and the hidden potential to utilize these systems. Since there is fairly little IT in use in this sector we wanted to explore if the values of

ECE professionals conflict with the values of IT and discuss if this could be one obstacle in the way of more efficient IT usage.

Research model and propositions

In our research we used the Theory of IT-culture conflict to build the research model (Figure 2). It is assumed that the gap between group member values and IT values leads to IT-culture conflict, i.e. the larger the difference between group member values and IT values the larger the IT-culture conflict.

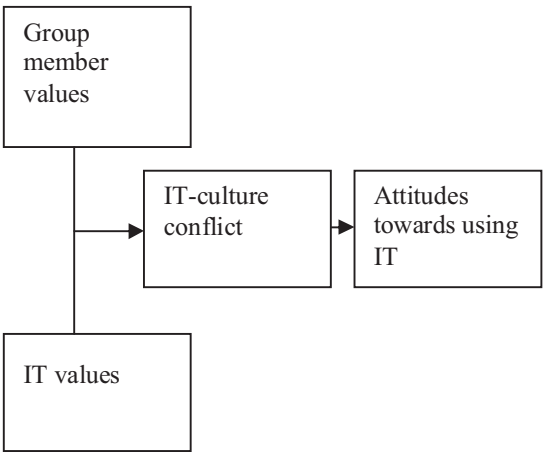

Figure 2 Research model

It is also assumed that IT-culture conflict will affect the attitudes towards using IT. It is assumed that the higher the ratio of IT-culture conflict, the lower the attitudes towards using IT.

The proposition of this study thus is:

The higher the IT culture conflict, the more negative the attitudes towards using IT.

In this study, we exclude all the other factors that assumingly affect the attitudes as well, such as skills, age, experience etc., the main purpose of this paper being the operationalizing and preliminary testing of the concept *IT culture conflict.*

5 METHODOLOGY

A cross-sectional survey was conducted to collect data for the study. Respondents were daycare workers in four communities in western part of Finland. Random sampling was made to choose daycare centers for the study. After that a mail questionnaire was sent to the head of the center to be distributed to the employees. For other day care personnel (those ones not working in a center) a communal contact person distributed the surveys. A survey was distributed to 615 employees out of whom 274 returned the survey representing a response rate of 45% which can be considered as a good rate (Baruch 1999). Out of the respondents 98% were women and 2% men representing the gender structure of the Finnish daycare employees. 26% of respondents were under 35 years old; from 35 to 44 were 28% of the respondents, from 45 to 54 years old 32% and over 55 years old 14%. 92% of the respondents were working in a daycare center while 4% worked home as a nurse and 4% in other kind of daycare centers such as group daycare centers.

To measure IT values and group member values we chose four subcategories each presenting a value. These values were: autonomy, equality, human centricity and effectiveness. These four values were chosen based on a literature review (e.g. equality, effectiveness) (Leidner & Kayworth 2006) and based on specific values found especially in the early child education field (e.g. human centricity, autonomy) (Laine, Wickström, Pentti, Elovainio, Kaarlela-Tuomaala, Lindström, Raitoharju & Suomala 2006). Question were created to measure how much each of these values is appreciated first, in the work in general and second, how much the respondents consider these values to be associated with IT in general. The scale was a seven-point Likert scale anchoring from 1 (not important at all) to 7 (very important).

A factor was calculated to represent each construct. The adverse scales were reversed in order to get all the measures comparable. Then each IT value construct (e.g. IT autonomy) were subtracted from the corresponding group member value (e.g. autonomy). Since the purpose is not to find out the direction of the subtraction but only the margin, the negative values were then turned into positive. Finally these figures were summarized to be the construct "IT-culture conflict". To measure if IT culture conflict has an effect on IT attitudes a

regression analysis was conducted using SPSS 14 for Windows.

6 RESULTS

The results of the regression analysis indicate that the impact of the IT culture conflict on attitudes towards using IT was statistically significant (Table 2 and 3).

Table 1 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,230	,053	,050	11,62285

Table 2 Coefficients

	Unstandardized coefficients		Std. coeff.		
	B	Std. Error	Beta	t	Sig.
1 (constant)	26,741	1,551		17,243	,000
Conflict	-,225	,058	-,230	-3,892	,000

The results indicate that IT-culture conflict is a statistically significant variable for explaining attitudes towards using IT. However, based on the results it seems to explain only a very small amount (c.5%) of the alternation of the attitudes.

7 DISCUSSION

Theory of IT culture conflict provides a very prominent theoretical background for exploring cultural issues in IS discipline. It provides a solid theoretical background with operationalizable constructs to be developed. In this study we aimed at creating measures that could be used when exploring the IT culture conflict. Measures used were found to be valid and usable. Also the link between IT culture conflict and attitudes towards using IT was found statistically significant. The results of this study suggest that IT culture conflict could be an important and interesting variable when explaining the adoption of IT or the attitudes towards using IT.

More research should be conducted in order to further develop measures for examining IT values and values in the workplace. The scope of the research could also reach different levels, such as national level values or purely individual level values since in this study we concentrated on group level (e.g. professional) values.

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Reducing Digital Divide: Adult Oriented Distance Learning

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Abstract
The present paper shows the digital divide that exists among the communities that use ICTs (Information and Communication Technologies) in their everyday lives and those that have total ignorance of the subject. A survey regarding information technology knowledge was performed in several communities with very different sociocultural characteristics. The results of the survey, from a technologic scope, shows the width of the technologic gap that separates those communities. Being aware of this digital divide, this research shows the results of the implementation of a strategy that allows deprived citizens, who live in the border zones, to reach information technology knowledge. This strategy includes face learning, distance learning, the use of massive communication media, practice in national university's computer labs and, theory and practice exams.

Keywords: Digital divide, Massive Media, Communication, Technology, Distance Learning, Training.

1. Introduction
In order to understand what the ICTs (Information and Communication Technologies) represent to our times it will be enough to try to live without them during a whole day. In this moment where cell phones, computers, TV sets… are a significant part of our daily life, it is very difficult to be able to conceive not to use these devices to perform habitual tasks by a large population sector. Consulting the bank balance, publishing and offering products, paying taxes and invoices, etc., are some of the multiple transactions that can be performed using internet. Otherwise, as a counterpart of the technological progress that enjoys a lot of communities, there are others that are technologically excluded.

"The social groups that have taken advantage of this progress in their member's benefit, have acquired a material and intellectual development level that separate them from other less privileged social groups"[1]

That is the reason why, it is possible to assert that digital divide exists among the communities that use ITCs in their everyday life, almost without noticing their presence, and those which don't have any knowledge of the subject.

One possible definition for digital divide is: "the technological distance among individuals, families, companies, interest groups, countries and geographical areas in their opportunities for information access, communication technologies and internet used for a wide range of activities."[4]

"Digital literacy" is influenced by the lack of economical resources in order to access to technological education or even in several cases by generational issues. Teaching Information Technology to adults requires a very particular approach. Adult students frequently feel that they are not able to learn and also they think that their technological ignorance is so deep that it will be very difficult trying to reach technology. Quite the opposite, young students that won't have any previous experience with computers won't give up until they are successful in reaching their goal.

People that has grown up in times when technology was not the boom that is nowadays, feels like foreigners in this information society where technological knowledge is essential. A lot of times the children are the ones who teach and guide their parents in using a computer.

Item 2 of this paper explains the performed tasks to measure the technological gap among communities that have different socioeconomic realities. Once the results of the tasks are shown and, being aware of the presence of the digital divide, item 3 shows the implementation of a strategy for marginal communities training through a massive communication media to reduce this technological gap.

2. Digital Divide Determination
In order to determine how wide is this digital divide a long research was made in a sector of Argentina's population. To achieve this goal, the research team made a survey among the Buenos Aires Province, more precisely in La Matanza County. This county was selected due to the following reasons:

1. To know the real needs of the population that leads to the creation of the public University of La Matanza (UNLaM) to which the research team belongs.
2. La Matanza County has an area of 323 km2 and a population's density higher than 4.644 inhabitants per km2. Fifteen towns belong to this

county. These towns can be classified in three population belts. Each belt includes communities with different sociocultural characteristics.

3. The coexistence of marginal and residential neighborhoods allows the determination of the bounds that made possible establishing the width of the digital divide.

It is important to highlight that the socioeconomical level reduces from the first belt down to the third belt. This third belt is the one which has the most marginal communities, and in addition, the third belt's neighbors have to travel more distance to reach educational centers.

In order to survey all the towns that belong to La Matanza County, the research team designed a survey form, which was distributed to the High Schools that collaborate with the research. These schools had to distribute them to the inhabitants of each town, according to precise ranges regarding age and gender to obtain a representative sample.

Moreover, in the third belt towns, university's assistants from the Social Studies Department of the La Matanza University, reach the poorest neighborhoods to survey the people who live in the area. Two universes and two different ways of fulfilling the survey were defined in order to minimized errors and cover the whole number of the county's towns:

1. A sample of 4 inhabitants per 10.000 inhabitants of the county (0.04%) was reached through the High Schools that collaborate with the research.
2. Just for the specific case of the towns that are included in the third population's belt and in order to decrease the possibility of errors, a fieldwork was developed that reached 14 inhabitants per 10.000 inhabitants, (this percentage represents 0.14%).

The total number of obtained surveys, either the ones performed by university assistants or the ones obtained with the High Schools collaboration, were analyzed in order to check their veracity. This goal could be achieved because some auto-checkable questions were included in the forms, that allowed the research team the detection of contradictory answers. The quantity of valid survey's forms was 1029.

2.1 Obtained Data Analysis

The survey's form allows carrying out a lot of comparisons among the three population belts. These comparisons address different subjects as: general knowledge level, information technology knowledge, economic issues, etc., in order to understand the situation in which each community is immersed. The results concerning training and technology show the most significant results. To be able to measure the digital divide some indicators belonging to different categories were selected:

1. Information technology knowledge level: It is possible to highlight that in the three belts, a big portion of the population declares that they don't have any information technology knowledge. The figure increases while the distance from the first to the third belt grows. Figure 1, shows the population's percentage with no information technology knowledge. In addition to the information shown in Figure 1, it can be watched that the highest percentage of inhabitants that declare to have excellent information technology knowledge, belong to the first belt, and is only 3%.

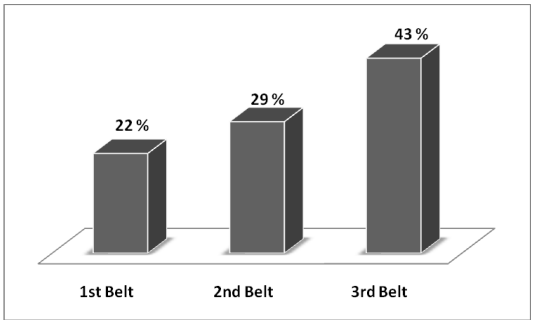

Figure 1. Population's percentage that doesn't have any information technology knowledge.

2. Population that is interested in learning information technology: Inhabitants who answered that they don't have any information technology knowledge, were asked if they were interested in learning it. The results show that in the three belts, more than 50% of the people want to learn information technology. Regarding the third belt, 75% of the respondent declares that they are interested in learning it. Figure 2 shows with a dark gray bar the percentage, by belt, of the people interested in learning information technology, and with a light gray bar, the opposite answer.

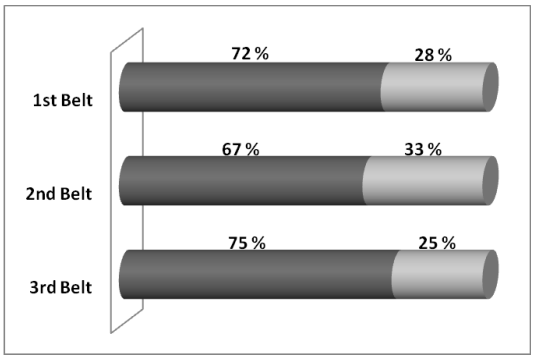

Figure 2. Percentage, by belt, of the people interested in learning computer science.

3. Microsoft Office Knowledge: The question regarding the Microsoft Office knowledge level was made only to the people who answered that they have information technology knowledge. The level detected in the three belts was poor. The third belt was the one that presents the lowest knowledge level in Microsoft Office

knowledge. Adding information to the one that is shown in Figure 3, it may be highlighted that the third belt is where can be found the highest ignorance percentage, being the "none" option the most selected with 52%.

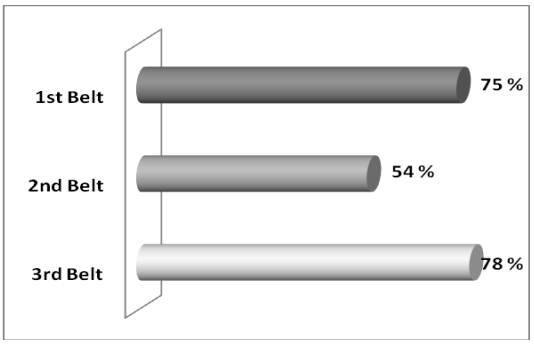

Figure 3. Population percentage with very few or none knowledge of the Office Suite.

4. E-mail Checking: In the three belts, less than 50% of the population navigate internet to check the e-mail. The third belt is the one with the lowest percentage of e-mail checking. This figures are not a surprise because that population have few economic resources and besides there are fewer cyber cafes. The habitual access to internet if you live in the third belt becomes very difficult.
5. Elementary School Education: While distance grows and economic resources decrease, not only the technologic ignorance increases but also the possibility to access to Elementary Education. It is important to highlight that the survey was made to people with, at least, 15 years old. A person of this age should be attending High School. However, due to different reasons, 10% of the population belonging to the 3º belt hasn't finished Elementary School. Figure 4 shows the situation of the three population belts regarding if they had completed Elementary School. It can be watched that the percentage of people who completed their Elementary School level decreases towards the third belt.

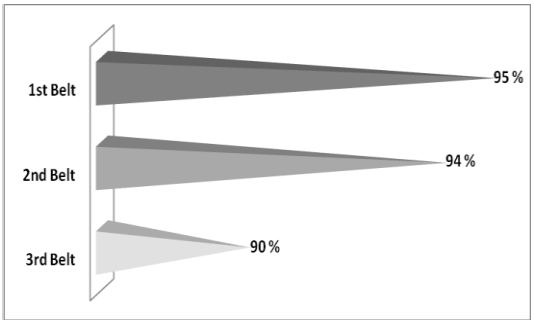

Figure 4. Percentage of population that complete elementary school.

6. People who made training courses: Only 8% of the third belt's surveyed population declared that had attended training courses. Also 28% of that 8% declared that they have abandon the training before it had finished.(See Figure 5)

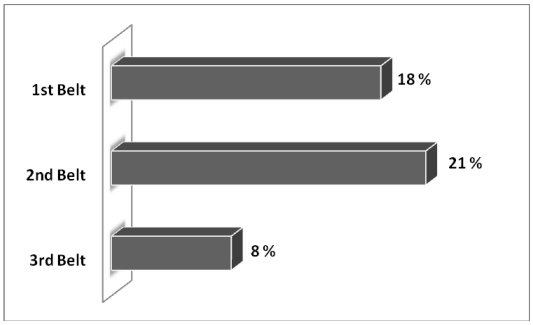

Figure 5. Percentage of population that had attended training courses.

2.2. Digital Divide Measurement

With the already shown results that are only some of the obtained by the research, it can be watch that, as economical resources decrease and distance grows, the possibilities for an inhabitant to access education are fewer. According to that reason, and in order to simplify its representation, the research considers the digital divide established between the first and the third belt. Only one indicator, information technology knowledge level is compared in the different belts. This comparison will allow marking a clear gap among communities. The width that separates the different communities must be watched in a dimensional way regarding the information supplied by the survey, from different angles:

1. Technological knowledge: In order to represent this category the research took this two topics: the percentage of population that doesn´t have any information technology knowledge and the percentage of population that doesn´t navigate internet to check their e-mail.
2. Training possibility: In one hand the number of inhabitants that had attended and finished training courses and, in the other hand, those who had abandoned the training before it had finished. It also takes into account the percentage of population that considers distance learning as a great possibility of training, because there are few or none travel costs and the time for training can be choosen by the trainee.
3. Socioeconomic issues: Although the survey form has several questions regarding the quantity of persons that lives in the family house, if they have their own vehicle and which kind it is, the significant questions, in order to determine the digital divide are oriented to technology. That's why, the research is based in indicators such as if the person has TV cable or satellite service or only TV by air.

Figure 6 shows the graphic mentioned in items 1 to 3. The x axis shows the indicators explained above. The upper line represents the result of the third belt survey where the deficiency percentages are higher. The

lower line shows the same indicators, but regarding the results of the first belt.

The area enclosed between the upper line (corresponding to the third belt) and the lower line (corresponding to the first belt) is the digital divide.

3. Strategy to Reduce the Digital Divide

Being aware of the digital device existence, and of its meaning to the involved population, it was decided to train the most marginal communities. The research team has studied several ways of reaching knowledge to those communities by means of free training. Although there had been a massive interest regarding the training, some drawbacks arise:

- It was impossible for the interested people to travel to the university to attend the training, due to the lack of money,
- It was impossible too, to have available computers in some marginal neighborhoods because there are some schools that don't have computers and, even worse, some other schools don't have electricity. Moreover, there are some organizations in the area of the population to be trained, that have computers, but they don't want to allow people from others communities to use them because of security problems.

Due to the problems explained above, the university offered their computer's labs to fulfill the training practice and provided buses for the people transportation. While the research goes on, some other problems arise such as the time schedule for the people to attend, because it was very difficult to find a time when everybody would be able to attend. Then, the research team decided to offer distance education. The training offered face learning to practice in the university computer's labs and distance learning to teach the necessary topics to make the practice. The University radio station was the massive media selected to broadcast the lessons. There were implemented microprograms, 20 minutes long, twice a week. This microprograms were repeated in different hour's ranges. But just when the mobility and equipment problems were solved, a new problem arose: the radio's range. It is important to highlight that in some towns, for example in a four blocks range the university's radio signal was received clearly, but in the next block, the signal was blocked by other local radio's signals.

The lower proposed age of the people who were going to attend the training was 22 years old. The High School's Principals of two marginal neighborhoods made a list with the names of possible people to be trained and hand out the sign up forms among school's neighbors, students' families, etc. A total of 148 sign up forms were received and each one was analyzed. As a result of that analysis the most deprived population, who only were able to attend free training, was selected. The sign up form had questions regarding the information technology knowledge level and also if the applicant was able to receive the university's radio signal at home. Those postulants with some information technology knowledge and who couldn't receive the radio signal at home were noticed of the reasons why they would not be able to attend the training. Some of these people declared that although they couldn't receive the radio signal at home, they could go to a neighbor or relative's home to hear the radio program. The High Schools' principals offered a school's room with radio to allow people to hear the program at school. In parallel, three members of the research team were trained to teach radio lessons. In distance education, contrary to face education, the teacher couldn't watch the students' faces and expressions; they couldn't ask questions to the students to check if they had understood the subject, or to check how quick they answer [3]. Also it is very difficult to teach about computers to students who had never seen or used one. That was the reason why some graphical material were made and delivered to the students through the High Schools, in order to allow them to watch the material while the teachers explain them in the radio program. Figure 7 shows three of these graphical materials as an example.

Figure 6. Digital divide between first and third belts.

The microprograms developed twice a week during two months. Each one of the sixteen microprograms was made alive with the following structure:

- Brief review of the previous class.
- Title and development of the day's class.
- Day's class conclusions.

The lesson was developed in a pleasant environment were the teacher chatted with the program's host who made more interactive explanations. Two telephone numbers were frequently repeated during the class: one for the students to call and ask questions, and the other to send text messages. All the questions that were received during the microprogram were answered alive in the discussion block. Three modules were developed: Hardware, Software and Internet. Each of them had theoretical issues explained during the radio program, also these issues were complemented with four practices, three hour long each one, fulfilled in computer's labs. Finally a final theory and practice exam was taken. Figure 7 shows the first page of each module. There were 11 pages in whole.

4. Obtained Results

As a result of the trainees selection explained above, 84 persons attended this first training experience. Three practice's groups were built in order to reduce the quantity of trainees for each practice class and to perform a better monitoring of each one of them.

The trainee's designation to the groups were made exclusively according to each person's time possibility to attend the practice. The three groups had 34, 27 and 23 students respectively. Table 1, shows the age's ranges of the trainees.

Table 1. Trainees' age's ranges.

Age's ranges	Percentage
Less than 25	2%
Between 25 and 40	37%
Between 40 and 60	35%
More than 60	26%

As a result of the training plan with the research team's proposed methodology, the following categories were obtained:

- Approved: Trainees who attended 75% of the practice training classes and who approved the final theory and practice exam at the first time or through a retake exam.
- Attended: Trainees who attended 75% of the practice training classes but didn't give the final exam.
- Disapproved: Trainees who attended 75% of the practice training classes but they failed the final exam.
- Absents: Trainees who attended less than 75% of the practice training classes

Figure 8 shows the percentages reached by: Approved (first time or retake exam) Attended, Disapproved and Absents.

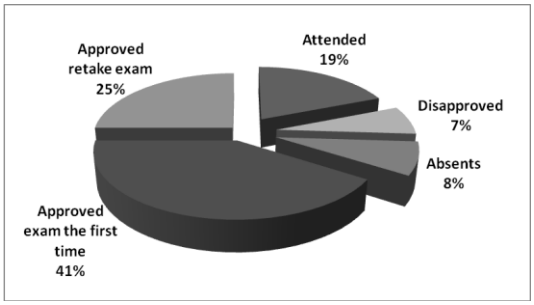

Figure 8. Obtained results

Only 16% of the population that participated in the research had access to a computer either in their homes, in a relative's home, neighbor's home or work place.

Because of the practice training were made in the university's labs, the trainees were advised, to do more practice somewhere else, such as cybercafes, etc. A lot of the trainees brought questions each next class regarding exercises that they had tried to complete and couldn't finish. This fact made that the training became successful because 66% of the students approved the final exam (see Figure 8). The desertion had been very low, only 8% of the attendees hadn't

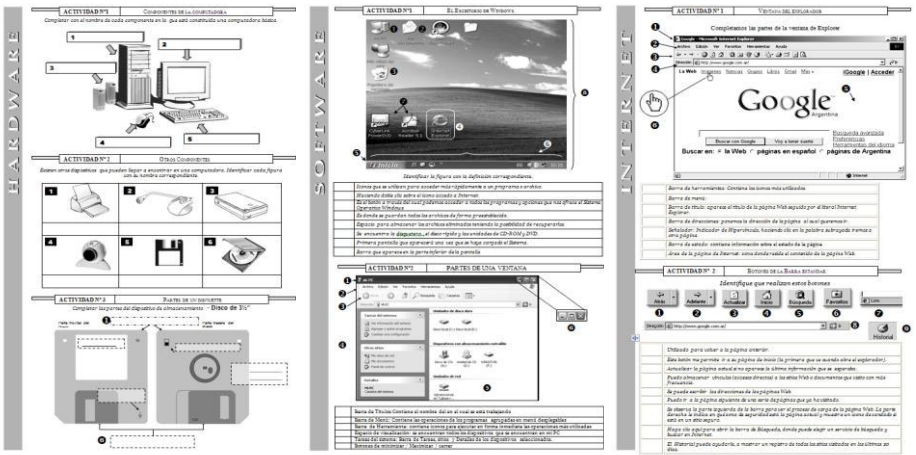

Figure 7. General view of each module first picture

finished the training. In a few cases the reason had been that it was impossible for the person to attend the practice because of the schedule. There were only 7% of the attendees that had failed the exam. However these same persons had completed the final survey, after knowing that they had failed the exam, and had written very good remarks regarding the training. The digital divide that separates La Matanza County different communities is wide but this research showed that it is possible to take actions to reduce it.

Due to the importance of the ICTs in nowadays world, the research tries to find a channel in order to provide the population of the La Matanza County with a tool that allow them to lose the fear they have to technology and, in addition, to decide what to do with the acquired knowledge.

The research demonstrates that it is possible to implement plans that make possible the reduction of the digital divide, being the massive communication media a very good channel to broadcast knowledge.

6. Related Work

It is essential to establish strategies that lead to reduce the intern digital divide that exist within each country. Even nowadays there are 776 millions of adults in all the world that don't know how to neither read nor write. More than 25 million of that figure live in South America, mainly in Mexico and Brazil. In Argentina there are 2.1% of the adult inhabitants (more than 800.000 persons) that don't know neither read nor write. This figures have been broadcasted by UNESCO [6]. Obviously, these people cannot have any access to computer's training, but to this percentage may be added people who knows how to read and write but who cannot access to computers training because of other reasons. Among them, the main reason is the lack of economical resources to access training.

The research team shares the concern to reduce this digital divide, technological and also generational, with other research works regarding the same subject:

- The research work [7] shows the subject of the Mexican society inequity from a simple observation of the last data census. This work shows a learning proposal and social practices for adults in marginal city areas.
- The INEA (National Institute for Adults Education) offers since 1982, several types of training and has considered the massive communication media as a viable alternative also to literacy [6].

The current paper shows that it is possible to use the massive communication media in order to offer technological training that can contribute to reduce the digital divide.

4. Conclusion

The current research has proved that a digital divide exists even among neighbor communities. In return to the economical resources shortage that prevents the marginal community to access technology and training, the enthusiasm to learn can overcame any type of barrier. It is only necessary to implement strategies that can allow these communities to reach the knowledge. The research shows a strategy that had been fulfilled giving good results. Most of the people who attended the training said that have never hope to receive an invitation from a university professor, nevertheless to be attending training into the university. The satisfaction of the research team was not only the percentage of approved trainees, moreover, before knowing that percentage, everybody was very satisfied because the mere fact of knowing that it was a task with a high social content.

We received persons who had never been in contact with a computer, we were with them sharing their efforts and we enjoyed their progress in each practice. The trainees had been able to make a final exam where they answered theoretical questions and solved exercises using a computer. This training was implemented to help the attendees to manage in a more and more digital and technologic world, to share information technology knowledge within their families, to get better jobs, and, to become citizens involved with their communities governments through e-government. It is just a humble sand grain to reduce the digital divide.

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Managing Conflict in Online Multicultural Student Teams

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Abstract: The use of teams by organizations of all sizes and orientation has grown significantly. Almost 70 percent of online students have reported working in teams in some form, in the last 12 months. Additionally, as globalization compresses time and space, the use of virtual cross cultural teams continues to rise. Learning to be an effective member of a team, especially a virtual team, has become a necessary career competency in many organizations. The sources of conflicts in student teams mirror those of face-to-face teams. Most conflict can be traced to differences in expected outcomes (grades), roles, style, values and resources (time), or basic personality conflicts. Because communication is often asynchronous and virtual, there are more opportunities for miscommunication. Online instructors often do not have the luxury of "seeing" the conflict holistically. This paper discusses the causes of conflict in student teams, the various behaviors that contribute to the conflict and the instructor strategies and practices that will reduce the impact of conflicts on the learning experience. In practice, the processes offered in this paper have reduced evident conflicts by 70%.

Introduction

I have had the privilege and at times, the agony of overseeing more than 250 graded online team assignments. After enduring many instances of conflicts in student teams and making mistakes in handling them, I realized that I needed to do something to either reduce or manage the conflicts. Through research, discussion with peers and experimentation, I have learned how to mitigate much of the inevitable conflict that arises. What follows below are a set of practices for handling these conflicts. These practices can help ensure that learning objectives are met and that students have a positive experience. Implementation of these guidelines has reduced the evident instances of conflict by 70% in the subsequent student assignments that I have overseen.

I conducted an informal poll from (2005 – 2007) of more than 300 students at the four universities where I have taught online courses asking about their overall experience with group assignments. I offered three response choices (positive, mixed or negative experiences) and results indicate that 63 percent (see Table 1) either had a mixed or negative experience ("disliked"). The primary reasons students offer are difficulty in getting everyone on the "same page," unclear instructions and expectations, and the fact that their grade depends on others.

Table 1: Student's attitudes towards online team assignments

Students	% who have participated in an online team assignment	Enjoyed the experience and thought it was a positive learning experience	Thought it was a mixed experience, overall worthwhile but some aspects detracted from the experience	Disliked the experience and thought it detracted from the learning experience
303	**252** (83%)	**93** (37%)	**51** (20%)	**108** (43%)

Given the potential conflicts in team assignments and the general disdain by students, why do professors persist in using team assignments? In discussions with many of my peers, the answers range from a belief in the value of learning how to be a positive team member to reducing their grading load.

Discussion

The Use of Teams - *An Essential Skill*

Almost 70 percent of my online students have reported working in teams in some form in the last 12 months. Additionally, as globalization compresses time and space, the use of virtual teams continues to rise. A recent study by the Gartner Group stated that by 2008, 41 million corporate employees will operate in a virtual workplace at least one day per week. Learning to be an effective member of a team, especially a virtual team, has become a necessary career competency.

A study by Ceridian Employer Services found that the ability to work in virtual teams plays a significant role in recruitment and retention. 50% of surveyed companies considered the ability to work in virtual teams a very attractive recruiting tool and 66% of the surveyed employees found the ability to use the Internet and work in virtual teams an "excellent" reason to stay with a company (Smith, 2008, p. 3).

On the other hand, the use of virtual teams brings challenges as well. These include issues related to trust, communication, the dependence on technology, time management, and team cohesiveness (Smith, 2008). It is more difficult to build trust virtually due to the lack of many of the clues that characterize face to face collaboration (non-verbals, proximity, consistency, observation). It is also more difficult to detect individual expectations in virtual teams compared to face to face teams. Expectations are individually-bound and often implicit. It is easier to detect mismatches face to face (Bosch-Sijtsema, 2007). Because they are distant, team members have more difficulty creating a "shared context" which helps shape expectations and build trust (Hinds & Baily, 2003).

Communication and language differences, time zone differences, differences in personal schedules, other time commitments, inconsistent time management capabilities and even cultural views on time can all create sources of conflict in student teams.

All of these can undermine team cohesiveness and serve as a foundation for conflicts in student teams. Virtual team members are more likely to experience task, role or responsibility ambiguity due to these factors (Shin, 2005).

Specific Sources of Conflict in Student Teams

The sources of conflicts in student teams mirror those of face-to-face teams. Most conflicts can be traced to differences in expected outcomes (grades), deliverables, roles, style, values and resources (time), or basic personality conflicts. Because communication is often asynchronous and virtual, there seem to be more opportunities for miscommunication, much like those we find in the workplace today with e-mail and instant messaging.

As I stated earlier, I have overseen more than 250 online student team assignments. I have been tracking instances of evident conflict in my online classes for the last three years. It that time I oversaw 127 online student assignments without the benefit of the array of conflict mitigation practices listed below. 78 or 61% had evident instances of conflict. "Evident" is defined as a clear instance of conflict that is visible to the instructor either in the form of a student complaint or can be observed in a group forum.

In that time, team members "going silent" was the number one source of conflict (42%) in the student team projects. The number two conflict involved "quality" - students unhappy about the quality of some of the input from their peers for the team assignment (31%). Number three, unfortunately, has been accusations of plagiarism about a teammate (12%) (See Table 2).

Table 2: Sources of Conflict in Online Student Assignments

Online Team Assignments (Tracked)	Evident Conflicts	Sources of Conflicts
127	78 (61%)	Differences in Expected Outcomes and Commitment ("Going silent"): 33 (42%) Differences in "Quality" (Deliverables): 25 (31%) Differences in "Values" (Plagiarism): 9 (12%) Personality Conflicts: 8 (10%) Other (including miscommunication): 3 (4%)

Mitigating Conflict in Student Teams

Evidence suggests that team-building exercises (Kaiser et al., 2000), the establishing of shared norms (Sarker et al., 2001; Suchan & Hayzak, 2001), and the specification of a clear team structure (Kaiser et al., 2000) contribute to virtual team success. I have used these as the basis for the creation of the conflict mitigation guidelines listed below.

Setting the Stage

I believe the foundation for mitigating team conflict is laid before the team even starts. It all starts with the instructor. The instructor needs to create a "collaborative learning atmosphere" where team members can share experiences and are encouraged to pool resources (Smith, 2008).

The Role of the Instructor

It begins with the instructor's attitude towards team assignments. I have learned that students will often perform to expectations if they are properly and consistently reminded of them.

The instructor must be a facilitator, boundary setter, traffic officer and motivator. The main role of facilitation is well understood by online instructors. If the instructor is only minimally engaged, discussion often loses energy or structure, team assignments can go awry and the antecedents to conflict missed.

The roles of traffic officer and motivator are two sides of the same coin. The instructor must regulate traffic flow, team expectations and team activity. If the team is slow to start, he must remind the students of the need to engage with the team. If the quantity, quality or visible interaction is drifting, the instructor needs to energize them. If individual students are not doing their part, he must "ticket" them and get them on track. The other side, cheerleading, is just as important. Creating a positive environment is critical to managing conflict. Praising in the team in public and critiquing any individual students in private, acknowledging focus and commitment, or thanking the team for productive work are examples of how the instructor can motivate student teams.

There are several preventative actions an instructor can take before the teams are set in motion. The syllabus needs to use "explicit structuring" of the teaming expectations to ensure greater content and context understanding of the team expectations. This will help to facilitate knowledge exchange between members and mutual understanding of the requirements (Hron, Hesse, Cress and Giovis, 2000).

The grade for the assignment should be significant enough to warrant proper attention—I recommend somewhere between 15 and 30 percent of the final grade. Additionally, the grading portion should clearly state that there is only one grade for the team assignments, and

each member will share that grade.

I also make use of a "Team Charter," to which I attach a portion of the team assignment's grade (5 percent). It is developed by the team based on a template I provide, which includes role assignment, a skills inventory, contact and meeting information, and the process to manage conflict within the team. At a minimum, the Team Charter focused the team members on the team requirements so there is the added benefit of subconscious "pledging" when the team commits to a Team Charter.

Additionally, I expect a "Team Log" to be turned in with each team deliverable. The Log essentially documents the team's activities and describes who did what.

The last section in setting the stage is the actual team formulation. Instructors form teams several ways. They sometimes let the students decide amongst themselves. If teams existed in the past, they may re-use them. Finally the instructor will assign the teams themselves. I have tried many different methods and have learned that when I assign them, there seems to be less conflict. I usually put together students from the same time zone, if possible, but certainly not more than 1 hour different. This has the effect of greatly reducing the complaints about access and scheduling. After logistics are considered, I look at talent level (attitude, writing skills, work ethic and quality of content). I spread out the talent a bit ensuring each team had both strong and weaker students. There is no full-proof method to team formation and because it is early in the semester typically, your selections are based on limited data.

Managing the Teaming Process

Once the teams are set, the instructor's role shifts to monitoring and encouraging. Because many team conflicts are often presented to instructors as "he said/he said" situations, it becomes challenging to manage interventions in an appropriate manner. I expect teams to perform "in the open." I create "team rooms" of some sort, to which I have access, so I can "witness" the team in action. Obviously, this does not always happen but I let students know that unless I have "evidence" of the conflict, I will assume the entire team is at fault for the dysfunction and grade accordingly. This seems to keep most of their activities out in the open. Finally, I monitor the team rooms from time to time (1-2 times per week), usually posting a message asking if they need anything or are having any issues. This lets them know I am hovering in the background.

Instructor Interventions

Despite this active preventative approach, conflicts do happen from time to time. I usually use a matrix of two types of intervention: soft and hard.

Soft interventions are gentle reminders that the team needs to solve its own problems. When I see an issue developing or receive a call or e-mail from a team member who is "worried" about the team, I will post or send a reminder about positive teaming behaviors, the need to adopt a team-first attitude, and their grade interdependence. I am not solving their problem but I am nudging them in the right direction.

If that does not work, I take a more direct approach. Hard interventions may include an array of instructor actions such as speaking to a specific student, speaking to the team itself, or changing the team parameters. In "hard" approaches, my focus tends to shift to specific recommendations to help them overcome the conflict.

I wish I could say that these interventions work 100 percent of the time, but sadly I have had situations where the team dysfunction was so bad it could not be resolved and the team experience was poor and the team deliverables below expectations. These, fortunately, have been rare.

The Aftermath

The biggest challenge for the instructor is to assign grades fairly for a team assignment.

Many instructors use a "one grade fits all" approach, not allowing for any distinction between team members. Other instructors create a means to adjust the grades within the team based on individual contribution. We use a "Team Evaluation" method that asks each student to assess their own and their teammates' contributions to the team assignments. The ability to administer grades individually has helped in specific situations, and just the potential for a grade adjustment within the team seems to lessen some of the students' angst about team assignments and grade interdependence.

Conclusion - Worth the Trouble

Because of the early painful lessons I learned in trying to deal with conflict in student online teams, I developed the process outlined above. Yes, it adds to an instructor's workload and can be tedious at times, but it does work. After deploying the full array of conflict mitigation steps listed above, evident conflicts in student teams have dropped almost 70 percent in my courses.

Table 3: Reduction in Conflicts after Conflict Mitigation Conflicts were Deployed

Online Team Assignments (Tracked)	Evident Conflicts
127 (Before conflict mitigation steps)	78 (61%)
98 (After conflict mitigation steps)	19 (19.4%)

I continue to use team assignments because I strongly believe this is a necessary career competency and I hope that the students will learn how to be positive team members.

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RESEARCH AND DEVELOPMENT LOW-COST BOARD FOR EXPERIMENTAL VERIFICATION OF VIDEO PROCESSING ALGORITHMS USING FPGA IMPLEMENTATION

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ABSTRACT

This paper proposes an architecture of a low-cost board for research and development engineering projects on video hardware processing. The current educational market lacks platforms for such designs and the majority of published scientific works only present software simulations. The presented platform enables the verification of the video operators under real experimental constraints, which are imperative to determine performance criteria for real time processing. It is composed of three modules: (i) the Video Input Interface (*'VII'*), that receives the ITU-R BT.601 interlaced digital video stream and delivers progressive digital video represented by the three parallel components YC_bC_r; (ii) the Video Processing Module (*'VPM'*), that implements a generic video processor, according to the user's need; (iii) the Video Output Interface (*'VOI'*), which converts video components from YC_bC_r to RGB. The architecture is both technology and manufacturer independent and has been implemented and verified in the Altera EP2C70F896C6 FPGA of Terasic's DE2-70 board. The main constitutive blocks have been developed using VHDL and the simpler, most generic ones, have been designed using Quartus II's megafunctions. The *'VII'* and the *'VOI'* modules have occupied together an area smaller than one percent of the FPGA's total capacity, leaving a great area dedicated to the Video Processing Module.

Keywords: Research and development on video processing, ITU-R BT.601, VGA, real time hardware processing, real experimental constraints, FPGA, VHDL.

I. INTRODUCTION

Nowadays, scientific works on image and video processing are usually restricted to the verification of the algorithms through software simulation and are only verified in simulation environments like MATLAB. This is due to the lack of low-cost platforms in the educational market that can enable the verification of real time video processing algorithms through experimental hardware implementations. However, the simple verification through simulation procedures does not detect problems that frequently occur in experimental tests, such as the limited quantity of bits to represent the analog signals, the processing time and the circuit latency, the memory required and the power consumption, among others. Some recent works, developed in the borderline between video processing and hardware architectures, have shown this preocupation [1]-[3]. Besides, image and video processing applications usually present a high level of data parallelism, a feature which makes hardware realizations very appropriate for implementation, in detriment of software realizations, whose processing is normally sequential.

This paper proposes a low-cost platform for scientific research and technological innovation projects on still image or video real time processing. The platform receives a digital video signal in the ITU-R BT.601 standard [4] (which is the default output from analog-to-digital standard definition TV converters), enabling its color components (YC_bC_r or RGB) to be processed by generic operators (such as encoding and decoding algorithms, image analysis, image restoration, image convolution and interpolation, among others). The platform also enables the visualization of either the input video or the processed video in a VGA (Video Graphics Array) monitor.

The board consists of two digital interfaces, named "Video Input Interface" (*'VII'*) and "Video Output Interface" (*'VOI'*), and also of a "Video Processing Module" (*'VPM'*). The *'VII'* aims at adapting data provenient from the TV decoder (presented in ITU-R BT.601 format) into a more adequate representation (supporting parallel channels for YC_bC_r) in order to independently and simultaneously process video components. The processing algorithms depend on the user's need and are implemented in the *'VPM'*. The *'VOI'* is responsible for transforming the video signal represented by its YC_bC_r components (from the output of the *'VII'* or from the output of the *'VPM'*) into the VGA format, in order to be visualized in a computer monitor. Alternatively, the outputs of the *'VII'* can be connected to the inputs of the *'VOI'*, in order to adapt color video representation from YC_bC_r to RGB, on which *'VPM'* can operate. That is, the *'VPM'* can choose between processing YC_bC_r or RGB.

The proposed hardware architecture for the board is both technology and manufacturer independent, allowing various device options for implementation. This architecture has been verified through implementation on Terasic's DE2-70 board, which already provides analog video inputs, the TV decoder ADV7180 and the FPGA (Field Programmable Gate Array) Altera EP2C70F896C6, in which both the interfaces and a simple *'VPM'*, for demonstration, have been implemented. The design has been developed in Altera's Quartus II tool suite. This realization using the DE2-70 board makes the low-cost Terasic's development board suitable for research and innovation developments in the area of real time video processing and analysis, such as computer vision, among others.

The paper is organized in the following sequence: Section II presents the proposed board's architecture and a general description of the proposed input and output interfaces. Section III de-

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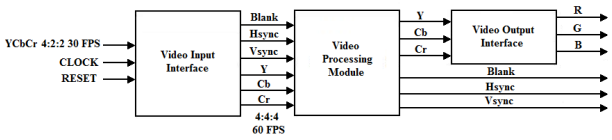

Fig. 1. The proposed hardware architecture

scribes the implementation of both the video interfaces into the DE2-70 board. Finally, Section IV shows a simple *'VPM'* that implements a one-dimensional convolution algorithm. The main conclusions of this paper are related in Section V.

II. THE PROPOSED BOARD'S ARCHITECTURE

Figure 1 presents the hardware architecture proposed for the real time video processing board. Usually, video operators manipulate image color components separatly. For this reason, they need these components provided by distinct parallel datapaths. However, the ITU-R BT.601 standard provides three multiplexed color components in the same datapath, as shown in Figure 2 [5]. Moreover, the ITU-R BT.601 presents an interlaced video stream with 30 frames per second (each frame with 720×480 pixels). Therefore, there are two image fields captured in different times: the field constituted by the odd video lines and the field composed of the even video lines.

Timing information on the ITU-R BT.601 standard is inserted into the video stream through special data sequences [5]. These sequences indicate "Start of Active Video" (SAV) and "End of Active Video" (EAV), in each video line. ITU-R BT.601 uses the H (horizontal blanking), V (vertical blanking) and F (field) control signals to compose information related to timing control: F = "0" for field 1 and F = "1" for field 2, V = "1" during vertical blanking, H becomes "0" during SAV and H turns becomes "1" during EAV (that is, H = "1" during horizontal blanking).

Both SAV and EAV are constituted by the preamble and the status word. The SAV's preamble is identic to the EAV's preamble, which is formed by the following sequence of data words: FF_H, 00_H, 00_H. The data word that follows these three words is the status word, usually identified by XYZ_H. It is the status word that differentiates a SAV sequence from an EAV sequence, depending on the H bit. The status word is also used to inform the timing signals V (which indicates vertical blanking) and F. Signals V and F, obviously, only change during EAV sequences.

A video line starts with the beginning of an EAV sequence. Next comes the horizontal blanking (with 268 samples), and then a SAV sequence follows. The active video samples only start to be transmitted after the SAV sequence. Y:C_b:C_r (the luminance and the two chrominances components) data is provided in 4:2:2 format (the Y component is informed for all the samples, while the chrominance components are only transmitted on the even samples) and the active video stream always begins with a C_b sample. In the multiplexed sequence, the co-situated samples (those that correspond to the same pixel) are put sequentially in the following order: C_b, Y, C_r. No chrominance information is transmitted for odd pixels. So, during an active video line 720 samples of Y are transmitted ($Y_0 - Y_{719}$), but only 360 samples of C_b and 360 samples of C_r occur (only for even samples). The final active sample, corresponding to Y_{719}, is also the last sample of the video line.

The "Video Input Interface" (*'VII'*) receives a 27 MHz clock, a reset signal and the video stream in ITU-R BT.601 standard as inputs. This video stream is converted into a video with 60 frames per second (progressive video, instead of interlaced video), with 720×480 resolution (the same as ITU-R BT.601), at 4:4:4 format (the three components Y, C_b and C_r are transmitted for all

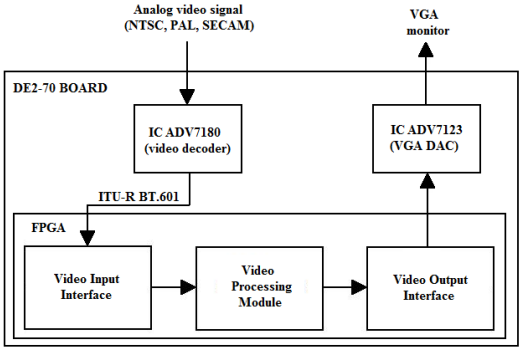

Fig. 3. Interconnection among video devices and DE2-70 Terasic's board

pixels), with independent and parallel datapaths (instead of multiplexed samples) for the luminance Y and for the chrominances C_b and C_r. In this way, the video components can be processed by a generic *'VPM'* and the resulting video can then be visualized in a VGA monitor, through the *'VOI'*.

The circuit implemented on the *'VPM'* is customized to the user's needs and depends on the video application. It presents a latency of N clock cycles, which is determined by the complexity of the implemented algorithm. The synchronism signals and the blanking signal provided as outputs by this module have to be identical to the outputs supplied by the *'VII'*, but N clock cycles delayed.

The second interface, named "Video Output Interface" (*'VOI'*), is responsible for transforming a video signal represented by its components YC_bC_r into a video signal represented by its components RGB. These components can be delivered to a *'VPM'* that process RGB components (instead of YC_bC_r) or to a DAC (digital-to-analog converter), along with the timing signals and the synchronism signals, in order to allow the video signal to be reconstructed on a VGA monitor.

Eventually, when the application is restricted to the visualization of the input video, the *'VPM'* may be suppressed and the *'VOI'* can receive the outputs signals from the *'VII'* directly as inputs.

III. EXPERIMENTAL REALIZATION OF THE VIDEO INTERFACES

The proposed architecture has been implemented and verified on Terasic's DE2-70 board [6] for development and educational purposes. This board has been chosen due to: its low cost (its price is USD 300 for any researcher); the multimedia interfaces supplied (such as TV decoder and VGA output); its storage devices and the large capacity of the EP2C70F896C6 Altera Cyclone® II FPGA, equipped with almost 70,000 logic elements that allow complex algorithms to be implemented. Figure 3 shows the communication mechanism among the interfaces proposed in this paper and the integrated circuits on the DE2-70(ADC - analog to digital converter, and DAC - digital to analog converter) utilized.

The DE2-70 board supplies two TV decoders (ADV7180 [7]) that convert an analog TV signal into a ITU-R BT.601 video stream. The board also provides a DAC (ADV7123 [8]) that allows the connection of the FPGA outputs to the VGA port.

The proposed architecture has been implemented using a modular and hierarchical approach, aiming at an easy and practical development both in the design and in the test steps. The bottom level of the architecture, which implements the constitutive blocks of the video interfaces, has been designed using either Quartus II's megafunctions or VHDL (Hardware Description Language for Very-high speed integrated circuits) [9]. This section first presents the

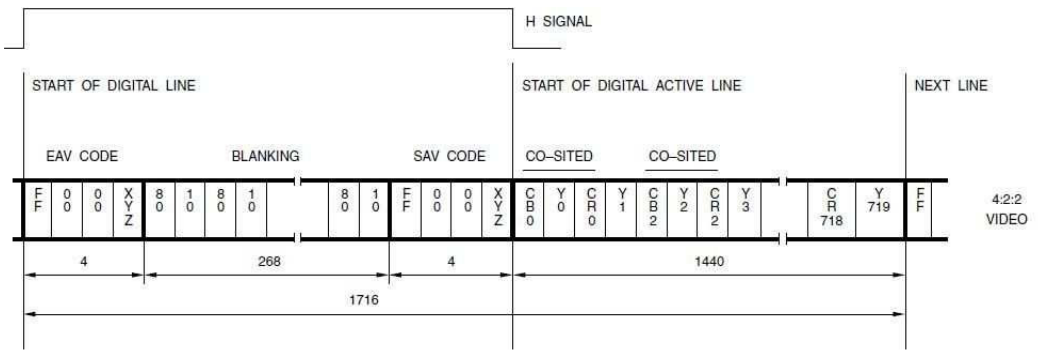

Fig. 2. Horizontal timing at a video line scanning in ITU-R BT.601 standard (4:2:2 Y:C_b:C_r; 720 active samples per line; 27 MHz clock)

top of the hierarchy (a schematic file) for the video input and output interfaces, for the case of monochromatic video, with detailed explanations of each block's behavior. The implementation for monochromatic video is a little simpler than the one for color video, since the luminance is used and the chrominance components are discarded. Afterwards, this section also presents the necessary modifications to adapt the implementation of the input and output interfaces for color video.

III-A. Video Input Interface (*'VII'*) for Monochromatic Video

In Figure 4, the top of the hierarchy is shown for the Video Input Interface (*'VII'*), in which the blocks "BT.601 Decoder", "Sync H", "Sync V", "Sample Counter" and "Demux lb enable" have been described using VHDL. The simpler and more generic blocks, "line buffer" and "mux line buffer out", have been developed using Quartus II's megafunctions.

Since BT.601 provides an interlaced video stream, but VGA is a progressive video standard, a deinterlace operation must be carried out in the *'VII'*. In progressive video, all the lines in a frame are sequentially sent. Unlike that, in interlaced video, odd lines, taken at time t_1, compose field 1 and are sent first. Even lines are taken at time t_2, constitute field 2 and are sent after the odd lines. The deinterlace operation consists of using the fields of interlaced video to estimate the missing lines of the frame, at each time t_i.

In the *'VII'*, the method used to implement the deinterlace operation is line repetition. In spite of being the most rudimental available method, it can be implemented without using memory external to the FPGA, since it is possible to storage a few lines in FPGA's embedded memory. Each "line buffer" block implements a memory capable of storing one video line.

The BT.601 bitstream is the input of the block "BT.601 decoder", which is in charge of identifying the preamble sequence and translating the status words into the signals SAV, EAV and Field, all described in Section II. The bitstream is also sent to the blocks "line buffer", in order to be stored. The block "sample counter", through its output "sample", implements a counter to provide the writing addresses for the blocks "line buffer". Since only the luminance Y is taken (that is, the chrominance components are discarded), the least significant bit of the output "sample" of the block "sample counter" is used as an activation signal for the blocks "line buffer". The reason for this procedure is that the least significant bit is always "1" at Y samples (and it is "0" for all the chrominance samples) and, by this procedure, only the Y samples are stored in the buffers.

Since the video transmission is intended to be made in real time , reading and writing of video lines must occur simultaneously. For this reason, two "line buffer" blocks have been implemented. While one of the blocks "line buffer" is used to store the Y samples relative to a video line, the other "line buffer" is read in order to transmit the Y samples relative to a previous line which has been previously stored. At the start of each new video line, the function of each "line buffer" block is switched, that is, the input streams' Y samples are written in the "line buffer" that was being read, and the "line buffer" which was being written to then starts to be read.

The least significant bit of the "sample" output from the "sample counter" block is connected to the "input" signal of the "demux lb enable" block, which addresses this signal to one of its outputs, "out0" or "out1". These outputs are connected to the "wren" (writing enable) inputs of each one of the "line buffer" blocks , which control the reading and writing enabling of these blocks.

The "demux lb enable" block also produces the "rd_sel" signal, which commutes every rising edge of SAV signal (provided by the "BT.601 decoder" block). The "rd sel" signal is the selection bit of the multiplexer implemented in the "mux line buffer out" block , which is in charge of the correct transmission of the signals from the outputs of the "line buffer" blocks to the "result" output.

In order to implement the line repetition necessary for the deinterlace process, each "line buffer" block must be read twice, while the storage of the following line to be read is done in the other "line buffer" block. The "sync H" block, which is responsible for the VGA video's horizontal synchronism, is also in charge of the double reading of each line from the "line buffer" block. It implements a counter that supplies the reading address for the "line buffer" blocks. So, during the time interval in which the "sample counter" block counts from 0 to 1715 (1716 samples the total: 4 samples of EAV sequence, followed by 268 blanking samples, other 4 samples of SAV sequence and, finally, 1440 active video samples), the "sync H" block counts only from 0 to 857, that is, the "sync H" block produces all the addresses for reading of the samples of one specific line for two times consecutively, while the "sample counter" block generates the writing addresses for storing each sample only once. It is important to note that the total number of addresses is the same, since the least significant bit of the "sample" output of the "sample counter" block is not used to compose the address. The counters implemented in the "sample counter" and "sync H" blocks are cleared by the SAV signal, which enforces the synchronism with the BT.601 bitstream video.

The "sync V" block implements a counter from 0 to 524 and operates as a line counter. The "sync H" block has an output named "ena_cont_V_out", which remains "high" during the last sample of each line. This signal is connected to the "sync V" block and makes its counter state increment one at the clock's following rising edge.

The "sync H" and "sync V" blocks are also responsible for generating the "H_SYNC", "H_BLANK", "V_SYNC" and "V_BLANK" signals. These signals's production is based on the count values implemented in each block. At the "sync H" block, the "H_SYNC"

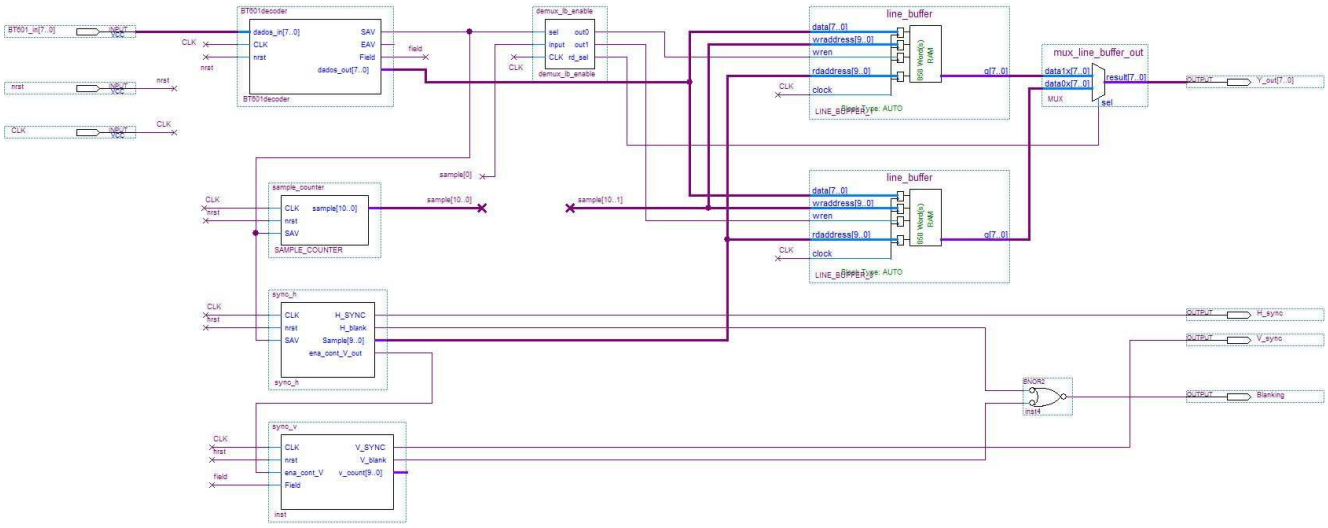

Fig. 4. Implementation of Video Input Interface (*'VII'*)

signal is "low" between the samples 745 and 847 and it stays "high" at the other samples. The "H_BLANK" signal stays "low" between samples 720 and 857 (non active samples) and it stays "high" at the other samples. At the "sync V" block, the "V_SYNC" signal is "low" between lines 11 and 13 and it is "high" at the other lines. The "H_BLANK" signal remains "low" between lines 10 and 44 (non active lines) and it is "high" at the other lines. The "H_BLANK" and "V_BLANK" signals are later used to produce a signal named "Blanking".

The "Field" signal from the "BT.601 Decoder" block is connected to the "V_SYNC" block and a falling edge at the "Field" signal turns the count of the "V_SYNC" block to the value four, synchronizing it with the BT.601 bitstream (the high to low transition of the "Field" signal occurs in the beginning of line 4).

III-B. Video Output Interface (*'VOI'*) for Monochromatic Video

Figure 5 shows the *'VOI'*, which is composed of only one block, which has been developed using VHDL and is responsible for the components conversion and for the contrast adjustment. Contrast is the range of possible values for video components. In the ITU-R BT.601 standard, this range is limited to 16-235. However, VGA monitors do not present this limitation and can reproduce video signals at a larger range. The "contrast" block converts the Y values in the 16-235 range, from either *'VII'* or *'VPM'*, to the 0-255 range, through the expression 1 and then each of the RGB components, in the case of monochromatic video, are made equal to Y',

$$Y' = (Y - 16) * 1,16363636363636 \quad (1)$$

in which Y' is the adjusted Y value and Y is the luminance value before the contrast adjustment.

Figure 6 presents the implementation of the proposed platform, operating with a NTSC TV signal originated from a video camera. In this implementation, the *'VPM'* has been suppressed and the platform application has been restricted to the visualization of the interlaced video input in a VGA monitor.

III-C. Modifications into the Input and Output Video Interfaces to Reconstruct Color Video

In order to provide color VGA, it is also necessary to process C_b and C_r components. As it can be seen in Figure 2, C_b and C_r

Fig. 5. Symbol for the Video Output Interface (*'VOI'*)

are subsampled and an interpolation operation must be carried out to estimate the missing chrominance samples (corresponding to odd pixels). The "*interp*" block, shown in Figure 7, implements an interpolation with a "Lanczos Filter" that uses eight samples (four samples before and four samples after the sample to be estimated) to determine each missing chrominance sample.

The "BT.601" bitstream that comes from the "*BT.601_decoder*" block is the $d_in[7..0]$ input for the "*interp*" block, whose main outputs are the signals Y, C_b and C_r. The "*interp*" block has a latency of eight clock cycles. Therefor, it is necessary that the synchronism signals SAV and EAV are equally delayed by the "*interp*" block.

Just like the Y samples, the chrominance components (that are provided for all video samples by the "*interp*" block), must be stored in order to enable the conversion from interlaced video into progressive video. Because of that, other four "*line_buffer*" blocks must be included (two dedicated to store C_b samples and two other to store C_r samples from one video line). The signals necessary to control these blocks' operation are the already existent signals used to control the storage of Y samples in the previous "*line_buffer*" blocks. Therefore, the deinterlace process happens in the same way for Y, C_b and C_r samples. The circuit *'VII'* to reconstruct color video (which provides the Y, C_b and C_r components) is omitted because of its similarity to the one presented in Figure 4.

The *'VOI'* for color video, consists on the "*YCbCr_2_RGB*" block, responsible for converting YC_bC_r to RGB. It is shown at Figure 8 and implements the equations 2 to 4, by which a contrast adjustment is also implemented.

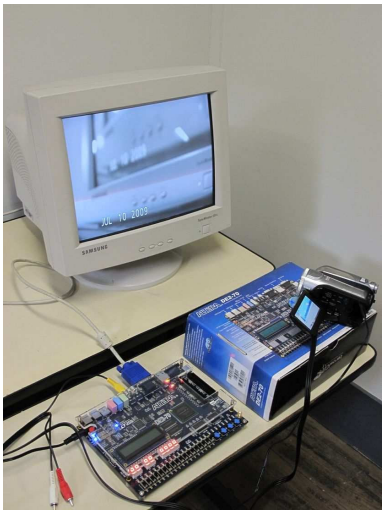

Fig. 6. Photograph of the implementation of Video Input and Output Interfaces

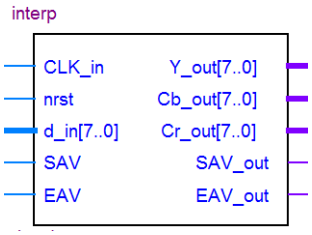

Fig. 7. Symbol for block "interp"

$$R = 1.164(Y - 16) + 1.596(C_r - 128) \quad (2)$$

$$G = 1.164(Y - 16) - 0.813(C_r - 128) - 0.391(C_b - 128) \quad (3)$$

$$B = 1.164(Y - 16) + 2.018(C_b - 128) \quad (4)$$

III-D. Experimental Results

Figure 9 has been generated inside Altera's Quartus II design tool and it shows the temporal simulation of the color video input and output interfaces prototyping. Since the time interval for one video line is many times larger then a Y sample time, temporal simulation of two or more video lines lack visual details. It is possible to see in the "BT.601_in" signal some time intervals with many transitions, which correspond to the active video samples, and also other stable time intervals of value equal to 16 (correspondent to non active video, or blanking). During the first video line, the R, G and B outputs stay on "zero" state, since the video signal is being written at one of the "line buffer" blocks. As soon as the second video line begins to be transmitted (after the non active video period), the R, G and B outputs begin to receive the values from the previous line. If the R, G and B signals are compared to the "BT.601_in" input video stream, it is possible to notice that the first line is read twice during the time interval that the second line is transmitted. From Figure 9, one can see that the "Blanking" signal is active during the non active video interval, just like the "H_sync" signal, which also occurs during the non active video period.

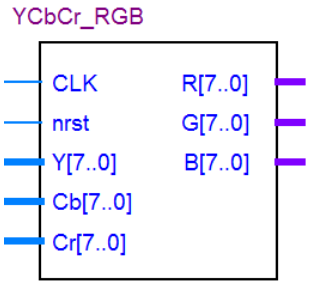

Fig. 8. Symbol for block "*YCbCr_2_RGB*"

Table I shows some compilation results extracted from Quartus II, relative to the implementation of the two interfaces ('*VII*' and 'VOI') for color video.

Table I
COMPILATION RESULTS - INPUT AND OUTPUT INTERFACES FOR COLOR VIDEO

Family	Cyclone II
Total logic elements	$942/68,416(1\%)$
Total combinational functions	$776/68,416(1\%)$
Dedicated logic registers	$530/68,416(< 1\%)$
Total registers	530
Total pins	$40/622(6\%)$
Total memory bits	$41,256/1,152,000(4\%)$
Embedded Multiplier 9-bit elements	0 / 300 (0 %)
Total PLLs	$0/4(0\%)$

IV. IMPLEMENTATION OF A UNIDIMENSIONAL CONVOLUTION MODULE IN THE 'VPM'

The purpose of this section is to implement a simple Video Processing Module to demonstrate an application that can be verified in the proposed Research and Development Board. It has been chosen a one-dimensional convolution module that operates directly over the RGB components (which are the '*VOI*''s outputs). A new S_i' value is calculated from the current S_i sample (that can be a sample of either R, G or B components) following the expression:

$$S_i' = \frac{Coef_0 S_{i-1} + Coef_1 S_i + Coef_2 S_{i+1}}{256} \quad (5)$$

in which clk is a 27 MHz clock, i is the column at which the current pixel is located and $Coef_0$, $Coef_1$ and $Coef_2$ are constants in the range -256 to 255 which depend on the type of filter demanded by the user (low-pass, high-pass etc).

Figure 10 presents the temporal simulation for the block which symbol file is given in Figure 11. Figure 10 shows that there is a latency of 6 clock periods. The signals "Hsync_out" and "Vsync_out" correspond to the synchronism input signals delayed by this same latency period. It can also be noted that the output frame rate is the same as the input frame rate, that is, a simple video processing application has been implemented in real time.

V. CONCLUSIONS

The achieved results show that the proposed architecture attends the initial objective, which is providing a low-cost board aiming at

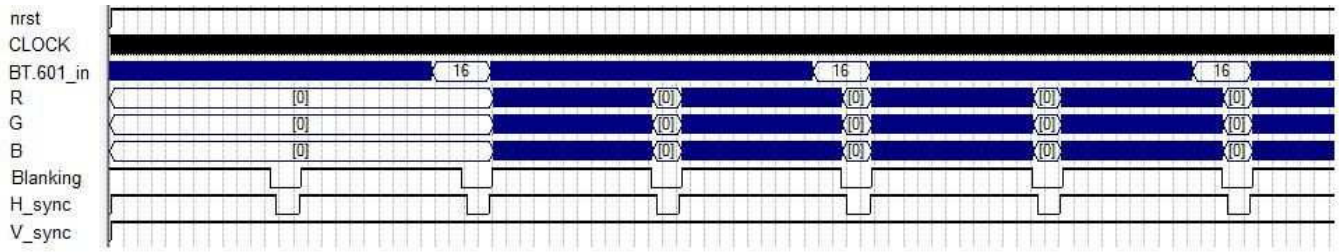

Fig. 9. Temporal simulation of the implementation of the video interfaces

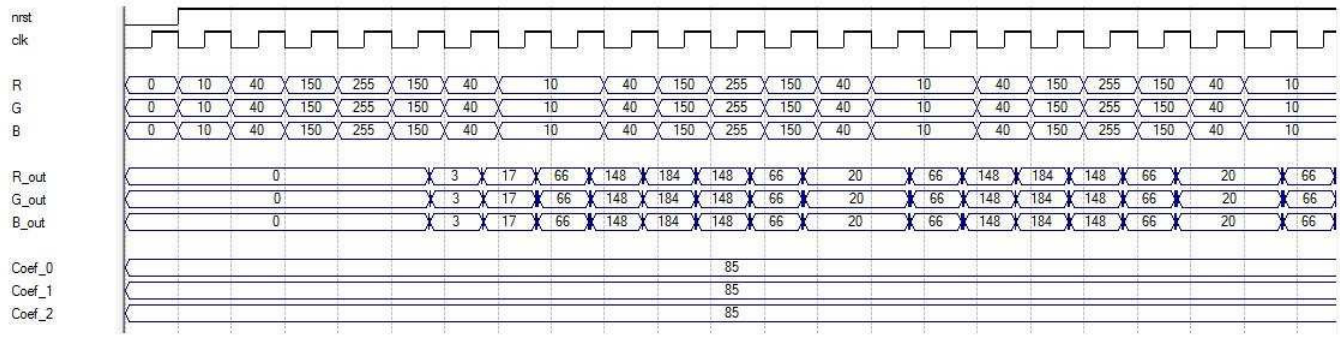

Fig. 10. Temporal simulation of the *'VPM'* that implements a one-dimensional convolution algorithm

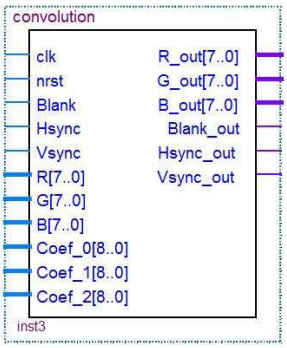

Fig. 11. Symbol for the *'VPM'* that implements a one-dimensional convolution algorithm

verification of generic video algorithms beyond the limits of software simulation. In this sense, the proposed board offers an adequate infrastructure for scientific research, for technological development and for the innovation in this knowledge field, since it allows the experimental verification of real time video processing under real hardware constraints.

Despite the fact that the board has been implemented into the Altera EP2C70F896C6 FPGA in Terasic's DE2-70 board, the proposed architecture is both technology and manufacturer independent. The only requirement is that the input signal of the architecture has to be a video bitstream in the BT.601 standard. Table I shows that in the presented implementation the device occupation with the video input and output interfaces is minimum, which allows the implementation of highly complex and highly computational demanding video operators in the *'VPM'*.

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SYNOPTIC METEOROLOGY AND ATMOSPHERIC THERMODYNAMICS EDUCATION IN FEDERAL UNIVERSITY OF ALAGOAS, BRAZIL

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ABSTRACT

This paper presents a new didactic material description for education in Synoptic Meteorology and Atmospheric Thermodynamics in Portuguese for short-term weather forecast in Brazil. Four book volumes include basic synoptic information and description of specific synoptic systems and process in South America. Also, software for student traineeship of the short-term forecast over South America is presented.

Keywords: software for traineeship, meteorology, books series and short-term forecast

1. INTRODUCTION

The synoptic meteorology course is the basic for meteorological education in all Brazilian Universities. At the same time, deficiency of didactical material in Portuguese and absence of books about specific synoptic systems of South America create educational problems. This paper informs about the second Brazilian books series of the Synoptic Meteorology in Portuguese. The first books of course ("Synoptic Meteorology" volumes I and II, 1999, 2001; [1] , [2]) were extended significantly. The base of this course is inspired in parts by Russian schools of the synoptic analysis and of satellite data interpretation for short term weather forecasting.

It is know that for short-term weather forecast is necessary to analyze too much different information in very short time period. The student traineeship in meteorological information selection and analysis is very important for educational process. Therefore the second aim of the paper is to describe software for student traineeship of the short-term forecast over South America.

2. SYNOPTIC METEOROLOGY BOOKS

The Synoptic meteorology course was published in books series (Figure 1, [3], [4], [5] , [6]):
Synoptic I: Thermodynamic analysis and identification by satellite data of clouds, adverse phenomena and air mass.
Synoptic II: Tropospheric dynamics and kinematics applied to the synoptic analysis.
Synoptic III: Structure and evolution of the synoptic systems: Barotropic /baroclinic cyclones and anticyclones, fronts and jet streams. Identification by satellite data.
Synoptic VI: Formation and evolution of the mesoscale and macroscale systems and processes acted in South America.

These books present didactic material as equations, figures, graphics and principal information about synoptic systems and processes. All material was described in a form of topics. Specific information about satellite data using for the weather analysis and short term forecasting was included. Volume IV includes integral information about systems and processes important for weather forecasting in South America; it is the first Brazilian book about it. Also, each book has additional information in *CD*.

a)

b)

c)

d)

Figure 1- Synoptic Meteorology books series: a) Synoptic I, b) Synoptic II, c) Synoptic III and d) Synoptic VI.

3. SOFTWARE FOR SHORT-TERM FORECAST

The original program for students' traineeship in short-term weather forecast is described [7]. Satellite data, results of numerical models (analyses and forecast) and soundings are used.

This traineeship method presents five principal groups of maps (pressure, temperature, vertical movement, humidity and instability). Each of these groups includes many different maps (for example, temperature group includes next temperatures: potential, equivalent potential, pseudo potential and relative geopotential maps).

This traineeship method shows similarities and differences between these maps inside each group, comparisons with the other group maps and satellite data of infrared, water vapor and visible channels. The complex maps of the different group information were created for synoptic situation analysis. A present situation interpretation and short-term weather forecast elaboration (up to 96h, each 12h) are final results of this traineeship program.

The program uses the LINUX operational system and software GrADS. The meteorological parameters maps were elaborated by ETA model (40x40km).

The next meteorological maps combinations (figure 2a) are used for the first step of student traineeship:
1) sea - level pressure with thickness between 1000 and 700hPa / stream lines with thermal advection at the pattern levels (figure 2b);
2) humidity convergence with stream lines / precipitation with sea- level pressure;
3) wind direction and velocity /relative vorticity with stream lines;
4) potential temperature with relative geopotential / relative humidity with air temperature;
5) stream lines with wind velocity at the middle levels / stream lines with wind velocity at the high levels.

Theses meteorological parameters combination helps to understand a synoptic systems spatial structure and to elaborate weather forecast.

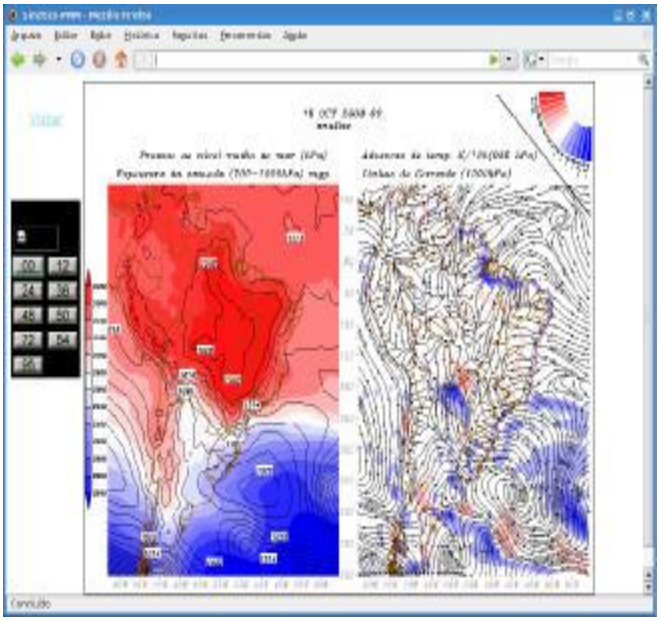

Figure 2- List of principal meteorological maps combinations (a) and example of four maps combination for synoptic analysis (b)

Also vertical soundings analysis (figure 3) and satellite information are used (figure 4). The soundings information is the principal data for adverse phenomena forecast. Instability indexes are calculated for this forecast elaboration.

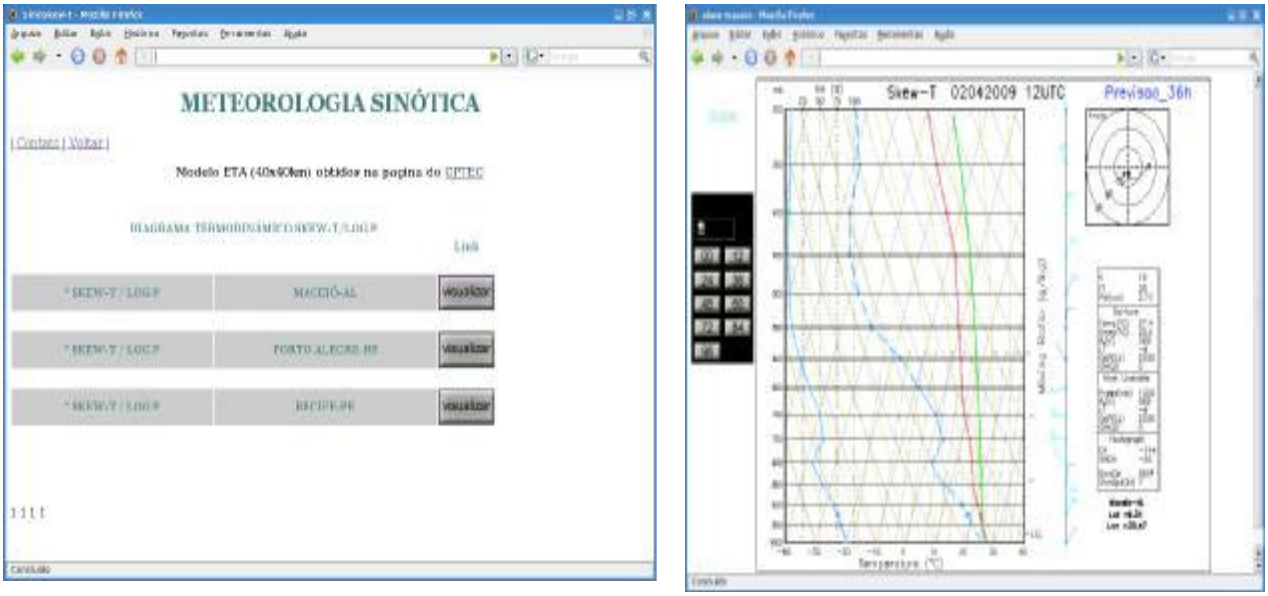

Figure 3- Analysis of vertical soundings: general information (a) and example of one sounding analyze (b).

The satellite information archives were created for time period 2006 - 2008. The satellite data combination was elaborated by two satellites: GOES (channel 4) and METEOSAT (channel 9). One example of the satellite information combination for synoptic systems analysis is presented in figure 4.

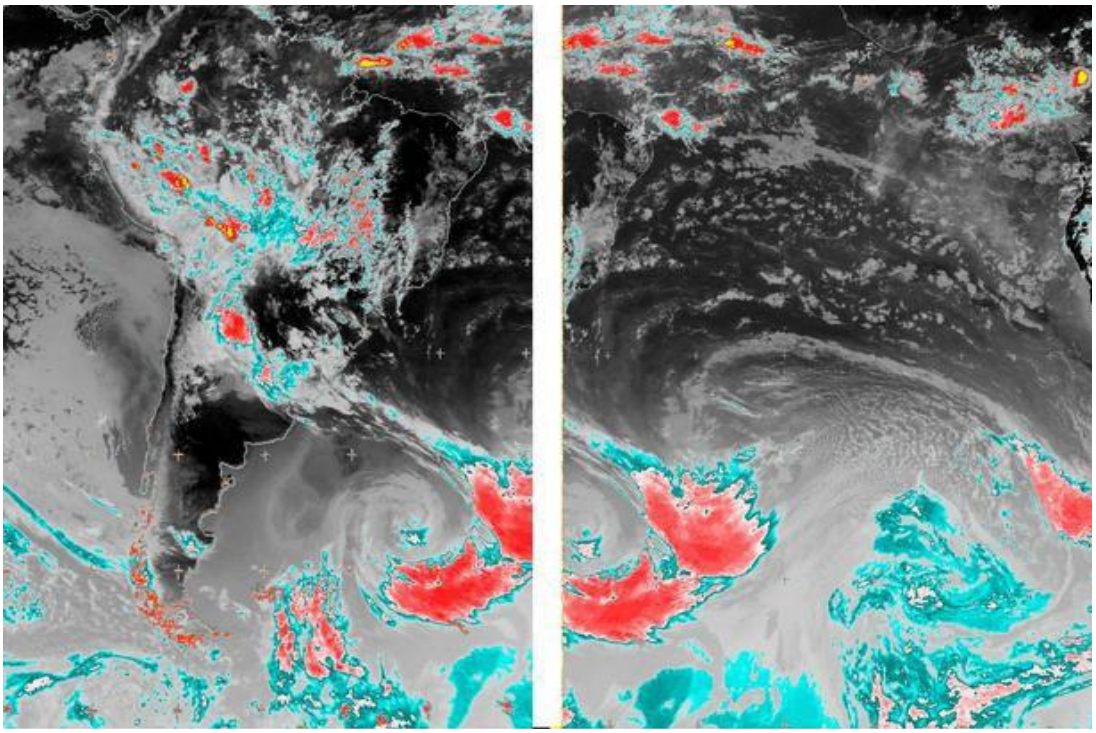

Figure 4- Example of the satellite data analysis: combination GOES e METEOSAT information in infrared channel in Mercator projection. The red color show more intensive cloudiness up to high levels and blue color present the middle levels clouds.

4. CONCLUSION

The Synoptic Meteorology course books can be used by undergraduate and graduate students of the meteorological departments and by professionals in weather forecast and as an educational accessories.

The software for the short-term forecast is used with success for student traineeship in the Institute of Atmospheric Science of the Federal University of Alagoas, Brazil.

5. ACKNOWLEDGEMENTS

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ICT: The impact outside the classroom. Study of Chilean PISA results

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ABSTRACT

This document allows progress in existing knowledge about ICT and its impact on learning in science for Chilean students. First, it presents comparative statistics on access, use and type of computer use by students. Secondly, it describes the econometric studies results that analyze the impact of ICT in achievement, controlling for variables of students and schools.
The main conclusions are based on the verification of the limited access to technology and connectivity faced by students of secondary schools in Chile. Differences are accentuated in certain groups of students, which creates gaps in learning and future job skills. Subsequently, it is found that access at home has a positive and significant effect on science PISA results and it is directly related with the frequency use. There is no evidence to support the same conclusions considering the availability of computers in school. Finally, there is evidence to suggest that not only computer use affects academic performance, the type of use also does: geeks spend much time using the computer but do not get better results.

Keywords: computers at home, ICT , student achievement, educational production, PISA.

1. INTRODUCTION

Over the last few years, the world has undergone transformation processes regarding the way economies are organized. Information and communication technologies (ICT) are playing a central role in the development of these new economies and in the social participation of citizens. As a result, the western world has made significant investments in order to enable students to access ICTs in an effort to prevent the technological gap from becoming yet another element of social inequality.
Despite these efforts, the evidence does not yet provide sufficient elements to enable understanding the relationship between ICT access and use and teaching-learning process. In fact, there is considerable ongoing research aimed at understanding the evolution of countries regarding ICT access and the use for educational purposes and the way in which students and teachers get involved with technology. Some of these studies have established that the effect is nil. For example, [5] points out that U.S. investment in technology in schools has not generated any impact on education. Other studies (such as those by [3], [15] and [1] have shown that ICTs have a negative impact on performance. These studies suggest that the computer constitutes a source of distraction, substitutes effective teaching methods, facilitates access to unreliable sources, and limits students' creativity. Finally, several studies (such as those by [7], [11] and [13]) have found a positive and significant effect of computer use on performance, and there are authors who even state it is possible that new generations of students will require a greater use of technologies in the educational process in order to obtain better results. This is the case of [12] who defines the New Millenium Learners (NML) as a highly integrated communicational generation. This change in educational subjects sets forth the need for adapting teaching practices to new thinking patterns. Along with the foregoing, the use of computers may have other effects in and developing other types of skills which, although not measurable in tests, are valued by the labor market [4].
However, those who defend the use of ICT tend to coincide in the complexity of the process. Obtaining returns on investments in educational technology requires much more than the mere introduction of technology. It requires the triangulation of content, sound teaching principles and high quality teaching. All of the above must be aligned with assessments and reporting [11], [15], and [2].
In the context of contributing to the above with information that is relevant to Chilean reality, this study sets the objective of providing evidence on the access and use of computers by Chilean students and to determine the correlations existing between this access and use and their performance in PISA 2006 [9] Science Test. The hypothesis of this study is that mere access to technology does not have an impact on results and that frequency use does not always relate positively to school performance – the relationship is conditioned by the type of activity performed on the computer.
The methodology used for both analytical phases (descriptive and econometric) is given below, followed by the main findings of such analyses. Finally, the study's conclusions are set out, including recommendations for the public policies area.

2. METHOD

In order to provide evidence on the access and use of computers, this study carried out a descriptive analysis on access and use of technology. For the purpose of finding conditioned correlations between computer use and student performance, the second part of this study estimated production functions, between performance and technology, controlling student and school characteristics.
The following questionnaires, applyed for the 2000 and 2006 PISA test [9 and 10], were used for the descriptive analysis:
- Questionnaire for students, which included questions on context and scientific interest. The PISA 2006 test also included a questionnaire on the use of technology.
- Questionnaire for schools.

By means of econometric analysis, the test estimated the conditioned correlation of access, frequency and type of computer use with the performance obtained in the PISA Science Test by Chilean students. A multilevel equation was modeled for each estimation.
The production function estimated to obtain conditioned correlations, has the following structure:

$$(1) \qquad P_{ij} = \beta_{0j} + \beta_1 F_{ij} + \beta_2 C_j + \beta_3 T_{ij} + \mu_{ij}$$

where P is the score obtained by student i, in school j, in the PISA Science Test. F is the set of variables related to the student's family and personal context; C is the set of variables related to the school where the students attend, and T are the variables related to the use of computers. The parameters β represent the estimated value of the conditioned correlation between the stated variable and the performance in science.

Specification of the production function permits a different intercept for each school (β_0) but limits the correlation between explanatory variables and performance (β) to be constant for all schools.

Five regressions were estimated:

- Basic equation: only control variables are incorporated. Technology variables are not included, since they are proposed as a basis for comparison.
- Access: basic equation variables included, in addition to the access variables at home and at school.
- Home frequency: only students who have access to a computer at home are considered. Basic equation variables included plus the frequency of use at home and access at school are included.
- School frequency: Basic equation variables included in addition to use at school and access at home.
- Type of use: Basic equation variables included plus the frequency of the following uses: Internet, techno-addicts and Office.

The aforementioned questionnaires were used in the econometric analysis, but only those applied in Chile, in the context of the 2006 assessment [9]. In addition, the following variables of the school were used[1]: Administrative dependence; registration fee; socio-economic group.

Regarding the socio-economic level, it is important to mention that the index built by PISA includes access to a computer. In this context, using both the PISA index and the access variable in the estimation would have generated a high correlation between both variables which would have caused the access variable to lose significance due to construction, distorting the possible conclusions of the study. Hence, when an attempt was made to correlate access with performance in science, the socio-economic index level constructed by PISA was not included, since it did not enable distinguishing the individual relationship between access and performance which this study tried to obtain.

Given the existence of unobserved variables, the econometric analysis can be biased due to omitted variables when these are correlated with interest variables. As it has been shown in several studies [14], students with a more advantageous family background, for example with better-educated parents or those with better jobs, in general tend to perform better, educationally speaking. Better-educated parents provide more tools for improving their children's education such as, for example, better academic support, greater motivation or better resources. Furthermore, students from a higher socio-economic background tend to have more computers at home. Thus, having a computer at home may be considered a socio-economic proxy while it may also have its own impact on students' learning. This same identification problem may occur at the school level. This study seeks to minimize the probability of omitting relevant variables, including the set of student and school characteristics provided by PISA 2006 [9] and information supplied by the Ministry of Education[2] for each school. However, some remaining characteristics could not be observed and were therefore not controlled.

On the other hand, there is a problem of endogeneity that impedes determining the trend of causality. In other words, it is impossible to affirm whether the use of computers empowers learning, or whether high-achieving students tend to use ICT with greater frequency. The inverse relationship could occur if high-achievers were to be "rewarded" with computers or with permission to use computers.

In view of all of the above, the estimations of this study must be interpreted with caution as conditioned correlations, in the sense that they report a relationship between computers and learning while keeping other family and school aspects constant. Even so, this conditioned correlation provides more information than a simple bivaried correlation.

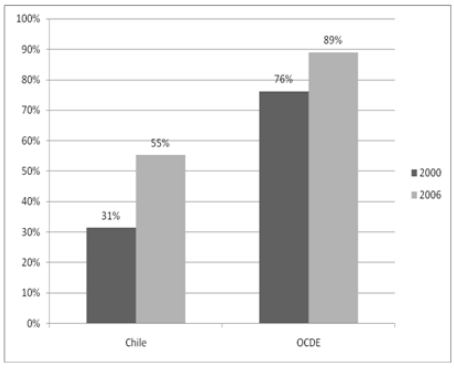
3. RESULTS

Descriptive analysis

Evidence on the access and use of computers by Chilean students is given below. The purpose is to evidence the degree of technological penetration in Chile, as well as to make comparisons that will enable identifying the degree of progress of the interest indicators and determining whether it has been enough to match the standards of other countries.

Access to the computer. With regard to computer access by Chilean students who rendered the 2006 PISA Test, the following can be mentioned: in the first place, and as observed in Figure 1, half of the students had access to a computer at home.

Figure 1. Percentage of students with a computer at home



Source: OECD. 2000 y 2006

As shown in Figure 1, in year 2000, 31% of all Chilean students had access to a computer at home, whereas in 2006, this access increased by 77% (that year, 55% of students had a computer at home). However, although growth in access by Chilean students is higher than the growth shown by OECD peers, the gap in home access between OECD-member countries and Chile is 34%.

In this regard, it is worth mentioning that according to national statistics on computer ownership in Chilean homes reported by the CASEN Poll [8], 34% of Chilean homes owned a computer in 2006, due to which it can be said that on average, households with at least one 15 year-old student, have a greater probability of having a computer available. This could indicate that the decision to purchase a computer is affected by the composition

[1] Information requested from the SIMCE in September, 2008.

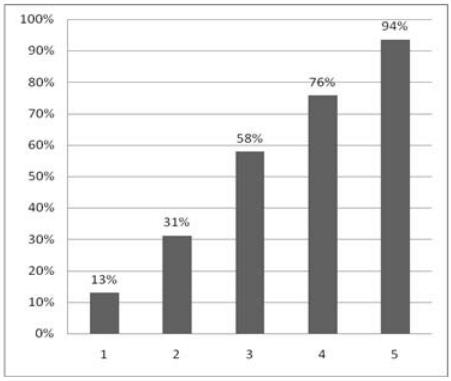
of the household, especially if it has students that could promote its use, which would coincide with what Pedró stated (2006), in terms of it being possible that the NML are pressuring for an environment with more technology.

Regarding Internet connection, in 2006 one third of Chilean students had access to a computer connected to Internet at home, which is equivalent to 55% of those who had a computer[9]. However, despite the 24% increase in access to a computer at home between 2000 and 2006, the increase in access to a computer connected to Internet was only 11% and the gap between Chilean and OECD country students in this area is 47% [9 and 10].

Nonetheless, findings show that access to a computer is substantially higher in the upper socio-economic groups. This is shown in Figure 2. Group 1 represents the most disadvantaged level and 5, the most advantaged group.

Along with the above, it is important to state that although access to a computer at home increased in all socio-economic groups in 2000-2006, students in the lowest group experienced a lower increase. Furthermore, it can be seen that 3% of the lowest socio-economic quintile had a computer connected to Internet at home as opposed to 76% of the highest quintile [9 and 10]. Nevertheless, this higher proportion in connectivity of students from higher socio-economic groups also did not match the average connectivity rate of OECD-member countries for the same year.

Figure 2. Percentage of students with a computer at home, per socio-economic level



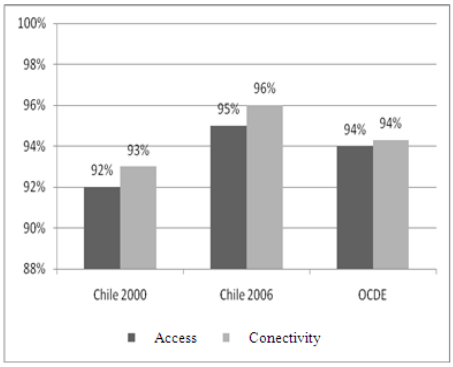
Source: OECD, 2000 and 2006

Regarding access to a computer at school, it can be observed that, in 2006, Chilean schools had an average one computer available for 25 students [9], even though in Chile the availability of computers per student in schools doubled between 2000 and 2006. In contrast, in schools of OECD-member countries, there are 6 students for every computer available for classroom activities [9 and 10].

However, a differentiated availability of resources is noticeable among Chilean schools – public schools are the ones that have fewer computers available per student for classroom activities [9].

Frequency of computer use. The frequencies of computer use at home, at school and other places are revised below in order to determine whether frequency has been affected by the increase in access. To facilitate this review, the following definitions are used: "little use" ranges from "sometimes during the month" to "sometimes during the year"; "frequent use" means once a week or more, and "never" means the computer is not used.

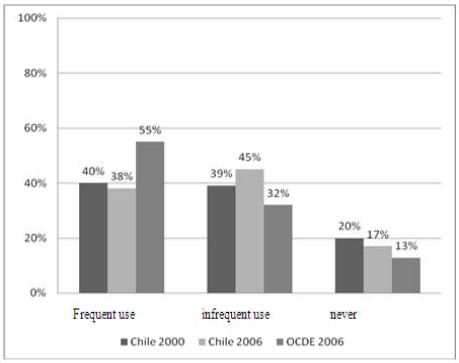
Figure 3. Percentage of students who frequently use the computer at home, according to access and connectivity



Source: OECD, 2000 and 2006

As shown in Figure 3, in 2006, 95% of all Chilean students who had access to a computer at home, used it frequently. However, unlike the foregoing situation, one can say that computers available at school are used with moderate frequency by students, as shown in Figure 4.

Figure 4. Frequency of computer use in school



Source: OECD, 2000 and 2006

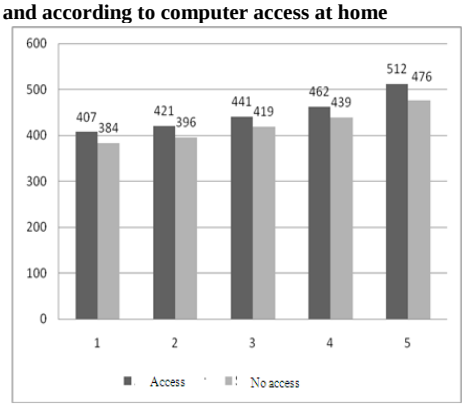
In effect, Figure 4 compares the frequency of computer use in school, showing three columns per group: the first represents Chile in 2000, the second in 2006, and the third the OECD in 2006. In the first group of columns ("frequent use"), it can be seen that in 2006, less than half (38%) of Chilean students used the computer frequently at school (only 5% said they used it "almost every day"). In contrast, a little more than half (55%) of all students from OECD-member countries said they used it frequently.

In this regard, it is important to mention that, although the ratio of computers per student in Chilean schools doubled between 2000 and 2006 [9 and 10], frequency use increased only slightly.

Relationship between the Pisa Science test scores and computer access. On comparing students with a computer at home with those who do not have one, it can be observed that scores obtained in the PISA-Science 2006 test are consistently higher for the former group, at all socio-economic levels. Likewise, the score gap between the groups with access and without access is almost identical, approximately 24%, in all socio-economic groups, except for the highest group where, having taken this information into account, it seems that the

lack of computer access at home generates a higher negative marginal impact[2].

Figure 5. PISA-Science 2006 test scores, per socio-economic level, and according to computer access at home



Source: OECD, 2000 and 2006

Relationship between Pisa-Science test scores and frequency per type of computer use. Since it is possible that the impact on learning depends on the type of use given to the computer, the frequency of use for different activities is compared to performance in the 2006 PISA-Science Test. However, since PISA records refer to a large number of uses, these were grouped by means of a factor analysis for the purpose of this study:

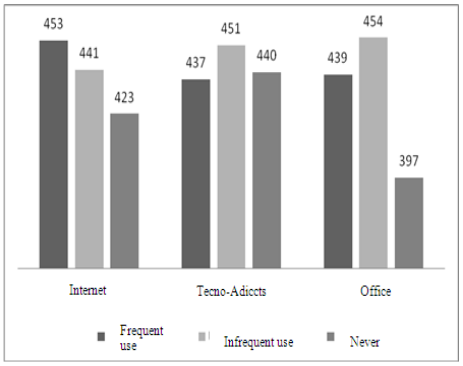
1. Internet user: students who use the computer for Internet-related tasks such as email or chat, downloading music, surfing, downloading software and collaborating on Internet.
2. Techno-addicts: students who have a "great fascination" for technology and IT, producing or using technology for fun and/or the recognition associated thereto. This type of user frequently performs tasks such as downloading music, playing games, programming, emailing or chatting, and downloading software.

There is a third user type in addition to the above, which is not evident in the factorial analysis and has been defined as the "Office user". This person uses Office-type programs mainly related to academic work and is included in the study since it was considered interesting to verify the relationship between these activities and performance

For the analysis of the data below, it is necessary to bear in mind that a student can fit into more than one group, since our purpose is to relate different types of use with performance.

Figure 6 compares the average score of Chilean students in science, taking into account the different frequencies of use per type of computer use. For each type of user, the first column shows the score of students that "never" use the computer; the second shows the score of those who use it "infrequently," and the third shows the score of those who use it "frequently". The first group of columns compares the average scores of Internet users; the second of techno-addicts and the third of Office users. It can be observed that as the frequency of computer use increases for Internet-related activities, average student performance also increases. Moreover, the relationship between performance and frequency in techno-addicts and Office users has an inverted U shape which reveals the possible existence of an optimum frequency in computer use when used for certain types of work.

Figure 6. Performance in the PISA-Science 2006 Test according to type of computer use



Source: OECD, 2000 and 2006

Econometric analysis

This section of the study presents the conditioned correlations between technology and performance in science. In this area, it can be stated that the relationship between access at school and performance is nonexistent, and that the relationship between access at home and performance is of little importance. In contrast, there are positive and significant relationships between frequency and performance and between the Office type use. Furthermore, the relationship between performance and Internet-related use is insignificant and that for techno-addict type uses is negative and significant. The Annex shows the results for each equation.

In this respect, it must be pointed out that the estimated regressions explain approximately 12% of the within-school variance and 86% of the inter-school variance. The low variance rate explained at the student level is due to the fact that student characteristics used to explain performance are not homogeneously distributed among the population. Since the scores have been standardized in such a way that the standard deviation is 100 points, the estimators can be interpreted as percentages of the international standard deviation.

Variables of computer access. As seen in Table 1, computer access at home has a positive and significant relationship to performance, although of little significance: 5% of a standard deviation of the distribution of PISA 2006 scores[3]. On the contrary, computer access at school, measured as the ratio between computers and registered students, does not show a significant relationship to performance.

Table 1. Results of access regression of frequency variables

Parameter	Estimation	Standard error	t	Sig.
Has a computer at home	4.91	2.348	2.1	0.036
Computer-registered students ratio	122.2	84.67	1.4	0.151

[2] These scores are statistically significant.

[3] By including the Socio-Economic Index Level in the regression, the relation between access and performance becomes insignificant.

Frequency variables of computer use. From the frequency use variables analysis (Table 2) it can be seen that that those students who never use a computer at home obtain 24 points less in the test compared to those who use it infrequently, and 30 points less than those who use it frequently. With regard to frequency of use at school, infrequent use is positively related to performance and frequent use does not have a statistically significant relationship[4].

On comparing computer use at home with the number of books at home, considered as a cultural capital reference, it was found that frequent computer use would be equivalent to the student having 200-500 books at their home.

Table 2. Results of frequency regressions

Parameter	Estimation	Standard error	t	Sig.
Low frequency use at Home	25.911736	13.494633	1.920	0.055
Frequent use at Home	30.239741	11.992827	2.521	0.012
Low frequency use at School	8.541579	3.221341	2.652	0.008
Frequent use at School	0.745226	3.567892	0.209	0.835

Type of computer use variables. With regard to the types of uses, as observed in Table 3, Internet use is not related to better performance in the PISA-Science test. However, "techno-addict" users seem to perform worse. This may be associated to the fact that these students devote a large part of their time to activities related to technology, disregarding their school work.

As for Office-type use, a positive relationship can be observed between infrequent and frequent use and performance. In this regard, Office tasks can be considered to be basic tools for computer use which enable accessing more sophisticated uses.

Table 3 Results of regressions per type of use

Parameter	Estimation	Standard Error	t	Sig.
Low frequency use of internet	-2.202237	3.586116	-0.614	0.539
Frequent use of internet	-4.239798	4.346597	-0.975	0.329
Low frequency use of "techno-addicts" tasks	-8.714779	3.121824	-2.792	0.005
Frequent use tasks of "techno-addicts"	-19.069756	4.233771	-4.504	0.000
Low frequency use of Office	16.353293	4.544145	3.599	0.000
Frequent use of Office	10.549175	4.857730	2.172	0.030

4. CONCLUSIONS

As previously stated, this study has two main objectives. On one hand, to provide evidence on the use and access to computers of Chilean students and, on the other hand, to determine existing correlations between this access and use, and performance in the 2006 PISA-Science Test. The hypothesis is that mere access to technology does not have an impact on results, and that frequency use does not always relate positively to performance – the relationship is conditional to the type of activity performed on the computer.

With regard to the evidence that was sought, it is important to point out that, in general terms, it can be seen that Chilean students have limited access to computers and Internet, and that both accesses are determined by their socio-economic level. This fact, in the long term, may translate into a relative economic disadvantage, as the result of the difference in technological skills developed today by the future work force. Telecommunication policies should review available options. The current technological gap in connectivity is much deeper than the traditional gap in books or didactic material in the home. In Chile, the monthly expense of a connection is equivalent to more than 10% of the minimum wage.

The results of the econometric analysis do not enable to affirm with certainty that access has an effect on performance. The limited relationship found between access at home and performance could be explained by unobserved variables related to the socio-economic level or parental motivation. On the other hand, the absence of a relationship between access at school and performance may be the result of low computer use, in view of current investment levels or because teachers do not use it appropriately [2]. Thus, these results are aligned with the hypothesis of this study, that mere access to computers does not improve performance.

On the other hand, a positive relationship between performance and frequency use is found, both at school and at home. However, this relationship hides the fact that technological tools have different uses, which relate to performance in different ways. Computer use could have an effect on performance when used as a support tool, but it can also be a distraction, which would have no effect, or even a negative effect, on learning. Specifically, it was found that there is no relationship between Internet use and science learning, a negative relationship between "techno-addict" type use and a positive relationship with Office type productivity programs.

Finally, the findings of the econometric analysis show that there is a positive relationship between performance and frequency in schools, but only for infrequent use. Most likely, and despite the progress made in computer access in schools, this continues to be so deficient that it does not allow to become an active and valid tool for performing or supporting classroom activities and impact frequency use inside schools. On the other hand, one must not forget the role that teachers play in the introduction of the computer in the classroom. If teachers do not know how to use the computer as an educational tool, frequency use will probably not change [2].

The findings of this study provide information that enables broadening the debate on technological equality and collaborating in decision making, with regard to where future technological investments should be prioritized and which minimum competencies should be developed by students and teachers alike. However, one must bear in mind that there is a problem of identification. It is impossible to control unobserved correlated variables with both ICT access and performance. On the other hand, there is a problem of endogeneity that impedes determining the trend of causality. Other limitations of this study are related to the impossibility of in-depth research into the context in which technological innovations are developed.

In order to advance in proposals for public policies, it would be interesting to have more quantitative evidence and experimental pilot studies that would enable evaluating the impact of different alternatives before defining large investments over the next few years. From a methodological standpoint, it would be

[4] This result is maintained, even though the student's socio-economic index level is included. Again, access at home loses significance.

preferable to use a longitudinal study to determine the effect of technological innovation that would enable eliminating biases related to the student's context [6].

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Annex. Results

	Basic equation	Access	Frequency at home	Frequency at school	Type of use
Intersection	339.59 (**)	326.4 (**)	314.29 (**)	328.36 (**)	354.85 (**)
Girl	-19.08 (**)	-19.32 (**)	-17.42 (**)	-18.71 (**)	-20.73 (**)
Class					
Grade Nine	45.27 (**)	43.39 (**)	39 (**)	47.12 (**)	40.52 (**)
Grade Ten	88.82 (**)	86.38 (**)	87.67 (**)	89.94 (**)	79.82 (**)
Grade Eleven	103.07 (**)	101.31 (**)	94.16 (**)	102.94 (**)	92.72 (**)
Foreigner	-23.14 (**)	-22.37 (**)	-20.8 (**)	-20.48 (**)	-24.47 (**)
Number of books at home					
11-25	1.6	2.81	-0.53	2.54	1.43
26-100	10.47 (**)	13.43 (**)	10.25 (**)	15 (**)	13.68 (**)
101-200	17.7 (**)	21.62 (**)	18.59 (**)	22,45 (**)	19.59 (**)
201-500	27.77 (**)	32.78 (**)	25.7 (**)	33.06 (**)	28.68 (**)
More than 500	22.28 (**)	26.49 (**)	26.67 (**)	25.02 (**)	21.46 (**)
Socio-economic index level	5.45 (**)	-	5.25 (**)	-	6.65 (**)
Mother did not complete 8th Grade	-5.47(*)	-9.18 (**)	-9.43	-8.64 (**)	-5.15
Index on interest in science	10.28 (**)	10.17 (**)	13.2 (**)	11.72 (**)	12.66 (**)
Index on quality of school resources	2.87	1.35	2.37	3.4	3.76
Rural area	8.41	4.95	2.64	13.22	4.33
School					
Private subsidized	1.34	0.14	-7.93	-0.78	-2.01
Private paid	13.72	10.48	3.22	13.99	10.72
Index autonomy to distribute resources	5.67(*)	5.86(*)	4.31	4.76	4.64
Socio-economic group (SEG)					
Lower middle SEG	3.63	4.16	8.5	5.1	4.54
Middle SEG	49.09 (**)	53.82 (**)	47.96 (**)	47.29 (**)	45.43 (**)
Upper middle SEG	69.11 (**)	76.81 (**)	71.97 (**)	68.82 (**)	63.74 (**)
Upper SEG	91.04 (**)	100.74 (**)	94.18 (**)	92.39 (**)	86.82 (**)

	Basic equation	Access	Frequency at home	Frequency at school	Type of use
Has a computer at home	-	4.91 (**)	-	6.12 (**)	-
Computer/school ratio	-	122.18	83.33	-	-
Infrequent use at home	-	-	25.91(*)	-	-
Frequent use at home	-	-	30.24 (**)	-	-
infrequent use at school	-	-	-	8.54 (**)	-
Frequent use at school	-	-	-	0.75	-
Infrequent use of Internet	-	-	-	-	-2.2
Frequent use of Internet	-	-	-	-	-4.24
Infrequent use techno-addict	-	-	-	-	-8.71 (**)
Infrequent use techno-addict	-	-	-	-	-19.07 (**)
Infrequent use of Office	-	-	-	-	16.35 (**)
Frequent use of Office	-	-	-	-	10.55 (**)
Variance explained					
Within-school variance	12%	12%	10%	12%	13%
Inter-school variance	85%	85%	87%	86%	87%
Observations	4,664	4,606	2,595	4,090	3,739

** Significant at 5%
* Significant at 10%.

Effective use of Wikis in College Mathematics Classes

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ABSTRACT

Wikis are used in mathematics education in a variety of ways [3]. As with *Wikipedia*, mathematics related Wikis provide pages and links that describe many different branches of mathematics. Another common use is as a portal for distributing and collecting mathematics course materials [1]. This article describes the authors' use of course wikis for two different purposes in two undergraduate math courses. In Calculus-I, a wiki was utilized to share and present the outcome of an optimization problem that required small groups to collect information about student homes' attic insulation status and eventually to compute the optimal amount of new insulation to add that maximizes heating savings. The second wiki was for a small seminar-style course on *Mathematical Mysteries* where students collected and posted the results of their research relating to famous unsolved problems in mathematics. This wiki was also used as a platform for in-class presentations by the students and the instructors. In both cases, the bulk of the wiki contribution was by students.

Keywords: Science and Mathematics Education, Technology, Distance Learning, Wikis, Collaborative Learning.

1. Introduction

Although Wikis are generally used to provide a collaborative learning environment in education, it is hard to find examples where students contribute significantly to course-based Wikis in mathematics. We developed a Mathematics Wiki Project for Calculus-I students at the University of Wisconsin Marathon County in fall 2008 followed by a second Wiki project in the fall of 2009 for a special topics course titled *Mathematical Mysteries*. The two courses were quite different in nature and the Wikis themselves served two very different purposes. The objective of this paper is to share our experiences with these projects, from the point of selecting the Wiki and the topics to how students engaged and performed in the projects. The first Wiki assignment was a "field project" where groups of 3-4 students selected a house and used calculus to find the optimal depth of additional attic insulation which would provide the maximum savings on heating/air conditioning over a period of years. The second involved individual students researching a collection of mathematical conjectures and using the Wiki to collect and share their findings.

2. What is a Wiki?

A Wiki is a piece of software which allows users to easily create, edit and put together a collection of web pages without the need for an overall administrator. As used in an instructional setting, they are basically smaller localized versions of the popular "Wikipedia" (www.http://www.Wikipedia.org/). What makes Wiki's attractive is that little or no programming skill is required, they are easy to maintain, documents can be easily formatted, edited and linked, images and other media content can be readily imbedded, multiple users can have access to facilitate collaboration, and they are inexpensive (free options exist).

Our use of a Wiki for mathematics came to mind in the fall of 2008 when our University linked a media Wiki engine to the course management sites and encouraged faculty to submit pilot projects. Our first task was to find a suitable Wiki engine (or a Wiki Farm as these are now known) for the project. Since the Wiki initiative came halfway through the semester, we had very little time to make a selection. We compared the potential benefits of Media Wiki and (www.Wikipsaces.com) and selected Wikispaces for its WYSIWYG interface and superior ability to incorporate Mathematical Equations.

3. Selection of Math Wiki Projects

We spent a considerable amount of time selecting an appropriate project for Wiki use. We decided that having students post solutions of routine mathematics exercises on a Wiki would not be an optimal use of this shared space since most students would use the same routine steps to get the answer. Also, once a student posts a

solution, the other students in the group would have little to contribute, thus failing to utilize the collaboration potential of a Wiki.

Collaboration is most needed when the problems are challenging and one person's input is not usually enough to finish the task. Most routine problems that you encounter in standard textbooks on Algebra, Trigonometry, Calculus etc., are not challenging enough for Wiki project. Also, CAS-calculators and available on-line applets can perform such calculations with no indication of students' understanding. Other than facilitate Collaborations, Wikis can also encourage creativity and critical analysis of others' work, skills that encompass the higher levels, *apply, analyze, evaluate and create* in Bloom's Taxonomy of cognitive tasks.

We then started looking for a mathematics project requiring enough challenge, creativity, originality, and collaboration, to make good use of the tools available in a Wiki. Around this time, while thinking about real-life applications, we recalled a college algebra project we'd used years earlier on quantifying the heat-loss from a home through its attic. In that project, students computed the annual heat loss through the attics of local homes. The heating cost savings function can be derived as a function of the insulation thickness, and as a calculus project, this function can be differentiated to find the critical thickness which will maximize the savings. It was felt that this would be an excellent candidate for a Wiki project because: The project is multi-stage, but accessible and of potential interest to students and could save their parents significant money; Collaboration is useful since numerous data such as attic measurements, local temperature averages, and insulation and energy costs must be brought together; A Wiki would facilitate extended group work on our mostly commuter campus; Each group could easily access and critique others' results in the final product. Further details and results are given in section 4.

In the Fall of 2009, we decided to utilize a Wiki in a different capacity to enhance a small seminar-style course "Mathematical Mysteries" in which we study the history, evolution of, and current status of some of the famous mysteries in mathematics such as Fermat's Last Theorem and the Goldbach Conjecture. The selected problems have been evolving for quite a while, and there are abundant stories, historical episodes, attempts at proofs, and technical articles surrounding them. We felt that having students research and bring together some of these facts and lore related to each mystery through Wiki pages would be a useful and productive exercise. Our emphasis here was to use the Wiki as a repository of students' individual research on the topics rather than structured collaboration with each other. This is similar to an application by Robert Talbert in [2]. A more detailed description of both Wiki projects follows.

4. Description of the Wiki Projects

Project 1: Using calculus to find optimal thickness for attic insulation.

Mathematical Background: The mechanism of heat loss through the ceiling of a home is primarily by conduction. Thus the rate of heat loss across the ceiling varies jointly with the temperature difference between the interior and the attic $(T_i - T_a)$ and with the area of the ceiling. The constant of variation in suitable units is the inverse of the R-value of the ceiling-attic insulation layer. Specifically, if the area is in square feet and the temperature difference in degrees Fahrenheit, the rate of heat loss in British Thermal Units per hour is

$$r_{hl} = \left(\frac{1}{R}\right) A(T_i - T_a) \frac{BTU}{hr}. \qquad (I)$$

When the average temperature difference over a whole day is added up over all the heating days of the year, this sum is called the Heating Degree Days (HDD) for that location. The annual heat loss is then given by

$$Q_h = \frac{A * 24 * HDD}{R}. \qquad (II)$$

From equation *(I),* we see that there are three means to reduce heat loss through the attic: Reduce the square footage of your ceiling; Make the temperature difference less, i.e. turn down the thermostat; And increase the R-value by adding insulation to the attic. This project deals only with the latter of these and aims to determine the optimal depth of new insulation to add to achieve maximum cost savings over a fixed period of years.

For our project we had students work in small groups that measured the ceiling square footage and current insulation status of the ceilings in two or more homes of students from each group. In addition, the type of heating system was identified and an estimate of the furnace efficiency was made to compute the total cost for heat loss through the ceilings in a year. In 2009, local natural gas costs were ~\$1 per 10^5 BTU. Thus a 90% efficient furnace supplies heat at $c_h = \$1/\,90{,}000\ BTU$. For electric heat with electricity at $\$0.12\ /\ (kw \cdot hr)$, $c_h = \$1\ /\ 28{,}500\ BTU$. The annual cost for heat loss through the ceiling is given by:

$$C_h = c_h \frac{24 * HDD * A}{R}. \qquad (III)$$

The value of R is determined initially and after adding x inches of insulation, and then the annual savings is computed as a function of x. Using local costs of insulation material, students computed the cost to add x inches to the attic for this one-time cost. Finally, the ten-year net savings is computed as a function of x. By using calculus (or simply plotting a graph) the maximum value of this function can be located.

Example: Professor Martin's Home in Wausau, WI initially had 3" of blown-in fiberglass insulation, 1100 square feet of ceiling space, and a heating system that supplied heat at $\$1/80{,}000\ BTU$. New cellulose insulation costing $\$0.40/ft^3$ was to be added and the local $HDD = 7834$. The initial R-value was $R_i = 7.6$

and the net savings function (over 10 years) for adding x inches of insulation was

$$S(x)=\left(1100\times 24\times 7834\times\left(\frac{1}{7.6}-\frac{1}{7.6+3.1x}\right)\times\frac{1}{80{,}000}\right)\times(10)-0.40\times\frac{x}{12}\times 1100. \quad (IV)$$

Graphically or analytically, the maximum net savings was ~$2385 over ten years when 12.6 inches of insulation were added.

The Wiki was named "marathoncalc" and was hosted with the main organizer site at http://marathoncalc.Wikispaces.com/ . We created 8 groups K1,K2,K3 ,K4 (For Kirthi Premadasa's section) and P1,P2,P3,P4 (For Paul Martin's section) and invited the students of all 8 groups into the Wiki with a separate page for each group. For example, the group P4 pages and results can be seen at http://marathoncalcp4.wikispaces.com/ . In the main organizer page, a sequence of six guided tasks was given to guide the students through the project. Some of the important formulas were given but the main calculations in equations (I) and (II) were developed by each group. Students then had to set up the savings function, differentiate it and get the critical value to determine the optimal insulation thickness.

Observations: The student groups selected one or two houses of the group members, entered the data and then proceeded with the calculations. Even though students were able to grasp the individual components of this project, they had a difficult time putting them all together and a lot of discussion was needed for some of the groups to come to their final product. Not all groups completed all components of the project due to our starting this in week 12 of the semester. In the future, we will likely use weekly progress discussions in class or use the Wiki itself to provide feedback and guidance to the groups as the project proceeds.

Project 2: Researching Mathematical Mysteries

The Course (and the Wiki project) researched information about the following famous Math Mysteries.

- The odd perfect number problem
- The search for Mersenne Primes.
- The Goldach Conjecture
- Fermat's Last Theorem
- The Four Color Problem
- Collatz Conjecture
- Catalan's Conjecture
- Twin Prime Conjecture
- Distribution of Primes
- The Riemann Hypothesis

Once again, Wikispaces was used as the Wiki engine. The Wiki was named "mathpuzzles". The main organizer website is at http://mathpuzzles.Wikispaces.com/. Each of the nine students enrolled in the course was invited to join and asked to develop their Wiki pages. In each class, a problem was discussed and selected students were asked to research some aspect of the problem and present their findings in the next class session through shared documents on the course Wiki. Examples of several student's work can be seen at http://mathpuzzles.wikispaces.com/Rich%27s+wikipage and http://mathpuzzles.wikispaces.com/Reba%27s+wikipage .

Conclusions: The level of effort that students put in the individual pages varied significantly. While some students clearly researched and found significant information to complete their assignments, there were a few who simply resorted to cutting and pasting from Wikipedia. For example, when asked to research the latest Mersenne Primes that were discovered one student simply pasted in a current table from a website. In some sense, this is partly what we wanted of this Wiki, i.e. to collect information from many places. However, in the capacity of collecting others' results and research, our students' work should focus on organizing and making a useful web document with relevant links. In another situation, a student spent a lot of time on an assignment to discover a partial proof to Catalan's Conjecture during medieval times. This turned out to be fairly difficult but the student made a significant effort to find it.

The facility available in Wikis to insert images, URLs and equations helped students to make their assignments more clear and comprehensive. When the students were presenting their assignments in class, they simply logged on to their Wiki from the classroom computer and projected their Wiki on to the screen. This saved valuable classroom time and was easier than making up PowerPoint slides or sharing printed documents. The students were able to find some exciting facts about these famous problems which are generally not known. Now they have been archived and anyone interested can visit and view the Wikis long after the course is finished.

The lack of a simple equation editor such as is available in MS Word is a minor drawback for beginning undergraduate students in mathematics. Wikispaces would only accept equations in LaTeX which can be a bit time consuming for beginning students who are more familiar with the MS Word equation editor. A website which does LaTex Conversion was provided to students, but not everyone used it.

5. Summary

Wikis provide a very useful platform for implementing collaborative assignments in mathematics. Our project choices of an extended real world application and an integration of information from the students in the class both worked well. During the insulation project, students appreciated the flexibility of working through the wiki, since they mostly commute from a fairly large area. Students were able to present from the Wiki itself and the instructors simply visited the Wikis to observe student work (and give feedback). This is a significant time savings advantage in Wikis. Even after the project was

finished, the findings are freely available to the general public. (If desired, the Wiki can be made private too.)

The Wiki allows instructors to track individual contributions made by students which we found useful for assigning grades. Students can be asked to evaluate the work done by other students through the Wiki. Unfortunately few students did this through our Wikis even though it is quite likely they argued within their groups. The ease of copy and paste can lead to plagiarism and the assessment of actual student work can be difficult. This showed up in the Math Mysteries Wiki and we addressed it as the semester progressed. Overall we felt that these projects were enhanced by the use of Wikis and we look forward to their continued use in these and other classes.

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Introducing Virtual Manipulatives in Science Experimentation for teaching and learning at the University Level

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ABSTRACT

The purpose of this study was to investigate ways of introducing VM within a science learning environment that involves experimentation. A pre-post comparison study design was used that involved 70 undergraduate students, enrolled in an introductory physics course that was based upon the *Physics by Inquiry* curriculum. The participants were randomly separated into three groups, each corresponding to one of the study's conditions: use of Virtual Manipulatives (VM) alone, use of Physical Manipulatives (PM) alone, and use of a combination of PM and VM. The first group (Control Group) was assigned 23 students to use PM, the second group (Experimental Group 1) was assigned 23 students to use VM, and the third group (Experimental Group 2) was assigned 24 students to use a blended combination of PM and VM. Conceptual tests were administered to assess students' understanding before, during and after instruction. The data collected through the tests were analyzed quantitatively. Findings revealed that experimenting with a blended combination of PM and VM enhanced students' conceptual understanding more than experimenting with PM or VM alone. No differences were found between PM and VM.

Keywords: Virtual Manipulatives, Physical Manipulatives, Conceptual Understanding.

1.INTRODUCTION

Current literature on reform in science education has reopened the debate on the role and practice of laboratory experimentation in science teaching and learning [1, 2, 3, 4]. One reason is the rapid growth of computer-based Virtual Manipulatives (open-ended simulations, such as, virtual labs) and their implications for teaching and learning [5]. During the past decade a series of empirical studies revealed the potential of VM to enhance students' skills, attitudes, and conceptual understanding [6, 7, 8, 9]. In spite of these findings, some researchers began to seriously question whether laboratory experimentation, as we experience it through the use of Physical Manipulatives (PM), should be redefined and restructured to include VM across K-16 [e.g., 6, 8, 10].

This study was designed in order to contribute to this direction. Currently, there is no framework portraying what is the optimum way to integrate VM within a science learning environment, such as, a learning environment provided through science experimentation. Previous research in this domain revealed instances where the use of VM under specific circumstances, may improve students' conceptual understanding more than the use of PM [see 9] and vice versa [see 11]. Moreover, other researchers have argued in favor of combining the use of PM and VM while experimenting. In this case, part of the experiments are conducted with PM and the rest with VM. The reasoning behind this mode of experimentation is the reaping of the benefits of both manipulatives [12]. Given these contradictory findings, the questions that are raised are "Would it be better to combine PM and VM rather than using PM and VM alone?", and if yes, "Under what circumstances?"

2.THIS STUDY

This study was contextualized through the *Physics by Inquiry* curriculum [13] aiming to compare the effect of three instructional conditions that differ in the medium (PM or VM) and mode (alone or in combination) of experimentation on undergraduate students' learning in physics, particularly, their conceptual understanding in the domain of light and color. The first condition involved the use of PM (Control Group or CG), the second condition involved the use of VM (Experimental Group 1 or EG1) and the third condition involved the use of a blended combination of PM and VM (see the *Experimental Design* part below for more details)..Blending PM and VM was based on each mediums' unique advantages/affordances (e.g., in the case of VM a student could experience reified objects) that were identified through prior research [see 9]. In other words, PM or VM were selected whenever they had an affordance/advantage over the other medium..

The purpose of including the CG and EG1 was to investigate whether the two modes of experimentation (PM alone and VM alone) are equally conducive to physics learning. The purpose of including the EG2 was to investigate if a blended combination would have a different effect on students' conceptual understanding than that of CG or EG1.

3.METHODOLOGY

Sample

The participants of the study were 70 undergraduate students, enrolled in an introductory physics course that was based upon the *Physics by Inquiry* curriculum [13], intended for pre-service elementary school teachers. The course took place at a university in Cyprus. The participants were randomly separated into three groups. The CG was assigned 23 students to use PM, the EG1 was assigned 23 students to use VM, and the EG2 was assigned 24 students to use the blended combination.

The students in all groups were randomly assigned to subgroups (three persons in each subgroup) as suggested by the curriculum of the study [13]. This particular curriculum is grounded upon a social constructivist framework that facilitates a constructive, situated and collaborative learning process that assures that the engagement is truly collaborative and helps all students make explicit their ideas. Knowledge and understanding is co-constructed among peers through complementing and building on each others ideas [14, 15] .

Curriculum materials: Physics by Inquiry

The selection of the *Physics by Inquiry* curriculum was based on the fact that through numerous studies it appeared to enhance undergraduate students' conceptual understanding across physics subject domains [16, 17], including the subject domain of light and color. This success of the *Physics by Inquiry* curriculum is grounded on three foundational components that were found to support conceptual understanding, namely, inquiry, socio-constructivism and the POE (Predict-Observe-Explain) strategy [see 9].

For the purposes of this study four parts of the module of Light and Color were used [13]. The four parts that were used focus on an introduction to light, light sources, masks and screens (section 1), shadows (section 2), pigments (section 3) and colored light (section 4).

Physical and Virtual Manipulatives

PM involved the use of physical instruments (e.g., rulers), objects (e.g., metal rings) and materials (e.g., lamps) in a conventional physics laboratory. During PM experimentation feedback was available to the students through the behavior of the actual system (e.g., shape of a shadow on a screen) and through the instruments that are used to monitor the experimental set-up (e.g., rulers).

VM involved the use of virtual instruments (e.g., rulers), objects (e.g., metal rings) and materials (e.g., lamps) to conduct the study's experiments on a computer. Most of these experiments were conducted though the Virtual Lab Optilab [18]. Optilab (see figure 1) was selected because of its fidelity and the fact that it retained the features and interactions of the domain of *Light and Color* as PM does. In its open-ended environment, students of the EG1 and EG2 were able to design and conduct the experiments mentioned in the module of *Light and Color* by employing the ''same'' material as the ones used by the students using PM.

In the *Optilab* environment, students were provided with a virtual work bench on which experiments can be performed, virtual objects to compose the experimental set-up, virtual materials whose properties are to be investigated, and virtual instruments (e.g., rulers) or displays (e.g., screen) as illustrated in Figure 1. Students were able to construct their own virtual experimental arrangements by simple and direct manipulation of objects, materials and virtual instruments. The software offered feedback throughout the conduct of the experiment by presenting information (e.g., distance, color) through the displays of the software. No feedback was provided by the software during the set up of the (virtual) experiment. The level of feedback was analogous to what is routinely available to students through PM experimentation.

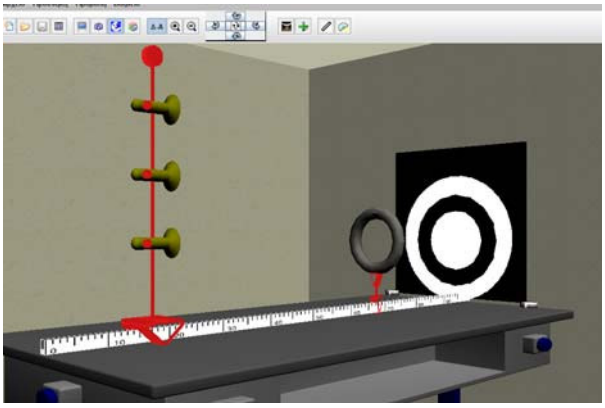

Figure 1. The Optilab environment

Experimental Design

A pre-post comparison study design was used for the purposes of this study that involved three groups, CG, EG1 and EG2, according to Figure 2.

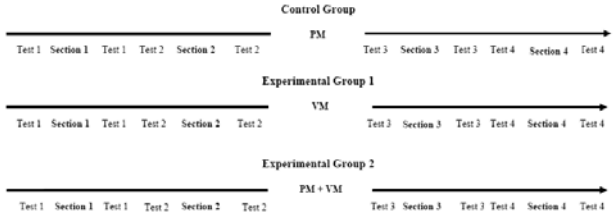

Figure 2. The experimental design of the study

Data Collection

Conceptual tests were administered to assess students' understanding of the concepts of light, shadows, pigments and colored light, both before and after introducing each section (1, 2, 3 και 4) of the study's curriculum (see Figure 2). The tests were developed and used in previous research studies by the Physics Education Group of the University of Washington [13]. All tests (1, 2, 3, 4) contained open-ended items that asked conceptual questions all of which required explanations of reasoning. The tests 1, 2, 3 and 4 were used for the assessment of section 1, section 2, section 3 and section 4, respectively. Each item of each test was scored separately; however, a total correct score was derived from each test and used in the analysis. All tests were scored and coded blind to the condition in which the student was placed. A rubric table was used that

specified different criteria for the responses to each item separately. Each response was scored on each criterion. The minimum score on each test was 0 and the total maximum score for all criteria of all items on each test was 100.

Data Analysis

The data analysis involved (a) paired-samples t-test for the comparison of the pre-test scores to the post-test scores of each test of each group and (b) ANCOVA for the comparison of the post-test scores of each test across the study's groups. Students' scores in the pre-tests were used as the covariate each time. The aim of the first procedure was to investigate whether the use of the combination of PM and VM, and the use of PM and VM alone, within the context of the *Physics by Inquiry* curriculum, improved students' conceptual understanding in each section. The aim of the second procedure was to investigate whether the effect of PM and VM alone on undergraduate students' conceptual understanding of *Light & Color*, differed from the effect that the blended combination had on students' conceptual understanding.

4.RESULTS

The paired-samples t-test analysis showed that the blended combination of PM and VM, and PM and VM alone improved students' conceptual understanding after each section of the study (see table 1).

Table 1. Paired sample t-test results

Group	Conceptual Tests	T	Df	Sig
CG	Post test 1 – Pre test 1	6,964	22	.000
EG1	Post test 1 – Pre test 1	6,635	22	.000
EG2	Post test 1 – Pre test 1	10,922	23	.000
CG	Post test 2 – Pre test 2	9,690	22	.000
EG1	Post test 2 – Pre test 2	7,749	22	.000
EG2	Post test 2 – Pre test 2	11,073	23	.000
CG	Post test 3 – Pre test 3	15,418	22	.000
EG1	Post test 3 – Pre test 3	18,293	22	.000
EG2	Post test 3 – Pre test 3	41,565	23	.000
CG	Post test 4 – Pre test 4	9,333	22	.000
EG1	Post test 4 – Pre test 4	10,849	22	.000
EG2	Post test 4 – Pre test 4	17,728	23	.000

The ANCOVA procedure revealed differences among the study's three groups in sections 2, 3 and 4 of the study (see table 2). In section 1, no differences were found across the groups.

Table 2. One way ANCOVA results

Test	df1	df2	F	Sig.
Test 1	2	66	1,712	0,188
Test 2	2	66	5,410	0,007
Test 3	2	66	6,072	0,004
Test 4	2	66	5,894	0,004

Bonferroni-adjusted pairwise comparisons suggested that EG2 students' post-test scores in tests 2, 3 and 4, were significantly higher than that of students in the CG and EG1. All p-values were found to be less than the 0.05 level. No differences were found between EG1 and CG. These results indicate that EG2 appeared to better promote the students' conceptual understanding of light and color, than the CG and EG1.

5. DISCUSSION & CONCLUSIONS

The purpose of this study was to investigate ways of introducing VM within a science learning environment that involves experimentation. The findings of this study indicate that the use of a blended combination of PM and VM enhances students' understanding of *Light & Color* concepts more than PM and VM alone. Off course, this presupposes a well thought blending procedure that is based on findings from prior research. Such a procedure is based on the identification of affordances/advantages that each PM and VM carries, with the optimum blend being the one that combines all the unique affordances/advantages of PM and VM. Hence, our findings imply that the most beneficial way of introducing VM within a science learning environment, when enhancing students' conceptual understanding is at task, is to combine them with PM. In other words, the use of PM in physics experimentation should be preferred over VM when its possibilities influence student learning, as specified by the learning objectives, more than VM (e.g., when the acquisition of specific perceptual-motor skills are involved) and vice versa (e.g., when very large or very small temporal dimensions are involved).

Furthermore, the findings of this study provide information about the potential and value of the use of PM and VM in physics experimentation, particularly, of VM which has been disputed as a viable means for experimentation, as opposed to PM. Our analysis showed that the use of VM could similarly promote students' understanding of physics concepts to the use of PM, when PM and VM are implemented within a context similar to this study; thus, confirming what has been argued in recent studies about the comparable effectiveness of PM and VM in promoting science learning [e.g. 6, 9, 19],

Finally, it should be noted that this study was done in a normal course of study in physics, thus adding additional validity to the aforementioned findings. On the other hand, the study faces some possible limitations that relate to the sample size. Therefore, it is essential to extend the empirical base through similar research in order to ground the perspectives advocated in this study.

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Comparing the use of Virtual and Physical Manipulatives in Physics Education

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ABSTRACT

The purpose of this study was to compare the effect of experimenting with Virtual Manipulatives (VM), Physical Manipulatives (PM), and two sequential combinations of PM and VM, on undergraduate students' understanding of scientific concepts in the domain of heat and temperature. A pre-post comparison study design was used, in which the experimentation manipulative – virtual and/or physical – was contrasted. The study involved 160 undergraduate students enrolled in an introductory physics course that was based upon the *Physics by Inquiry* curriculum (McDermott and The Physics Education Group, 1996). The participants were assigned to three experimental groups (EG1=50 students, EG2=30 students, EG3= 30 students) and a control group (CG=50 students). The CG used PM to conduct the experiments, whereas the EG1 used VM. The EG2 and EG3 used two different combinations of PM and VM to conduct the same experiments. Conceptual tests were administered to assess students' understanding before, during and after instruction. The data collected through the tests were analyzed quantitatively. Findings revealed that experimenting with Physical Manipulatives (PM), Virtual Manipulatives (VM) and the two sequential combinations of PM and VM were equally effective in promoting students' conceptual understanding in the domain of *heat and temperature*.

Keywords: Virtual Manipulatives, Physical Manipulatives, Conceptual Understanding

1.INTRODUCTION

Findings of recent empirical studies in physics education that involved comparisons between Virtual Manipulatives (VM – open-ended simulations, such as, virtual labs) and Physical Manipulatives (PM – physical laboratory material), although limited, revealed instances where the use of VM would appear to be more beneficial to learning than the use of PM [1, 2, 15] and vice versa [6]. The differentiation in the degree of the effect of VM and PM on conceptual understanding could be attributed, on a first look to the differences that exist between VM and PM. In an attempt to examine why the findings of these studies appear to be discrepant to each other, we have taken a closer look at the experimental designs and manipulatives (virtual or real) of these studies, which revealed that the findings vary due to differences in the treatments used in the experimental design of a study (e.g., the method of instruction or curriculum materials were not controlled) or in the affordances that PM and VM could offer. For example, the findings of the Finkelstein *et al.* [2] study, which revealed that the students that experimented with VM outperformed the students that experimented with PM on a conceptual survey of the domain and in the coordinated tasks of assembling a real circuit and describing how it worked, could be attributed to the fact that only the use of VM (a computer simulation) allowed students to explicitly model electron flow.

In order to arrive at valid conclusions concerning the comparative value of VM and PM in learning, all factors related to the method of instruction/experimentation should be controlled and the manipulatives, virtual or physical, should be stripped of any differing affordances. Needless to say, PM would have an advantage over VM in a study where the acquisition of specific perceptual-motor skills (e.g., exploring the operation of an electromagnetic see-saw or making precise incisions during dissections) is involved, because the difference in movements that are required for manipulating a keyboard or a mouse and an apparatus would interfere with perceptual-motor skills needed in the target domain. On the other hand, experimenting with VM involves virtual manipulation of not only real objects (objects that look and act like their counterparts in the real world, e.g., train) but also of conceptual "objects" (objects that have no perceptual fidelity but are represented visually by using arrows, dot-trails, sounds, and so forth, (e.g. vectors) and (representational) "objects" which represent relations between properties of other objects (e.g., graphs, equations), [12]. The manipulation of conceptual objects and objects that represent relations between properties of other objects is a unique characteristic of VM. Consequently, in a study where abstract constructs (physical and mathematical, e.g., velocity) are to be manipulated, VM offers additional affordances and hence would have an advantage over PM [14].

Therefore, given the theoretical perspectives described above and the contradictory findings of the empirical studies of this domain, the question remains about whether the two modes of experimentation are equally conducive to learning when stripped of their differing affordances. In this study, only the experimentation manipulative – virtual or physical – used in a physics learning environment was contrasted, while controlling

their affordances and the method of instruction such that other factors that may influence learning through physics experimentation were the same for both VM and PM.

This study is significant because it could potentially provide further insight on the debate about Virtual versus Physical and Manipulation versus Physicality. Research in this area is particularly scarce across the science education literature [4], especially, physics education [16]. Therefore, any contribution towards this direction is important. For instance, we are far from reaching consensus about the circumstances that the use of PM in physics is preferable to VM and vice versa, as well as, whether their difference, one being virtual and the other physical, promote differences in the physics learning process. Additionally, we are far from understanding what elements or differing affordances of the PM and VM are critical for imparting educational benefit and how VM and PM should be integrated in a physics curriculum.

THIS STUDY

Drawing on the methodological underpinnings of prior research [4, 13, 16] a conscious effort was made to design a study controlling for any variable affecting the experimental design of the study (to the degree that is possible), including, the method of instruction and curriculum materials that, according to Klahr, Triona and Williams [4], appear to be the most important limitations of the studies that examined the effect of VM on learning. Moreover, the study's manipulatives were carefully selected in such a way so that both could offer the same possibilities for experimentation to the participants.

As a result, this study was contextualized through the *Physics by Inquiry* curriculum [7] aiming to compare the effect of four instructional conditions that differ only in the medium (e.g., PM) and mode (alone or in combination) of experimentation on undergraduate students' learning in physics, particularly, their conceptual understanding in the domain of heat and temperature. The first condition involved the use of PM (Control Group or CG), the second condition involved the use of VM (Experimental Group 1 or EG1), the third condition involved initially the use of PM and later on the use of VM (Experimental Group 2 or EG2), and the fourth condition involved initially the use of VM and later on the use of PM (Experimental Group 3 or EG3), (see the *Experimental Design* part below for more details). The purpose of including the CG and EG1 was to investigate whether the two modes of experimentation (PM alone and VM alone) are equally conducive to physics learning when stripped of their differing affordances. The purpose of including the EG2 and EG3 was to investigate if switching the medium of experimentation (PM to VM and vice versa), while following the same sequence of instructional activities and conditions as CG and EG1, would have a different effect on students' conceptual understanding than that of CG or EG1, and if so, to also examine whether the influence is different when PM experimentation precedes VM and vice versa. In other words, the inclusion of the EG2 and EG3 aimed to provide evidence on how two sequential combinations of PM and VM experimentation compare between them and to PM and VM alone. Additionally, the comparison of the two sequential combinations to PM and VM experimentation alone could provide information on whether it is possible to combine PM and VM and have a smooth transition from the one medium of experimentation to the other, and if not, to better understand what the consequences are, positive or negative, on students' conceptual understanding in doing so. The nature of transition from the one medium to the other, is also an indicator of equivalency or variance between VM and PM, thus, making the experimental design and outcomes of the study more informative than just comparing PM alone and VM alone.

2.METHODOLOGY

Sample

The participants of the study were 160 undergraduate students, enrolled in an introductory physics course that was based upon the *Physics by Inquiry* curriculum [7], intended for pre-service elementary school teachers. The course took place at a university in Cyprus. The participants were assigned to three experimental groups (EG1=50 students, EG2=30 students, EG3= 30 students) and a control group (CG=50 students).

The students in all groups were randomly assigned to subgroups (two or three persons in each subgroup) as suggested by the curriculum of the study [7]. The particular curriculum is grounded upon a social constructivist framework that facilitates a constructive, situated and collaborative learning process that assures that the engagement is truly collaborative and helps all students make explicit their ideas. Knowledge and understanding is co-constructed among peers through complementing and building on each others ideas.

Curriculum materials: Physics by Inquiry

The selection of the *Physics by Inquiry* curriculum was based on the fact that through numerous studies it appeared to enhance undergraduate students' conceptual understanding across physics subject domains [8, 10, 15], including the subject domain of heat and temperature [16]. This success of the *Physics by Inquiry* curriculum is grounded on three foundational components that were found to support conceptual understanding, namely, inquiry, socio-constructivism and the POE (Predict-Observe-Explain) strategy.

For the purposes of this study the first four parts of the module of *Heat and Temperature* were used [7]. Specifically, the curriculum parts used in this study, focus on constructing an operational definition for temperature (section 1), on investigating temperature changes when samples of hot and cold water are mixed (section 2), on heat and heat transfer (section 3) and on the concepts of heat capacity and specific heat capacity (section 4).

Physical and Virtual Manipulatives

Physical manipulatives include real instruments (thermometers), objects [containers (beakers and Styrofoam cups) and heaters] and materials [solids (wood and aluminum) or liquids (water)] in a conventional physics laboratory, whereas, virtual manipulatives are regarded virtual instruments (thermometers), objects [containers (beakers and Styrofoam cups) and heaters] and materials [solids (wood and aluminum) or liquids (water)] to conduct the study's experiments on a computer. In this study, the Virtual Lab *ThermoLab* (see Figure 1) was used for this purpose [3, 5, 9]. ThermoLab was selected because of its fidelity and the fact that it retained the features and interactions of the domain of Heat and Temperature as PM did. In its open-ended environment, students of the EG1, EG2 and EG3 were

able to design and conduct any experiment mentioned in the module of Heat and Temperature by employing the ‘‘same’’ material as the ones used by the CG

Figure 1. Thermolab

Experimental Design

A pre-post comparison study design was used for the purposes of this study that involved four groups, EG1, EG2, EG3 and CG, according to Figure 2.

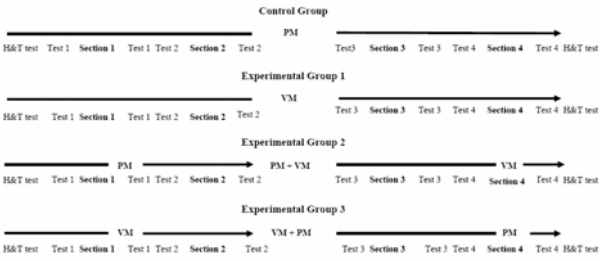

Figure 2. The experimental design of the study

Data Collection

Conceptual tests were administered to assess students’ understanding of the concepts of heat, temperature, heat capacity and specific heat capacity, both before and after the study (Temperature, Change in Temperature, Heat transfer, Heat Capacity and Specific Heat Capacity, Test or H&T Test), as well as, both before and after introducing each section (1, 2, 3 και 4) of the study’s curriculum (see Figure 2). The tests were developed and used in previous research studies by the Physics Education Group of the University of Washington [11]. All tests (1, 2, 3, 4) contained open-ended items that asked conceptual questions all of which required explanations of reasoning (see Appendix for a sample of items of Test 2). The H&T test included 6 open-ended items assessing all parts (1, 2, 3, 4) of the study’s curriculum, whereas, tests 1, 2, 3 and 4 were used for the assessment of section 1, section 2, section 3 and section 4, respectively. No identical items were included in the H&T test and the rest of the tests (1, 2, 3, 4). Each item of each test was scored separately; however, a total correct score was derived from each test and used in the analysis.

Data Analysis

The data analysis involved (a) paired-samples t-test for the comparison of the pre-test scores to the post-test scores of each group, (b) ANCOVA for the comparison of the H&T post-test scores of the four groups, and (c) ANCOVA for the comparison of the post tests that were derived from the application of different kind of manipulative. The aim of the first procedure was to investigate whether the use of PM and VM, and the use of PM in two different combinations with VM, within the context of the first four parts of the *Physics by Inquiry* curriculum, improved students’ conceptual understanding. The aim of the second procedure was to investigate whether the effect of PM on undergraduate students’ conceptual understanding of heat and temperature changed when PM was substituted or combined with VM. The aim of the third procedure was to investigate whether the substitution of VM for PM or their combination had a different effect on students’ conceptual understanding of Heat and Temperature.

3.RESULTS

The quantitative analysis showed that the two combinations of PM and VM, and PM and VM alone improved students’ conceptual understanding after the study (see table 1).

Table 1. Paired sample t-test results

Group	Conceptual Tests	t	Df	Sig
CG	H&T Post test – H&T Pre test	22,2	49	.000
EG1	H&T Post test – H&T Pre test	23,8	49	.000
EG2	H&T Post test – H&T Pre test	13,9	29	.000
EG3	H&T Post test – H&T Pre test	14,9	29	.000
CG	Post test 1 – Pre test 1	13,6	49	.000
EG1	Post test 1 – Pre test 1	19,5	49	.000
EG2	Post test 1 – Pre test 1	9,3	29	.000
EG3	Post test 1 – Pre test 1	7,2	29	.000
CG	Post test 2 – Pre test 2	10,552	49	.000
EG1	Post test 2 – Pre test 2	10,459	49	.000
EG2	Post test 2 – Pre test 2	5,264	29	.000
EG3	Post test 2 – Pre test 2	7,042	29	.000
CG	Post test 3 – Pre test 3	5,259	49	.000
EG1	Post test 3 – Pre test 3	6,061	49	.000
EG2	Post test 3 – Pre test 3	4,321	29	.000
EG3	Post test 3 – Pre test 3	4,859	29	.000
CG	Post test 4 – Pre test 4	18,822	49	.000
EG1	Post test 4 – Pre	19,986	49	.000

	test 4			
EG2	Post test 4 – Pre test 4	14,309	29	.000
EG3	Post test 4 – Pre test 4	15,414	29	.000

The ANCOVA procedure designated that the development of students` conceptual understanding of heat and temperature (difference between pre and post H&T tests) seems to be similar between the four groups, when their pre-existing knowledge is controlled [F(3, 151)=1.9, p=0.13]. A second ANCOVA revealed the same results regarding the students` performance in the posttest scores of the four groups for the tests 1, 2, 3 and 4 of the study (see table 2). This finding suggests that the use of physical and virtual manipulatives were equally effective in promoting the students' understanding of concepts concerning temperature, changes in temperature, heat transfer, heat capacity and specific heat capacity.

Table 2. One way ANCOVA results

Test	df1	df2	F	Sig.
H&T Test	3	151	1,9	0,12
Test 1	3	151	1.8	0.13
Test 2	3	151	0.12	0.95
Test 3	3	151	0.37	0.76
Test 4	3	151	1,4	0.17

4.DISCUSSION & CONCLUSIONS

The findings indicate that the use of PM and VM and their combination, when grounded in the framework of the *Physics by Inquiry* curriculum and controlling the complete range of variables that influence the learning process and outcomes, can provide equally interactive experiences that enhance students understanding of concepts related to *temperature*, *changes in temperature*, *heat, heat transfer, heat capacity* and *specific heat*. This contrast is particularly important because it could provide information about the potential of the two modes of experimentation, particularly, of VM which has been disputed as a viable means for experimentation. The data analysis showed that the use of VM, within the context of the *Physics by Inquiry* curriculum and when all other aspects of the conditions are preserved, could similarly promote student conceptual understanding to the use of PM. The findings regarding the sequential combinations, namely, switching between PM to VM and vice versa while controlling for their possibilities, provides further credence to the argument that PM and VM are equivalent as mediums for experimentation. Even though, they differ in nature, one is physical and the other is virtual, the fact that the switching could occur without affecting in any way students' understanding implies that both offer the "same" kind of manipulation and representations.

These findings provide further credence to the idea that VM can be used (in some contexts and given specific conditions) to provide authentic laboratory experiences that are not substantially different to the methods employed in using PM. However, this call for reform creates the need for understanding how both modes of experimentation should be integrated in activity sequences for physics teaching and learning. On the whole, it is essential to expand the empirical base through similar research in order to test further these perspectives as well as to ground theoretical conjectures regarding a framework for integrating PM or VM within physics learning environments.

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Introducing an Electronic Laboratory Notebook to PhD Students Undertaking Chemistry Research at A Research Intensive University

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ABSTRACT

The School of Chemistry at the University of New South Wales, Australia, is trialing an electronic laboratory notebook (ELN) to determine its suitability as a means to capture the research conducted by PhD students. ELN implementation required a partnership to be established between the Library (server space and digital curation), ICT services (technical expertise and IT management), researchers in School of Chemistry (end-users) and the creators of the ELN at Southampton University in the UK. Students who opted to participate in the trial were in the first year of their three-year PhD program, with students in later stages of their PhD (year two and onwards) seeing little value in investing in learning a new work process. The students participating in the trial use an average of five different types of instruments when conducting their experiments and this represents more than five different types of file format. We are now 6 months into the trial and can report that all student participants have found this particular ELN sufficiently flexible to accommodate their experimental work. We are yet to realise the capacity of the ELN as a means to publish data directly from the kinds of instruments used in chemistry research (e.g. mass spectrometers, nuclear magnetic resonance). However, once this has been achieved, we expect to introduce the ELN into undergraduate chemistry curricula.

Keywords: electronic laboratory notebooks, ICT in postgraduate chemistry research, Web 2.0 technologies in science practice.

1. INTRODUCTION

Information and communication technologies (ICT) have changed the way we practice as educators and researchers in the higher education sector. For several decades, the online environment had enabled flexible access to learning and teaching resources via the internet and our reliance on email for sustaining asynchronous collaboration is profound. The Web 2.0 environment promises enhanced means of collaboration and given that the practice of science is collaborative, more so than other disciplines [1], one would predict that the use of Web 2.0 tools in science practice would be high; however, this is not the case. Although scientists are technically savvy there are some important aspects of current science practice that seem to constrain the adoption of *e*Research[†] across the science discipline. The most accessible *e*Research tool for scientists is the collaborative electronic laboratory notebook (ELN) (Figure 1).

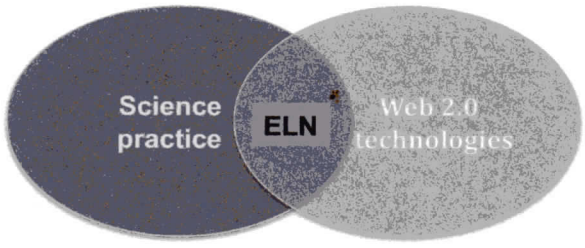

Figure 1. An electronic laboratory notebook is a blog that allows experimental data to be digitally annotated.

[†]The term *e*Research is used to describe research that exploits the Web 2.0 environment and advanced information and communication technologies.

Chemistry research practice

For laboratory-based science, such as chemistry, the details of each experiment are recorded in a paper-based laboratory notebook. Best practice requires a laboratory notebook to be date-stamped and signed at the end of each day and so, the laboratory notebook becomes a legal document that proves proof of when an experiment was conducted and by whom, i.e. the "provenance" of the experiment [2]. Keeping a laboratory notebook is a requirement of all science students undertaking research in a laboratory. As shown in Table 1, the laboratory notebook is the only part of our experimental practice that remains in hard-copy and is where details of how an hypothesis is being tested, i.e. the experimental design. Some data are recorded in the notebook as words and/or as annotated hand-drawings. The laboratory notebook is used when formally writing up the research as a thesis and/or publications. Replacing the laboratory notebook with an electronic version requires a major shift in both experimental practice and perceptions as to how well an ELN will be able to encapsulate an individual scientist's experimental design and associated datasets [2]. What a laboratory notebook cannot do is make electronic links from the experimental design to the data sets generated from scientific instruments. This is the key advantage afforded by ELN.

Drivers for change in the Higher Education sector

The move to a digital commons: In Australia, as in the UK and USA, there is a push to digitally archive (a data commons) all publicly funded research, including the original experimental records [3]. For this to be realised, it means a shift in the way research in science is currently practiced where the primary means of record keeping is paper-based laboratory notebook to keeping all records in a digital format.

We should be mindful of our current data management practice as, according to a recent survey of academics in Australia, 81% of survey respondents said that they store their research data on internal hard drives [4]. It would seem that that there is still some considerable distance to cover before we see a research data commons.

The research-teaching nexus: In the higher education sector there is a strong push to improve the linkages between our tertiary level teaching programs and research by adopting research-led, or research-informed, teaching methods and asking students to complete authentic assessments. Brew and Boud [5] assert that teaching and research share "a concern for learning" and critical to this is being able to introduce students the science discipline territory as termed by Becher and Trowler [6]. In Australia, PhD students undertake an intensive research program under supervision and are required to produce a thesis. In order to compete for employment on the international market, ideally students need to produce scholarly publications. For PhD students, the challenge is to complete their research program in a three-year timeframe and the ELN offers a way to manage all records related to this program in the one place.

Table 1. Alignment of the Scientific method with how is practiced and communicated.

Scientific method	Science practice	Science communication
Examine the literature posit an hypothesis	**Access literature** (*digital* .pdf) in the office/home.	**Introduction**
Test hypothesis experimentally	**Record** experimental design in *hard-copy* lab notebook in the lab, requires date stamp and sign-off.	**Materials and methods** (reproducibility)
Critique experimental findings (evidence)	**Prepare** samples, **measure** key characteristics of samples using instruments (*digital* data files) in the lab. **Data** 'crunched' to **generate** evidence in the office/home.	**Results**
Generate new ways of understanding the world (physical/biological /chemical)	**Discuss** findings with research team (students, supervisors, colleagues) and write paper in the office/home.	**Discussion**

There is an obligation on our part to align our research students' practices to the how scientific research will be done in the years to come. With the impending government requirement to have the data generated from publicly funded research housed in digital commons, it is judicious to trial ways of achieving a data repository that are sympathetic to discipline practices.

Introducing the electron laboratory notebook

The primary impetus for this trial was to offer a means by which students could keep their experimental records in a digital format rather than a paper-based laboratory notebook. The ELN offers a way to archive data sets directly from their source, i.e. the instruments that generate the data, on an institutional server. The ELN offers other advantages over a paper laboratory

notebook in that it provides:

- a way for data files to be annotated and linked to the context of the experiment (experimental design)
- a portal for sharing data and collaboration, i.e. between student and supervisor who may not be co-located
- a means of archiving experiments so that experiments can be easily revisited
- a place where the data files generated by scientific instruments used in experiments can reside.
- the experimental record templates in the Southampton ELN are created by each researcher lending the required level of adaptability for research purposes.

Here we seek to characterize both the benefits and sticking points of introducing *e*Research into a PhD program, focusing on an ELN in chemistry research. Do the advantages that ELN proffers translate in practice for research in chemistry?

2. APPROACH

In August 2009 we undertook a trial of an electronic laboratory notebook (ELN) in the School of Chemistry at UNSW. The ELN selected was developed at Southampton University, UK, [2, 7] for use in a research environment and is "open-access" software grounded in the philosophy "open science" [8].

Project implementation
Prior to implementation of the ELN we identified stakeholders that included:

- ELN creators at Southampton, UK
- The Library: to provide server space and associated curation
- IT support: to manage the ELN at UNSW
- Researchers: PhD supervisors and their supervisors as participants in the trial.

The ELN trial
Staff and students in the School of Chemistry were surveyed at the start of the ELN trial as to their:

- main research area within chemistry
- the instruments they rely on to generate experimental data
- how they retrieve their data from these instruments and the software they use for data-handling
- student computer and internet access, including home access
- how they share experimental findings with their collaborators (e.g. for students this includes their supervisor)

3. RESULTS

We are 6 months into the pilot and generally speaking, those students who opted to participate in the trial were in the first year of their three year PhD program. Students in later stages of their PhD (year two and onwards) saw little value in investing in learning a new work process. From surveys and focus groups with our student participants (n = 9) we report that the users of the ELN have written templates tailored to the experiments they are performing. This tells us that the ELN format has been able to accommodate the kind of chemistry research being undertaken at UNSW and that the experimental design (the context) is linked to the datasets generated from those experiments.

On average, our PhD students are generating data from five instruments (e.g. mass spectrometers, nuclear magnetic resonance, UV-Vis spectrophotometers). Because of the nature of instrument software, the number of different file formats that each student is handling is in excess of this number. Most of the data generated from instruments used in experiments are in file formats that can only be accessed via proprietary software residing only on the computer attached to the instrument that generated the data. Effective workflow and archiving of experimental data files means that both the original data file (generated from the instrument) and the derived data file (in a more usable file format e.g. Excel or Origin) need to be archived. Currently students are sending their data files from the instrument to their computer using email.

All students participating in the trial are aware of the requirement to document their experimental work by way of a laboratory notebook. The rate for completing a standard paper-based laboratory notebook ranges from less than one book to over two laboratory books per year of study. This suggests that there are differences in how students currently use their laboratory notebook to record their data and/or that there are differences between the types of research conducted.

Students are using the ELN as both a place to store and to annotate their dataset. Most of our participants are linking their records to the relevant published literature. We expect that the practice of linking experiments to the published literature will, in theory,

make the process of writing up their work as a thesis and papers much easier for students.

The use of the ELN for collaboration is low. Currently we are devising systems to directly link instruments to the ELN so that data files can be available to users over the internet. We have identified deterrents to using the ELN for research in chemistry, which are:

- the ELN does not interface directly with the proprietary software such as instrument software generally and ChemDraw specifically
- having to login to the ELN to make minor entries

The survey indicated high-use instruments and we are discussing how to proceed with putting instruments on the intranet/internet so that data files can be accessed via the ELN and linked directly to the experimental protocol and the inferences from the data.

We are continuing to work with the creators of the ELN to improve functionality for research in chemistry. We will continue to monitor how students are using the ELN particularly with regard to the level and quality of collaboration and interaction with their supervisor(s).

4. CONCLUSIONS AND FURTHER WORK

We are working towards having high-use instruments 'pushing' data to the ELN. This is no trivial task; it requires 'good will' and resourcing at all levels of the institution to a sustainable system of having instruments online. Once instruments are blogging data the ELN we will be in a position to introduce the ELN into the undergraduate chemistry curriculum. Using an ELN as a data portal will allow undergraduate students, wherever they are located, access to a much more diverse range of experimental equipment. The potential of the ELN to address access issues in the science higher education sector is enormous, particularly as not all universities have invested in the same range of equipment.

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Role of Empathy in Science Class: A Collective Case Study

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ABSTRACT

Caring for students' progress is an important characteristic of a teacher that impacts students' learning experiences and their content understanding. In science classroom, how empathetic teachers are towards their students has not been well investigated. To explore the concept of expressing empathy in a class from a teacher's perspective, we conducted a case study at a science education graduate program. Two science education graduate students were asked to talk about their views on empathy in class and its impact on student learning experiences. In this paper, we present the two participants' understandings of the role of empathy in teaching and discuss some implications for practice.

Keywords: Empathy, Science Education, Teaching, Case Study, and Student Learning Experience.

1. INTRODUCTION

Students' skills, interest, and experience about the subject matter play a vital role in their learning process. At the same time a teacher's competence, passion for teaching and extent of rapport with the students also affect students' learning [1]. A teacher can establish a nurturing relation with her students by putting herself into her students' positions and viewing the things from their perspectives. Science classroom is one of the places where the phenomenon of expressing empathy in a class and using it for personal development can occur. As this subject has not been broadly explored, the present study attempts to provide a framework of investigating science educators' views on empathy and their perceptions towards expressing it in class for the efforts to positively impact student performance and learning experience.

2. THEORETICAL FRAMEWORK

Brunel, Walker, and Schleifer said "Empathy, broadly speaking, means the ability to identify other peoples' feelings from their points of views" (p. 226) [2]. Roger stressed that empathy is probably the most important aspect in learning (as cited in Brunel, Walker, and Schleifer [2]). Teich highlighted that if students feel empathetic towards a topic, it helps them to produce unique results [3]. Gilly said that "relationship between teachers' empathy and their teaching ability is linked to the classical notion that a teacher cannot properly instruct pupils without knowing them well" (as cited in Brunel, Walker, and Schleifer [2], p. 228). Seeing things from other person's perspectives helps in understanding their emotions and feelings. Empathy is crucial in creating a welcoming and a positive learning environment for all students.

The role of teacher's empathy in science teaching has not being well explored. Science teachers are often taught to acquire science content knowledge and pedagogical knowledge. Pedagogical knowledge that science teachers are

instructed with focuses on learning theories, science teaching strategies and methods. It often lacks the discussion of the role of teacher's empathy in class and how this may impact student learning experiences and subject matter performance. To explore the science educators' views on the role of empathy in class, we have talked to two science education graduate students.

3. STUDY METHODS

In the present study, we conducted a collective case design which is helpful to optimize understanding of the cases choosen [4]. Two science education graduate students were chosen as the cases. Students' views on empathy and its role in teaching were the units of analysis. We designed a semi-structured interview protocol in order to explore our participants' views of empathy and its role in teaching. The protocol included twelve questions, yet, based on the conversations with the individual participants, we asked emerging questions and omitted few of the questions in the protocol. Appendix presents the twelve questions originally listed in the protocol.

Participants and Their Selection

We used a convenience sampling procedure [5]. The criteria used in choosing the participants were: (a) being a graduate student in science education program; (b) participants' willingness and availability to participate in the study; and (c) convenience for the researchers. The two participants; John (a pseudonym) was an M.S. student; and Lily (a pseudonym) was a Ph.D. student in science education at the time we collected data. The two respondents' teaching experience varied considerably. John had about two years of teaching experience whereas Lily had more than 20 years of experience in teaching. John's major was in physics and he was studying to receive an M.S. degree in science education. Lily's major was in biology and she was studying for her PhD degree in science education.

Data Collection and Analysis. We invited the participants to the interviews. Both agreed to participate. We talked to the each interviewee for about 45 minutes. The conversations were audio-taped. The recordings were transcribed within the next five to ten days. We analyzed the transcriptions using the constant comparative method [6], which helped us identify the common themes and delimit the categories. We read the transcribed verbatim [7] a couple of times as we identified the common themes. Participants' responses were categorized based on the themes emerged from our readings. Themes that did not belong to any categories were deleted. Below is the summary of the themes with excerpts from the interviews.

4. FINDINGS

Both participants agreed that empathy plays a role in teaching. However, they believed that it is difficult to maintain a balance between being empathetic sometime and not empathetic at all. The participants differed in their ways to express empathy in class and how empathy helps in connecting teachers with the students.

Within-Case Analysis

Case 1- John: According to John, empathy is understanding other people's feeling at that particular time and context. When asked to define empathy John said:

> *"…empathy could be explained by taking an example of doctors. The analogy is to have sympathy and feel bad about the patients but they should understand their feelings and I think that is an important part for me, that is how we define it, that the teacher should understand what the students are going through and may be make adjustments accordingly."*

John maintained that a teacher with no empathy cannot teach successfully. John said:

> *"If a teacher does not have empathy skills, to me that means that they do not care about the students at all and if they do not care, what is*

their goal? If they are trying to get their students learn, shouldn't they care about what the students are doing? How they are learning? Their progress."

When we asked John whether connecting emotionally with the students is same as being empathetic he replied:

"That is a difficult question for me because in some respects it is the teacher's responsibility to maximize students' learning to make every effort but at some level it is also a student's responsibility to learn and work and if the teacher takes empathy too far and takes too much of responsibility therefore it could weigh down a lot of successful teachers because if the students are not performing well as they should and, it might not be a teacher's responsibility but I think there is a fine line there, should a teacher feel bad that the students are performing poorly, absolutely, I do when my students perform poorly when I did student teaching, I did feel bad and want to do everything I could to get them there and I encourage students to provide extra opportunity to make the efforts."

Among the advantages of having empathy John listed are: understanding the nature of students' problems and difficulties and providing feedback accordingly. John said:

"[Empathy] always pushes you to try a little harder because you are understanding the nature of [students'] problem, what their difficulties are. And if you do really care about the students, I think that you try a little harder rather than just getting through the material so I think the disadvantages though would be if you care too much you may become either very depressed or pulled down because you cannot have 100 % success or you cannot change the world."

When we asked about the ideal situation to express empathy, John responded that one on one situation is the most ideal. He said:

"I think that it is most useful when you are in one on one situation. I do not think that it means as much or comes across as a correct way if you say it in front of the whole class. I think it is more important on one on one basis because then you can address the issues and let those students know what to address."

Case 2- Lily: When asked about the importance of expressing empathy, Lily said that:

"…yes, but within limits. I think if you are too empathetic then you go too far to the other side. Because at some point you might feel sorry for the kids that their situation is so bad that at some point they have to be held accountable for what's going on."

When asked about the advantages of empathy, she responded:

"[empathy] helps in every form with them. When they think that you care about them they are gonna respond better in the classroom, you will have less classroom management issues if they think that you care and you listen to them and feel what they are feeling."

Lily maintained that knowing the limit to express empathy is tricky. She told:

"…it is different for every kid, some kids can manipulate you and can take advantage; oh, she likes me; she feels sorry for me; I will give her some excuse trying not to do my homework. So you kind of get the feel of the kid and make sure they are not manipulating you or playing on your feelings. But at the same time you do not want to be hard so that the kids know that you care about them."

To demonstrate empathy Lily tries to be authentic and does not put on a façade. She said:

"I think it also relates to being authentic with the kids; not putting on a facade, like I am a tough guy, or anything like that, then I always try to be myself. Basically listen to the kids."

On the issue of creating a boundary, Lily mentioned that it is hard to find where the line is but you need to use your judgment and see all aspects before acting just based on your emotions.

"Yes, I had a student I remember that I kind of coached, she was complaining about certain issues at home, At first I was panicked almost ready to call the protective

services and then I had conference with her mother and found out that there are certain issues with a boy and this and that. She [student]) was portraying that they were mean to her. At one point I was on her side. I realized that she might be number one attention seeking from me and may be sort of manipulating to her side or whatever so I remember that case."

Lily explained that connecting emotionally is helpful in feeling empathetic towards the person. When asked about the importance of emotions in empathy she mentioned:

"Definitely although you feel more empathetic towards someone you know but if you see a homeless person on the street you say look at that. I feel more about people whom I know or family members but even those who I see in the world I feel, oh look at that person! You see commercials on TV like that."

She further mentioned it is equally important to be empathetic within reasonable limits as sometimes the students may take undue advantage of the teacher.

Cross-case Analysis: The participants narrated their experiences to elaborate about the role of empathy in class. Their explanations of the role of empathy differed to some extent. John related empathy with caring and emphasized on its role in connecting with the students. He gave examples to elaborate the differences between expressing empathy in different scenarios. He stressed on the practical applications of empathy. John also related empathy with improving students' performance. According to John, it is best to express empathy in "one-on one" situation because it helps address the issue in a more practical way.

Julie mentioned the importance of expressing empathy within limits. According to Julie, the importance of expressing empathy in class cannot be neglected. However, it needs to be exercised with caution. Julie also highlighted that we feel more empathetic towards people who we are familiar with or have known more. She agreed with John that a teacher can improve students' performance by being empathetic towards her students. An interesting finding from the Julie's interview is the notion of students taking undue advantage of the teacher. She mentioned that if a teacher tries hard to connect with the students, students might come up with a strategy to gain sympathy from the teacher for undue reasons. Julie further stressed a teacher should be genuinely concerned about the students' progress for effectively expressing empathy with the students. Even though participants differed in their views of expressing empathy in class, they both agreed on the essence of expressing empathy in teaching.

5. CONCLUSION

Our participants reported that empathy plays a role in students' learning. They noted empathy expressed in a typical classroom is complicated because it may include many dimensions. Although, empathy helps in connecting with the students they believed, it was equally important to know the limits and ideal situations to express empathy. Our participants had different teaching experiences that might have contributed to the differences in their views.

Further studies are recommended to explore ways to express empathy and the demarcation of the boundaries and setting the limits to express it. There may be other characteristics that impact people's views of empathy and its role in teaching. Teachers' sex, age, experience, and even the topic of instruction can play roles to what extent empathy is expressed in class by the teacher. This study has provided a framework that can further be investigated. Future studies can focus on other disciplines Students' views about their teacher's empathy and the ways of expressing it can also be a focus for future research.

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APPENDIX

Interview Protocol

Main Research Question: What are the participants' views of empathy in class and its role in teaching?

Questionnaire

1. Please describe empathy in your own words.
2. How do you feel if you find someone in distress?
3. What do you think about the statement that a teacher should be empathetic towards their students?
4. When is the ideal situation to express empathy in class?
5. How can empathy be expressed in class? / How can a teacher be empathetic towards the students?
6. What do you do to judge your students' feelings?
7. How do you feel when your students succeed? How do you feel when they fail?
8. How do you relate to the difficulties your students face by?
9. What do you do if you have a disagreement with a student of yours on an issue?
10. How do you approach when you want to correct one of your students' mistakes?
11. Have you ever been in a situation when you felt helpless, hopeless or frustrated in your class? How did you deal with the situation?
12. Have you ever come across a situation where being empathetic was counterproductive? How do you deal with such a situation?

Multiple means: Identifying literacy learning experiences of at-risk youth in community informatics contexts

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ABSTRACT

Digital youth are agents of change in participatory learning culture. Information and communication technologies (ICTs) are enabling individuals of varied ages and skill levels to seek information, produce media, distribute instantly to millions, and participate in peer networks that span the globe. Community technology centers offer programs with opportunities for youth to learn multiple forms of literacy, as well as to develop the social and technical skills that contemporary educational systems are not designed to teach.

This paper takes a trans-disciplinary perspective on investigating how at-risk youth can engage in multiple literacy learning through community-based digital media programs, and presents a study design to identify the characteristics of community technology centers with programs that effectively engage youth in development of technological literacy, media literacy and critical literacy for lifelong learning.

Keywords: digital youth, community technology centers, participatory culture, technological literacy, media literacy, ICTs.

1. INTRODUCTION

Critiques of the technology access in urban public education systems suggest that many students at-risk of academic failure do not have the computing experiences that will allow them to engage in self-directed and individualized learning. Institutional Internet limitations, mandated by legislation and school district policies, set in-school student access to information-only searches [1]. Few schools offer the collaborative learning experiences that allow students to develop the range of computing skills for participation in emerging global knowledge contexts. Educators of technology, arts, languages, and other subjects recognize the potential for engaging youth to develop literacy through digital media arts. Libraries, community organizations, schools, and universities are providing collaborative outreach activities focused on out-of-school digital arts computing experiences [2].

2. PARTICIPATORY CULTURE

Participatory culture is not a new phenomenon. It is a cultural phenomenon where individuals can potentially contribute their ideas, through the media, to the public discourse. In the last century, participation through newspaper editorials and telephone call-in talk shows were common as was public cable access participation. In the digital age, contribution to participatory culture is widely possible through ICTs with few barriers of media production costs or distribution channel limitations. Participation in digital contexts allows people to have greater voice in cultural arenas where they previously had not been able, as well as possessing the ability to access information as never before possible [3]. With these allowances comes the need for individuals to assess the quality of their findings, as well as to develop the ability to contribute in a meaningful way

to the public discourse. Learning through participatory culture brings opportunities for self-directed knowledge seeking and contribution to global communities. Optimally, in order to gain the greatest educational advantages, students will have opportunities to develop the literacies that will allow them to engage successfully in participatory learning.

3. LITERACIES

Literacy is a dynamic concept, with definitions emerging that are specific to various disciplines with terms focusing on interaction with texts—both visual and verbal—that are tied closely with an individual's social and cultural references For the purpose of this paper, literacy is defined as a continuum of gains in legacy knowledge (historic content and disciplinary traditions), learning skills, skill sets, navigational abilities, and application of abilities through continual, lifelong practice. Development of multiple literacies is necessary for successful participation in traditional academic systems as well as emerging educational contexts. Technological literacy [4], media literacy [5], and critical literacy [6] are the three that are to be identified in digital arts programs in community informatics settings.

4. CONTEXTS

Community Technology Centers (CTCs) take many forms with some operating as stand alone organizations and others functioning as embedded programs within other institutions such as YMCA, Boys and Girls Clubs, or other community-based organizations, with some CTCs very closely aligned with the local school systems as is the case of the Cincinnati Arts and Technology Center (CATC).

An example of a youth media and computing center that offers participatory learning experiences is The You Media Center at the Harold Washington Library in Chicago [7]. The center is designed to facilitate the participatory learning tendencies of contemporary youth based with areas for youth to 'hang out, mess around or geek out' using digital media [8]. Indicators exist that distinguish learning contexts supporting participatory learning as well as those that support multiple literacy learning. These indicators include the types of activities, the themes students study, the methods of instruction, leadership in the organization, and the degree of autonomy students are able to exercise in selecting their focus in the program.

This study is informed by findings of the MC^2 project [2], where the CATC functioned in essence as an extension of the Cincinnati Public School system, with students experiencing limited computing opportunities because of district policies and curriculum priorities. The question became how to identify the out-of-school computing programs that do offer computing opportunities for learning multiple literacies, specifically technological literacy, media literacy, and critical literacy?

5. STUDY DESIGN

The study is designed in two phases. In the first phase is the creation of an assessment instrument to first identify potential CTCs and digital arts programs. Indicators include organizational, programmatic and pedagogical aspects of the digital arts learning opportunity. The instrument will then be used to selected a program that indicates the existence of participatory learning experiences to teach multiple literacies (technological, media, and critical).

In the second phase, will be a site visit to implement the instrument and to develop a case study of the selected program. Interviews with an administrator, an instructor, and students will be conducted as well as two observations, one of a class session and one of an individual work session. A focus group will be conducted to generate information about challenges and successes encountered in the program.

Development of the instrument and implementation of the site visit will result in data for the first case study that will be used as a basis for a comparative case methodology for future research.

6. SUMMARY

Expansion of ICT use among digital youth allows engagement in learning in new ways that existing educational systems do not support. Community technology centers have the potential to provide experiences for developing the multiple literacies youth need to participate in global educational contexts, to assess the quality of the information they encounter on-line, and to contribute meaningfully in those contexts. This project identifies CTCs with digital arts programs designed to support successful youth engagement in participatory learning culture through development of multiple literacies.

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Engineering Math Based Bridge Program for Student Preparation

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ABSTRACT

University of Alabama (UA) retention statistics showed less than 33% of engineering freshmen were retained through graduation. This is 23% lower than the national average of 52% for similar programs. Analyses indicate the primary reason for low retention is an inability of incoming freshmen to perform well in first-year calculus classes. Low performance in calculus was found to impact upper-level engineering classes. To combat this deficit, UA developed a unique informal, interactive, and interdisciplinary summer residence class called the Engineering Math Advancement Program (E-MAP) sponsored by the National Science Foundation. The program aims to increase prepare students to 1) do well in calculus and 2) to excite them about engineering, introducing students to hands-on "Living-Lab" experiences, industry trips and a community service project led by professional engineers.

Math Placement Test (MPT) data show that 84% of participants skipped one math course and 41% 2-3 courses. Post-program grades (GPA 79.7) are greater than pre-program grades (GPA 56.6). Approximately 30% of participants have been minority and women students. Female scores were higher compared to male scores, the first year showing a significant difference (up to 10 points) in math scores. LASSI, Math Science Inventory and Meyer-Briggs studies are used along with pre- and post- MPT and ALEKs (Artificially Intelligent Assessment and Learning System) assessment providing both qualitative and quantitative data. The program's goal is to determine the best set of teaching methods and materials providing greatest impact on student performance.

Keywords: Engineering Retention, Summer Bridge Programs

Acknowlegement: Excerpts taken from article, "Integrated Engineering Math Based Summer Bridge Program for Student Retention," accepted fall 2009, Journal of Engineering Education. Authors: Jim Gleason, Karen Boykin, Pauline Johnson, Larry Bowen, Kevin Whitaker, Celina Micu, Dheeraj Raju, and Carter Slappey.

I Introduction

During the 1980s and 1990s, the number of undergraduates in engineering programs was in a significant decline [5],[7] as can be seen in Figure 1. Because of this decline, a large portion of the engineering workforce is nearing retirement age. Since the number of engineering jobs has remained stable during recent years (as can be seen in Figure 2), a large number of individuals with engineering degrees is necessary in the near future. While the engineering enrollment numbers have increased in the past few years [5],[7], increased recruitment and retention of undergraduate students in the field of engineering is critical.

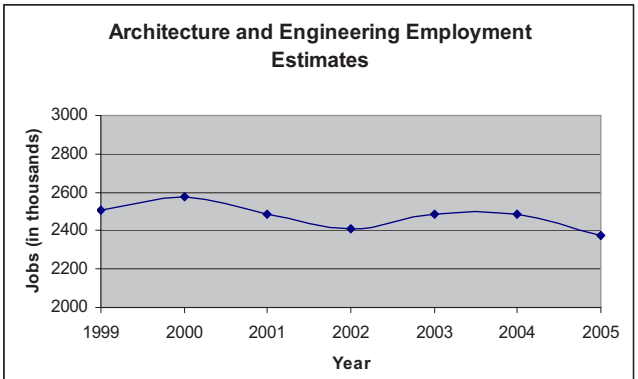

Figure 1: Architecture &Engineering Employment Estimates [1]

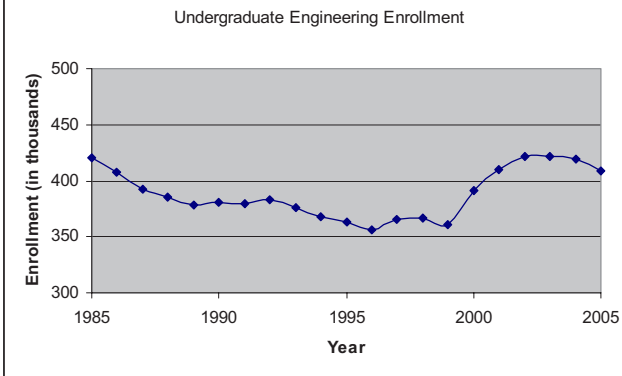

Figure 2: Undergraduate Engineering Enrollment [5], [7]

In an effort to increase the engineering workforce, the National Science Foundation has funded programs designed to improve the recruitment and retention of undergraduate engineering students through the Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP). At The University of Alabama (UA), these funds are used to focus on the retention of incoming freshmen who have declared engineering as their major.

Since the mathematics requirements of the engineering majors is an area that causes many students to drop out of engineering, the core of the program focuses on mathematics preparation. This mathematical preparation involves non-traditional classes in pre-calculus and calculus concepts designed to take incoming students who place in a pre-calculus class and improve their mathematical knowledge so that they are able to start their calculus sequence in the fall. In addition to the core mathematics content of the program, the students also participate in physics and chemistry classes as well as hands-on engineering activities and fieldtrips to introduce the students to various engineering fields.

II Literature Review

Importance of Mathematics to Success in Engineering
Math is one of the primary tools of engineering. The earlier the student learns to master the tool, the better he/she can manage the tool and apply it to problem solving. Lack of preparation in math is one of the main factors contributing to student dropout in Engineering at UA. The UA student retention statistics showed that less than 33% of incoming engineering freshmen were retained through graduation. This is 19 points lower than the national average of 52% for similar programs. Analyses indicate the primary reason for low retention is an inability of incoming freshmen to perform well in first-year calculus classes.

Current Status of the Mathematical Background if Incoming Freshmen
Studies at UA have established that around 60-70% of entering freshman engineering students are not calculus ready [6],[14]. Since the engineering program of study at UA assumes calculus ready students, 70% of entering freshman engineering students are under-prepared for the program due to deficiency in mathematics. The main results of this are poor performance in math related engineering classes, longer time to graduation and low graduation rates from engineering.

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Calculus courses are fundamental to the engineering curriculum as they provide a strong base for future engineering courses. Therefore success in calculus is important to success in engineering [9]**Error! Reference source not found.**. Many research studies support the fact that freshman students entering engineering program lack the ability to progress through the calculus sequence [3]. [15], [16]. Furthermore research indicates that students entering into current engineering programs do not have the ability to solve multistep problems, and lack higher order thinking skills necessary to solve engineering problems. They have also not developed a questioning attitude necessary for the fundamental understanding of the meaning behind many concepts presented. These important skills are required at all levels of the curriculum to enhance success in engineering [16]**Error! Reference source not found.**.

Programs Designed to Improve the Situation
A study on the effects of mathematics courses taken by students at the junior and high school level showed that the number of mathematics courses plays a prominent role in higher level mathematics achievement [15]**Error! Reference source not found.**. A number of successful programs address the deficiencies in entering freshmen preparedness for the engineering curriculum.

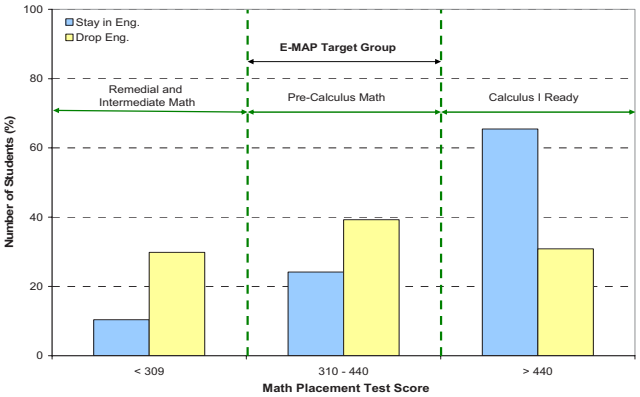
The Emerging Scholars Program (ESP), one of the oldest intervention program developed in the 1970's, has been adapted in mathematics courses at several major universities. These programs offer workshops which help freshman students build necessary mathematics background and develop the skills required to be successful in engineering [2]. Students who attended a "summer bridge program" on calculus performance among engineering freshmen at the University of Missouri in Rolla showed significantly higher performance than their counterparts who did not attend the program [9]**Error! Reference source not found.**. A similar engineering mathematics retention program at Wright State University included a freshman level engineering mathematics course replacing traditional math prerequisite requirements. This program improved overall success in student grades and motivation and helped improve student retention [10]**Error! Reference source not found.**. In another study, at-risk freshman engineering students who participated in a supplemental program received higher course grades and had higher retention rates.

The one week mathematics bridge program at Purdue allows students to discover strengths and weaknesses and improve preparation in mathematics. This program was one of the most effective pre-college retention programs offered by the schools of engineering [8]. Other bridge programs were 10 weeks long and the participants received course credits for participation. Many of the programs offered were free of charge and included scholarships.

Another engineering retention program at the University of Maryland tried to "bridge" the gap between high school preparation and expected standards of engineering freshman majors. This program focused on improving academic success and included life-skills, with social and motivational components. The students who attended this program benefited largely in terms of settling down and dealing with first semester [8].

Program Description

When students first arrive at The University of Alabama (UA), they take a mathematics placement exam, designed by the Department of Mathematics, which determines the mathematics course in which they may enroll. This initial placement has a strong correlation with student engineering retention rates. Historically, students scoring below 310 on the Math Placement Test do not have the math skills needed to pursue a career in engineering and either do not enter into engineering or leave the



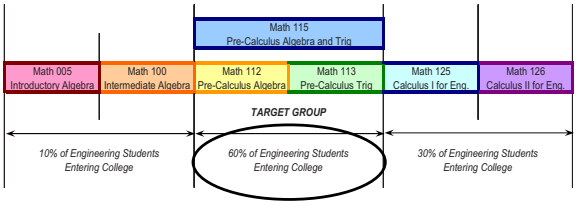
3: Retention as a Function of Math Placement Test Score, [6]

college soon after starting the program (see **Error! Reference source not found.**). For students with math placement scores below 440, retention is also low due to their math skills not being at the level that allow them to succeed in engineering math based courses. Although not as significant, retention is a problem in the higher scoring group, with the main reasons being unchallenging initial mathematics courses and lack of motivation to continue in the pursuit of a career in engineering [6].

To combat this deficit, UA developed a unique, informal, interactive, and interdisciplinary five-week summer residence program called the Engineering Math Advancement Program (E-MAP) to prepare incoming freshmen for calculus. The program aims to increase retention by preparing students to be successful in calculus and excited about engineering. In addition to a non traditional math class, the program includes hands-on "Living-Lab" experiences, field trips and a community service project led by professional engineers. The non-math aspects of the program were developed to strengthen mathematical skills indirectly through engagement of the students in laboratory and real world engineering problems, in the idea that solving skills are best nurtured through hands-on experiences [9], [10].

E-MAP is tuition-free, the only cost being food and on-campus accommodation. Scholarships are available for up to 10% of the participants based on need. Although freshmen students are not required to participate in E-MAP, they are strongly encouraged to do so. Recruitment involves an intensive mailing campaign and high school advising. Promotional material includes program flyers, poster presentations, a web site, and advertise-ments on the university and College of Engineering websites.

E-MAP specifically targets the 60% of students entering the College of Engineering who have math skills which place them into the pre-calculus range. Normally, these students would enroll in Math 112 (Pre-Calculus Algebra) and 113 (Pre-Calculus Trigonometry), or Math 115 (Pre-Calculus Algebra and Trigonometry), placing them in either case a year behind the remaining 30% entering at the Engineering Calculus 125 level. Up to an additional year is required to get back on track with the core engineering courses. Because the lower 10% in incoming students only have a 10% chance of graduating with an engineering degree (**Error! Reference source not found.**), these students do not create a large enough pool to justify a program targeted toward them. The upper 30% consist of engineering students ready for calculus and are therefore also outside the scope of the E-MAP program (4).



4: E-MAP Target Group Related to Math Placement Score

E-MAP Structure

The program includes a variety of experiences to enhance math skills and student engagement in engineering. Engineering related activities include hands-on "Living-Lab" experiences, field trips and a community service project led by professional engineers. The incorporated fun learning experiences, teambuilding and social activities help avoid summer burn-out and encourage participation and bonding. The mathematics classes are primarily in the mornings with the afternoons allocated by rotation to Living-Labs, Calculus Lab, and Community Service Project. One day per week is reserved for the learning experience through the field trips. Social activities and/or math tutoring are available in the evenings.

Math Class

The E-MAP program offers an alternative curriculum for pre-calculus math building upon the principal that students are individuals with different learning styles. The structure of the E-MAP math program provides time for individualized mentoring experiences that could not take place in the traditional lecture classroom because it involves all three forms of learning through the use of multi-media introduction of new material, one-on-one tutoring, and hands-on experience with applications. The classroom model is based on a small student/teacher ratio with a lead instructor assisted by two teaching assistants (TAs). Students are taught pre-calculus algebra and trigonometry for two hours per day. The math class incorporates relevant math concepts from engineering labs and service projects that the students are participating in. Additionally, tutoring sessions are available in the afternoon and evening. Classroom TA interacts within the groups to explain and reinforce concepts. In class testing including a final exam determines if E-MAP students are calculus ready.

Living Laboratory

The Living Laboratories are based on the eight areas of engineering at UA and they are taught in multiple blocks to keep student-instructor ratios low and to allow flexibility in scheduling. Each student is required to take four three-hour labs. Students may select three out of nine offered laboratories, the fourth one being assigned by the program coordinators based on student interest and lab availability. The two primary objectives of the laboratories are: the use of math skills in an engineering setting, and student exposure to the practical side of each engineering discipline. The application of math skills in engineering is experienced, for example, by exposing students to "data-gathering" experiments in each laboratory, data is then used to examine, explain, or derive basic engineering theory. The second objective is achieved by giving "broad-picture" engineering problems to illustrate the thought process behind each step of engineering analysis, and to design and teaching students how to break large, complicated projects down into small manageable pieces. This is an opportunity for the departments to immerse the students in the "hands-on" work within each field and assists the student in career selection and development.

Engineering Site Visits

One day per week is dedicated to exposing students to off-campus engineering practice such as plant and project tours. The field trips, ranging from a half-a-day to day long, are designed to focus on one or more engineering career fields. The field trips facilitate student exposure to basic engineering processes, career choices, and potential employers by providing introductions and promoting interactions between students, key industry, government representatives and decision makers. An effort has been made to line up effective speakers, demonstrations and interactive exhibits at functional plant sites so that students are engaged rather than just observers. Engineering, mathematical, and physical concepts key to operations at the plants are explained. An example used for civil and mechanical engineering students include visualization of superelevation, curve design, and torque by tracking vehicle speed on the Barber Motor Sports track and examining race car

engine operation. Aerospace engineering students worked with Boeing scientists at the United Launch Alliance facility on rocket launching projectile motion problem sets. While electrical engineering students experimented with sound vibration devices at Southern Company's Holt Hydroelectric Generation plant. Sponsorship of site visits may change from year to year, however, the project team works to keep consistency where possible. Sometimes this involves working with the companies to tweak concepts to keep things fresh for the professionals as well as E-MAP staff.

Community Service Themed Project

The societal benefit component introduces students to participate as "team engineers" on real-world projects sponsored by the West Alabama Chamber of Commerce's Environmental Task Force. The "Chamber Project" addresses how to research a project, how to work as part of an engineering team, and the thought process in tackling a large engineering problem. Chamber members have been extremely impressed with the student's presentations and their interaction with local engineers. They asked for continued sponsorship of E-MAP as a Chamber outreach program and have helped to advertise activities with the local press. Year two incorporated a real world societal benefit project for the creation of a "theme park" in the Lake Tuscaloosa area (Figure 5). Problems related to the various design aspects were reiterated and reinforced in various program components. A final presentation consists of a student competition judged by Chamber leaders, local engineers, and other community representatives involved. E-MAP staff attempts to keep the project "low-key" as a reinforcement tool where students work during class time, but keep their focus and priority on the program's math skill development components.

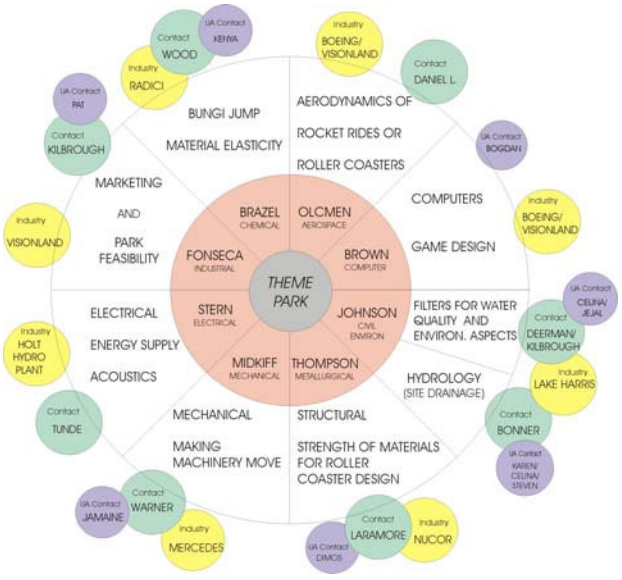


Figure 5: Community Service Themed Project- Water Park

For 2007, the themed project focused on Sustainability, working with the Hale County Empowerment and Revitalization Organization (HERO), a foundation dedicated to helping build low-income housing in rural West Alabama. Students were teamed and asked to work in their engineering discipline areas then tasked with developing ideas related to what an engineer in their field might do in designing a sustainable house. Students were teamed with professional and academic engineers and scientists. Ideas developed included fluid flow for wind maximization through an aerodynamically designed house, a low-cost construction material made from recycled glass and plastic the students called "Glastic"™, and electrical engineering designed wood combustion fueled lighting system. Although they were not required, most student groups built models. All teams are required to learn basic engineering principles and theory that related to their work.

RESULTS

Improved Mathematical Knowledge-

To measure the effectiveness of the E-MAP program at improving the students' mathematical knowledge, the mathematics placement exam was given to the students before arriving for the summer program and at the conclusion of the program during year 2 and 3. The E-MAP students showed an increase (M=54, SD=50.8) in their math placement score. This increase was statistically significant, $t(46)=7.30$, $p<0.01$, one-tailed. The majority (58%) of the participants who were eligible to improve their mathematics placement did so with some of the participants moving two or three classes ahead of their original placement.

Therefore, E-MAP is successful at improving the participants' mathematical knowledge and allowing the participants to begin their college education at a higher level within the mathematics curriculum. This leads to the question of if this increased initial placement within the curriculum reflects a shortening of their undergraduate program by removing one or two mathematics courses.

Success in First Mathematics Course

Although this was not a goal of E-MAP, as a way of measuring the goal of increasing the E-MAP participants' ability to succeed in mathematics courses, the success rate of the E-MAP students was compared to the overall success rate of incoming engineering students with similar mathematics placement exam scores in their mathematics courses during their first semester at the university.

The series of graphs to follow compare E-MAP student's grades with non-E-MAP student's grades from their first college math class again seem to indicate that E-MAP students placing in Calculus 1 (Math 125) after the course seemed to do better than the general population as a whole. E-MAP Students placing in lower math courses seemed to have an elevated withdrawal or incomplete rate over the general population. No direct relationships were observed in the data sets showing good correlations between withdrawal, incomplete, or failing rates except that all these students (for both populations), scored between 200 and 300 on the math placement test (not all students scoring within this range did poorly). Based on this outcome, future work is targeting this sub-population for additional help to change this issue, specifically including use of the ALEKS program, developed by the University of California System with the National Science Foundation.

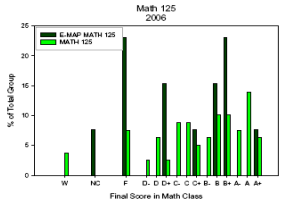


Figure 6: 2006 Math 125 score comparison.

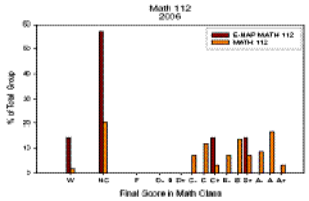


Figure 7: 2006 Math 112 score comparison

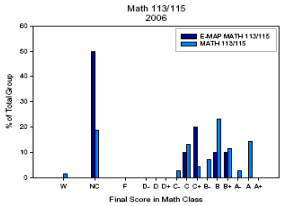


Figure 8: 2006 Math 113/115 score comparison

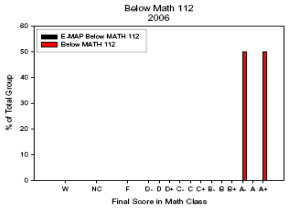


Figure 9: 2006 blow Math 112 score comparison

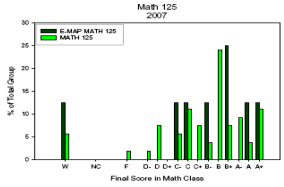


Figure 10: 2007 Math 125 score comparison

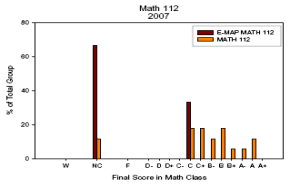


Figure 11: 2007 Math 112 score comparison

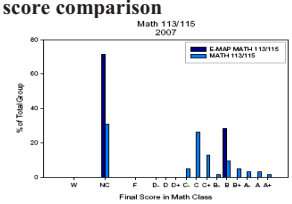


Figure 12: 2007 Math 113/115 score comparison

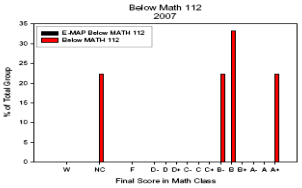


Figure 13: 2007 blow Math 112 score comparison

The data was parsed by ACT score and the E-MAP group and non-E-MAP group was compared. The figures below suggest that within each population there are two subgroups: those that score below 25 on their ACT and those that score above 24. At 25 and above, a correlation exists between the Pre-Math Placement Test and the ACT score grouping. Below 25, there is no strong correlation, suggesting that students in this range of the ACT will probably score within the same distribution.

Interestingly enough, by comparison between Figure 14 and 15, the E-MAP student Pre-Math Placement Test distribution was generally about 100 points lower than the non-E-MAP group. This is due to policy adjustments were by students scoring below 310 were allowed into the program. In 2008, original attendance requirements for scoring pre-calculus level or above was reinstated. Initial examination of student performance for 2008 as measured by the ALEX software is promising.

Subdividing the two populations into two groups each above and below an ACT Math score of 25 gave four distinct distributions. These are plotted on the probability plot on the following page.

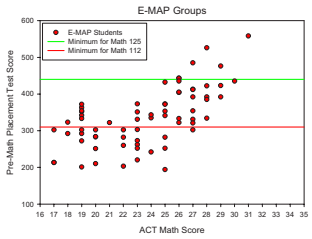


Figure 14: Correlation between ACT Math Score and UA Pre-Math placement test scores in E-MAP groups.

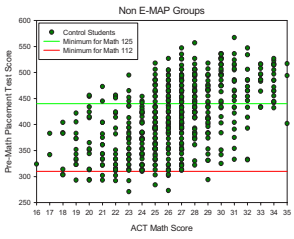


Figure 15: Correlation between ACT Math Score and UA Pre-Math placement test scores in non E-MAP groups.

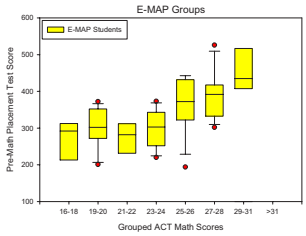


Figure 16: Box plots summarizing correlations between E-MAP student ACT Math Scores and UA Pre-Math placement test scores.

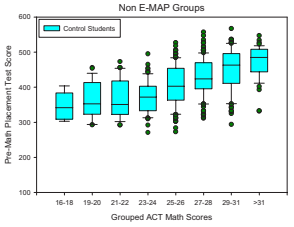


Figure 17: Box plots summarizing correlations between non E-MAP student ACT Math Scores and UA Pre-Math placement test scores.

Figure 18 shows the probability plot of the four data sub-sets. An ANOVA analysis was conducted to ensure statistical appropriateness and significance. The ANOVA confirmed that the subsets are from statistically different populations. This may explain observations from Figures 6 through 13 and answer why

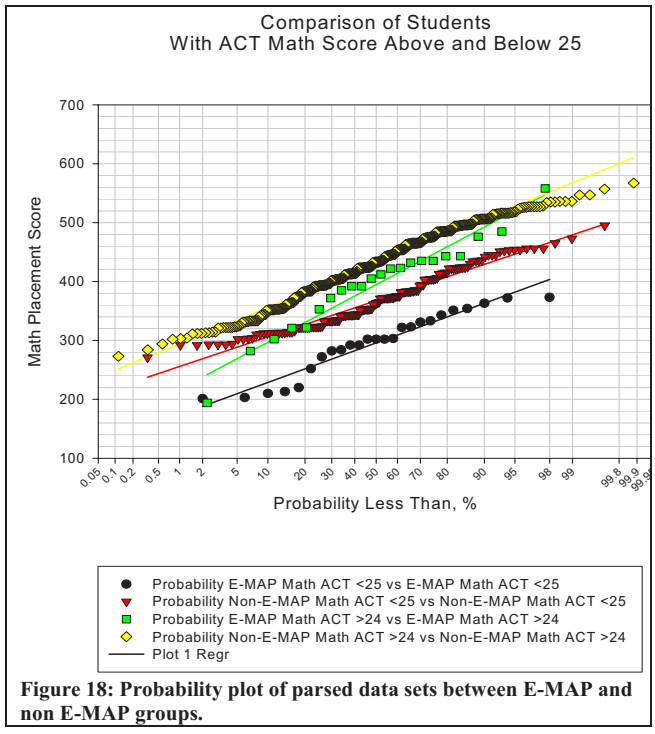


Figure 18: Probability plot of parsed data sets between E-MAP and non E-MAP groups.

a higher portion of the E-MAP students than the control group withdrew from the math classes, while those that stayed performed equally as well as the control. This would indicate that future iterations or similar programs should consider students scoring between 200 and 300 on the Pre-Math Placement test *and* with an ACT Math score less than 24 should be considered a higher risk and given additional instruction.

Retention

One focus of the program goals is to enhance student retention within STEM fields. The data suggests that the program is accomplishing this objective. Below are tables comparing the individual data sets with the data parsed by program year.

The pilot program of 2005 was tracked for retention over the past three years along with the programs for 2006 and 2007. The first subgrouping shows a comparison between those E-MAP students scoring between 310 and 440 (the program target group) on the math placement test and those non-E-MAP students in the same range. Student third-year retention in STEM areas of E-MAP students was 100% for this subgroup compared with only 63.2% of the general STEM students. Examining the entire 2005 E-MAP class, student retention was just over 78% in STEM fields at the end of the third year compared to just over 66% for the control group. First year retention in all cases with E-MAP students was 100% compared to upper 90's for outside students. E-MAP improved retention of students in STEM fields overall by approximately 12%. Note that student status was broken down into those (1) remaining in engineering, (2) leaving engineering and STEM areas, and those (2) leaving engineering but remaining in other STEM areas. This was determined by (A) UA enrollment or (B) direct survey of student if they left the University. A small portion of the students, less than five, who had left the university and were no longer at known addresses were assumed to have left engineering based on their GPA upon leaving.

Conclusions

Based on the 2006 and 2007 data analysis it appears that:

1. The E-MAP program is successful in elevating math placement test scores allowing students to enter college at a higher math level.
2. E-MAP is the most successful with students scoring in the range of 310 to 440 on the math placement test.
3. Students scoring between 200 and 300 on the math placement test have an elevated risk of dropping out of math or failing over other students.
4. E-MAP students outperformed non-E-MAP students in Math 125.
5. 100% of E-MAP students within the 310 to 440 subgroup (the target group) were retained in STEM fields while only 63% of non-E-MAP students at the end of three years.
6. E-MAP improved retention of students in STEM fields overall by approximately 12%.

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"Teacher Leadership Development at Hebei University in China"

By Dr. Silvia Braidic and Dr. Kevin Lordon

INTRODUCTION

"Leadership is Influence"…John Maxwell

This definition of leadership is one of the best I have discovered in my years of school leadership. Leadership is one of the most studied, discussed and written on topics today. It is defined in many ways and applied in many styles. Questions focus on whether leaders are born or made. Does one style of leadership work better than others? What are the essential qualities for successful leadership? Maxwell's definition of leadership hinges on being able to influence people. The key concept is that if "leaders" do not influence the people they need to lead, they are heading in a direction on their own. As a former school administrator, it became clear to me that the more leadership in a system the greater the results. An annual goal was to create an environment that fostered leadership skills in my staff. That was accomplished by building the leadership capacity of the staff through professional development, by placing staff in situations where they could exercise their skills, and by providing the resources needed for success.

In higher education, the question becomes can teacher leadership be presented so that professors can develop their leadership skills and add to the capacity and quality of the university system.

This paper is the result of staff development conducted at Hebei University in Baoding China. The focus of the program was to identify the leadership skills level of the staff, create an understanding of effective leadership qualities, and identify areas where the qualities may be applied. The format for the staff development was a series of lectures conducted on site.

Why Teacher Leaders

There are different levels of leadership. The basic level is leadership by position or title. In the university setting those positions could include department head, dean of a school or central administration. A title brings certain rights and responsibility. If a leader remains at that level, their organization will not reach maximum capacity. In order to grow, a leader must build relationships with the member of their staff and thus gain permission from them to lead. Once relationships are established, people look to see if the leader can get results. Once this foundation is set, people will then let the leader develop their leadership skills.

This is where the concept of Teacher Leader enters. Whether it is in the public school sector or higher education, effective leaders know that by developing their staff they build influence. A good positional leader knows that the success of their institution depends on the leadership contribution of the members of that institution. Therefore, the challenge is to create an environment that fosters leadership development.

What is the first step?

The foundation of developing leadership is establishing an understanding of effective leadership qualities. The question that begins the process is, "What are the qualities that make an effective leader?" The many times I have done this, the most frequent answers are: integrity and honesty, good decision making skills, demonstration of caring, ability to effect change, and effective communication. When the professors in China were asked these questions, their answers fit into these categories.

The cornerstone of every leader's influence is trust. Trust depends on integrity. The theory is that the only one who can destroy your trust is you. Even in difficult decisions, integrity needs to be the overriding principle. Too often leaders in an effort to please everyone will give the answers people want to hear. Truth is often

not the popular position but needs to be the preferred response if a leader is to have a foundation of trust. Establishing trust is the first step to teacher leadership. Solid trust relationships with students and colleagues will enable the teacher to take both groups to learning and instructional levels that will impact the organization.

Leaders are constantly making decisions. A good decision comes when the leader gathers data relevant to the decision, analyzes the data, and makes the decision that is in the best interest of the organization, implements the decision and establishes an evaluation to determine success measures. For the teacher leader, decision making occurs in every instructional episode. A teacher leader makes teaching and learning decisions using the steps outlined above. The decision making process in the classroom translates well to decisions made within the school unit.

Will you follow a person that demonstrates a lack of concern for you? You may if you are forced to do so. Having a genuine concern for the people you intend to lead will gain you great influence, an influence that can even overcome deficiencies in other leadership qualities. When people know you care about them, they will often give you the benefit of the doubt in a decision or change event. This leadership quality can only be developed through relationships. A good leader seeks to understand the life circumstances of people and remembers that all of us deal with trials and situations that impact our lives. As teacher leaders builds those relationships with their students through in and out of class interactions. With colleagues, a teacher leader is supportive and understanding.

Change is imminent. We live in a world where change is occurring at a rapid rate. Technology is the most vivid example. In teaching, system change comes in the form of curriculum design, teaching pedagogy, school structure, and students learning. A good leader knows that change will happen. The challenge is to make the change effective to achieve the goal. In education it is student learning. A teacher leader has a self learning focus. They are continually seeking effective teaching strategies to improve student learning. In the school unit, the teacher leader makes change happen as opposed to letting it happen to them. That includes visioneering to identify change areas and developing the preferred successful change implementation. (Visioneering is a concept where a vision is set to a specific need as opposed to a broad vision.)

All of these qualities depend on the ability to effectively communicate with the various groups. A leader needs to clearly communicate their vision and the steps for implementation. The communication must be undergirded by a foundation of trust, integrity and care. When this is established, influence will be established, and the leader will not be walking alone.

What does the research say?

The Center for Comprehensive School Reform and Improvement created a research brief entitled “What Does the Research Tell Us About Teacher Leadership?” The information summarized came from a study conducted in 2004 titled, “What do we know about teacher leadership? Findings from two decades of scholarship.” One of the goals of the brief was to summarize the findings through a comprehensive review of the teacher leadership literature.

The study defined teacher leadership as

> “Teacher leadership is the process by which teachers, individually or collectively; influence their colleagues, administration, and other members of the school community to improve teaching and learning practices with the aim of increased student learning and achievement.”

A good teacher leader is a facilitator who seeks to strengthen the school. They accomplish this by monitoring improvement efforts, selecting and developing curriculum, providing peer coaching, becoming a change catalyst and decision maker, mentoring, and fostering culture development. Influence is developed by

teacher leaders through both formal and informal relationships.
The authors of the study claim that teacher leadership grows when optimal conditions exist in the areas of school culture and context, roles and relationships, and school structures.
School culture and context facilitate leadership growth when the school environment has the following characteristics:

- The school is focused on learning, inquiry, and reflective practice.
- Staff is encouraged to take initiatives.
- An expectation of teamwork and shared responsibility, decision making, and leadership are present.
- Teaching professionals are valued as role models.
- A strong sense of community among teachers that fosters professionalism.

Teacher leadership is nurtured through roles and relationships when:

- Colleagues recognize and respect teacher leaders who have content and instructional expertise.
- High trust and positive working relationships exist among teacher and school leadership.
- Teacher leadership work focuses on the learning process not managerial tasks.
- Teacher leader and school leader domains are clearly defined.
- Interpersonal relationships among staff and school leadership flourish.

Structure impacts teacher leadership when is provides the resources needed for the teacher leader to be successful. That includes materials, time, and space. In addition, the structure fosters growth when the school leadership believes in the importance of staff development.
The research review assisted the authors in presenting a conceptual framework for implementing and expanding teacher leadership in a school. Of the six concepts of the framework, the first three set foundation conditions for teacher leadership. They include:

- Teacher leaders are respected as teachers, want to learn leadership skills, and have the capacity to develop such skills.
- Teacher leader's work is valued by peers, visible in the school, continually negotiated through feedback and evaluation.
- The culture within the school supports teacher leaders by providing the resources needed to be successful.

Once teacher leaders are establish in a well grounded setting they:
Maintain a focus on teaching and learning and establish trusting and constructive relationships.
Concern themselves with the activities that meet the goal of improved student achievement.
Produce outcomes that result in high levels of student learning and achievement.

The reality is that teacher leadership goes against the trend in a school setting that has a hierarchical leadership model. The concept goes against the cultural norms and the tradition of individualism of a school setting. This creates a set of challenges to the concept. To underscore one challenge, research review uses the metaphor of "crabbing" presented by Daniel Duke. The metaphor equates the teaching culture with the concept of crabbing where the crab fishermen do not need to place a lid on the crab bucket. This is the result of the other crabs pulling any crab that tries to escape back into the trap. This is the mentality that many perspective teachers face in their school. The culture of no one standing out and no one being poor is a large barrier to the goal. Other challenges include how the teacher leader approaches the task. They need to work in a collaborative style versus an authoritative. The method of teacher leader selection can create a hurdle. Who and how they are selected can create issues. An effective

teacher leader may not be the most senior staff member or the most popular and if they are selected without staff input they are the leader's pet.

The bottom line of the study is that we do not have a wealth of research on the topic of teacher leadership. They do conclude that because of the high expectations on schools, fostering teacher leadership seems prudent and that traditional forms of management must be more horizontal and less vertical for teacher leadership to be successful.

Teacher Leadership Development

Phase 1.

The instruction on teacher leadership was conducted with professors from the university. The format was a series of seven (7) teaching lessons over a period of two years. The objectives for the instruction included creating an understanding of leadership, of the key qualities of an effective leader, and of key skills of a leader. In addition, the instruction included teaching of several teaching strategies. The foundation for the leadership skills was based on a work by John Maxwell entitled, "Developing the Leader Within You." The content for the teaching strategies came from years of staff development presented over my administrative career.

The initial activities included a brainstorming think-pair-share on the qualities the professors believe were important for successful leadership. A list was generated and the result was a definition that leadership is the ability to influence people. All of the traits identified fit under that definition. The concept of influence and how a teacher can influence people in the system became critical to the remaining lectures.

Once the concept of leadership was established, the participants completed a leadership inventory. This gave the professors insight into the various leadership styles, the characteristics of each style, and an indication of their predominate style of leadership.

The next step in the learning experience was to conduct a series of lessons on key leadership points. For each leadership concept, the focus was how as teacher leaders they can impact their students and their system in a positive manner. The concepts discussed included: Levels of Leadership, Setting Priorities, Integrity and Character, Change, Problem Solving, and Decision Making

Phase 2:

The second phase of teacher leadership development focused on Professional Learning Communities. Using online communication a group of 8 professors from Hebei University and California University of PA met to discuss topics related to teaching and learning. The result was a PLC that worked as a team to enhance teaching. This step was a result of Phase 1 of the program that identified the use of online staff development to develop teacher leaders. The first session of the PLC used an article on teamwork as a basis for discussion. The session stressed the need for teamwork to be an effective learning community. This session was followed by an online discussion regarding the planning of lessons. At this point, a Wiki was introduced into the program. The Wiki enabled us to post sample lesson plans and to make comments. The third session focused on assessment. The discussion dealt with traditional assessments of English as a Second Language learners and how assessments could be varied effectively.

Research Results

The participants in the PLC were asked to share their insights into the benefits of the experience. This was accomplished via email with participants sharing their thoughts answering questions about the PLC experience. The questions asked simply were what did you learn from the PLC discussion and what questions do you have. After the first session

on teamwork, participants commented on the need for teamwork and referred to their cooperative learning experiences. Concerns expressed centered on the challenges of time, staff commitment and the resources needed to be successful. The topic for the second session was lesson planning. The team members expressed their desire to implement the techniques of lesson design, backward design and their components. The challenges included implementing some of the suggestions. They felt that a slow implementation was best for their situation. The next session dealt with student assessment. Responses expressed a desire to vary the assessments of students and supported the need to assess students frequently in both the written and oral format. Teachers expressed concern about the time required to assess frequently and a lack of confidence in their ability to implement the suggestions.

Conclusions

The results of the data indicate that a foundation is being set in the area of teacher leadership and that it is impacting the teaching of the participants. With the implementation of PLC, teachers seem to be more confident in their abilities. They are willing to try new techniques because of their commitment to student learning. This desire will translate into improved student achievement. The next step in the process is to increase the roles of teacher leadership and to expand the implementation of PLC in the university.

This will be accomplished by a follow up visit by an American professor to observe the implementation of the various techniques and a continuation of the PLC sessions.

The key question is "What should that look like in the Hebei setting? The objective will be to increase the professors understanding of how teacher leadership and PLC can influence student learning.

Suggested Reading and Web Sites

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Using Cognitive Maps to Support the Problem-Based Learning Evaluation

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ABASTRACT

This work aims at to search the learning performance of the Civil Engineering students using the Problem-based leaning (PBL) method as part of pedagogical innovations in Engineering Transportation course. A questionnaire for the assessment of learning was built to analyze the performance of the sample and the PBL effects resulted. The questionnaire built contributed to evaluate and compare the learning of the sample with a group of students submitted to the conventional class design. Cognitive maps were used as a strategy to investigate the instructional innovations, specially the PBL effects and the existence of distinct learning performance among students. The results indicated that PBL students were engaged in their own learning and performance. Furthermore, they reached stronger behavior development, attitude, and involvement. They demonstrated increased satisfaction and a significant learning performance with the new pedagogical innovations in the design course. Finally, some research suggestions are also proposed.

Keywords: Problem-based learning, Cognitive maps, Engineering education.

1. INTRODUCTION

Adjusting the teaching and learning engineering to the innovations and decisions established by profession of the future engineers has been a challenge to the engineering schools all over the world. Professors, researchers and experts from many higher education institutions, as the ones from the engineering education [1] - [5], who have found to adjust or restructure the curriculum to improve the engineering courses to promote better engineers professional practices.

In Brazil, some professors and researchers [6] - [8] have also found instructional alternatives to provide improvements to the teaching and learning process in engineering. One of the pedagogical innovations implemented in one course in Civil Engineering is related to the use of the Problem-Based Learning (PBL) in a distance education platform, based on students' learning preferences [7] and [9]. The use of this pedagogical alternative, associated to the course content, composes the starting point for the accomplishment of part of this study.

By understanding that the adoption of instructional alternatives can improve the teaching-learning process; the proposal of the current work is the investigation of the students' performance in this pedagogical experience, mainly referring to the use of the PBL, as a learning method, in Engineering. To evaluate the efficiency of the instructional proposal in the students' performance, especially the PBL method in the students' improvement, it was used an innovative structure which strongly contributed to the investigation. The challenge was to perform the learning evaluation based on problems using the technique of the Strategic Options Development and Analysis (SODA) in the construction of cognitive maps.

The use of mapping to evaluate the learning allowed a deeper investigation of the students' performance, as well as PBL method effects on problem-based learning evaluation. However, there are no studies which integrate cognitive maps on learning evaluation using PBL as method in engineering education.

2. PROBLEM-BASED LEARNING

PBL was constituted as a method in the beginning of the 1970s, with Barrows and Tamblyn's studies [10] – [12]. PBL was developed to supply the difficulties found in teaching in medicine course [13] and [14]. According to [15], the students concluded the course with many concepts, but few behaviors and strategies associated with the information applied to a diagnosis.

The "ideal" learning method include the acquisition of knowledge, high self-esteem, critical thinking, problem solving skills, and life-long learning, providing better professional practices and personal development. In this sense, PBL learning provides learners attributes, according to [16] increasing higher-order thinking skills, explore authentic and ill-structured problems, and the possibility to students take part in social interactions and receive coaching from peers and teachers.

As [17] note, in PBL the learning objectives and activities are based on the knowledge and skills needed to address problems encountered in the field. Thus, PBL emphasizes learning instead of instruction, in contrast to traditional methods. Since problems do not respect the disciplinary boundaries, PBL often involves collaboration and integration of a wide range of disciplines or subjects. This requires knowledge interaction from several issues and courses. This experience intensifies the ways to conduct, grasp or learn how to learn, before its complete application [18].

PBL is generally applied approach of learning in areas related to health and as a general model initially was developed for medicine teaching, but PBL has been refined and implemented in several schools [19]. PBL has been adopted in areas including administration, nursery [20], pedagogy [21], [22], engineering, architecture, law, social service [23] and, even in other levels of education, such as primary and high school [24], [25]. Moreover, in the twentieth century, it was extended to countries such as Australia, Holland, New Zealand and, today many universities and schools have their programs developed from PBL.

In Brazil there are few universities and courses which have adopted PBL, as reported by [15], besides the medicine course initiated at the Federal University of São Carlos in 2007, which uses PBL as a teaching-learning method. However, these initiatives are still scarce, showing the need of researches involving PBL in Brazilian education, though is possible to verify significant results where PBL has been implemented. Since, PBL is an adjustable method for a variety of educational environments [24].

Many researches have shown the efficiency in PBL learning performance improvements. According to [4] and [5] PBL is recommended in engineering, particularly because it provides a deep learning and develops problem solving skills. In addition, PBL supplies significant improvements to the development of general skills and positive attitudes [4].

However, experiences carried out using PBL point to the necessity of changing in habit of both students and teachers to deal with the active learning strategies and independent learning. According to [3], some students find it difficult to become active critical thinkers and, some professors may face difficulty when performing their role as tutors, managing group work or, even challenging students to develop critical thinking.

Conversely, [8] points to the advantages in PBL method adoption related to the students' grades. By using a quantitative approach was possible to prove the development of higher levels of performance using PBL. Theses outcomes can be observed in Table 1.

Table 1. Test average between PBL and "Traditional" students

Methods	Students	Mean	Standard Error	Standard Deviation	[Confidence Interval - 95%]	
PBL	29	6.568	0.1866	1.005	6.186	6.951
Traditional	26	5.2	0.3054	1.557	4.570	5.829
Set	55	5.921	0.1964	1.457	5.5279	6.315
Difference	—	1.3689	0.3498	—	0.6672	2.0707
diff = mean(0) - mean(1)					t = -3.9127	
Ho: diff = 0					degrees of freedom =	53
Ha: diff < 0		Ha: diff != 0			Ha: diff > 0	
Pr(T < t) = 0.0001		Pr(|T| > |t|) = 0.0003			Pr(T > t) = 0.9999	

The result, considered statistically significant, indicates that the students who learned through PBL obtained an addition of 1.368 on average when compared to the students who learned through traditional method. This lesser variability points to the fact that PBL reduces the heterogeneity in students' grades. Previous outcomes involving students' grades and their performance can be found in [8].

3. METHODOLOGY

This study involved 30 undergraduate students of a Civil Engineering course in São Carlos School of Engineering, at the University of São Paulo. The Planning and Analysis of Transportation System course is a subject offered to Civil Engineering course which the sample are representative of two classrooms. This subject is usually taught by two professors, each one responsible for one classroom. The students are separate in two groups: (group 1) - 12 students who experienced PBL as part of the new pedagogical proposed by one of the professors in the subject, experience described in details by [7] and [8]; (group 2) – 18 students who attended the subject with "traditional" teaching methods, by another professor.

To investigate if the adoption of PBL resulted in a better students' performance, a questionnaire for learning assessment (QLA) was applied to the students. QLA was made by the professor responsible for the new pedagogical proposal. QLA is comprised of two parts. Part 1 is divided into three topics (Questions 1a, b and c), concerning the planning and analysis of transportation system theory. Part 2 proposes two problems (Questions 2a and b), involving practical application of knowledge and techniques developed in the subject.

Part 1) What do you mean by:

a. *Planning of Transport Systems*;
b. **Analysis of Transport Systems**;
c. TRANSPORTATION SYSTEMS.

Part 2) You´ve just got applied, along with fifty candidates, to the last stage of a selection process to compete for a place of engineer in a large company that operates in the field of Logistics, located in Campinas, São Paulo. This step is decisive for the choice of professional to be hired and will be based on the assessment of the alternatives you submit to the following two problems:

a) There is a demand located in Milagres, Bahia, for a particular product, which is produced only in Campinas and is valid for 24 hours. Knowing that should be given regular doses of medicine in the next 15 days, with delivery of a box of 5kg per day, how would you transport this product and how could you think of the cost transportation to the buyer?

b) The company intends to apply for a bid that provides for the delivery of the entire supply of alcohol fuel needed to meet the city of Manaus in the next 5 years. Which alternatives and costs can you think the company must submit to compete for that contract, knowing that alcohol is available in Paulínia, São Paulo?

Chart 1. Questionnaire for learning assessment

QLA Part 1 was structured in a way that the students could show their understanding in relation to the three topics, and their responses allowed to collect the central concepts dealt with in the discipline. In Part 2, the problems a and b were proposed allowing students explore the techniques and the intrinsic knowledge to the subject.

Students' responses allowed the construction of cognitive maps using the Strategic and Options Development Analysis (SODA) to group several maps, making possible a better organization and view of the data in them. The technique employed and the constructions of those maps are founded in [26] and [27] about cognitive maps.

Among several possibilities of use, the cognitive mapping can be seen as an attempt to isolate and represent the individuals` constructs and their hierarchical use. This way, a map can be seen as a network of ideas, which can be captured directly from someone who expresses them, and they are connected so that reflecting the way as, in this individual's perspective, they relate to one another.

In this study the maps represent briefly the students' understandings and perceptions about the topics of the subject. The aim was to investigate the use of PBL in the students' performance, by comparing the responses supplied by the participants, as well as the non-participants of the experience.

The concepts presented in the maps express the understanding, explanations, strategies and data used by the students, whereas the link between the concepts are represented by arrows, which indicates how a concept leads to, or has implications upon the other one. Knowing that the concepts generally reflect the understanding of the student about the questions, the maps are designed in a way that they flow from the center to the border.

In order to organize the responses on the maps, mainly in Part 1 of the QLA, was adopted a system thus, in Part 1 Question 1a is in italics (*Planning*); Question 1b is in bold (**Analysis**); Question 1c is in upper cases (TRANSPORT SYSTEM). Furthermore, there are cases in which the concepts involve Questions 1a, 1b and 1c, being represented simultaneously by the three resources aforementioned. To Part 2, the responses to Question 2a are located in the upper part of the figure, whereas the ones related to Question 2b are in its lower part. The results of the cognitive maps are analyzed and discussed in the sequence.

4. RESULTS: COGNITIVE MAPS AND THE STUDENTS' PERFORMANCE

The results of the use of mapping as a way to investigate the students' performance in adoption of PBL and its effects as part of a pedagogical innovation provided evidence that alternative instructions can favor the teaching and learning process, especially in engineering.

Regarding fist mapping, Figure 1 shows the students' understanding about topics 1a, 1b and 1c of the QLA Part 1. The map represents briefly the responses of group 1 at the top of the Figure 1 and group 2 at the bottom. The detailed maps can be seen in [8].

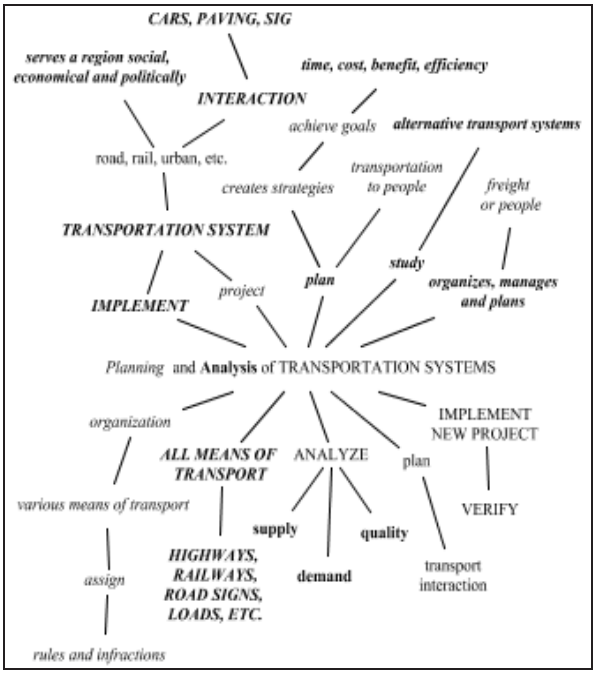

Figure 1. Cognitive map of group 1 and group 2

In general, through the responses on the maps is noted that group 1 grasp the most general subject concepts, pointing out their meanings, functions, purposes and examples of use referring to planning, analysis and transportation systems. It can also be noted that the range and depth level in the way the questions were answered, pointed by [28] as fundamental in

problem solving. This suggests that PBL fostered a positive effect considering the way found by students to solve the problems.

Although, there were no strong differences between responses compared to group 2. It is possible to note that through the conventional teaching method group 2 showed the development of memory techniques related to this method, allowing this group answered the questions, even without the concepts make sense to them.

Moreover, solving questions Part 1 and 2 indicates the development of techniques related to PBL understood during the experience that involved the use of the method by group 1. Such ways demonstrate that group 1 became progressively responsible for their own learning, facing the fact that they took the responsibility over the selection of the information in the field to be explored, and deciding on the level and amount of information to be used. Furthermore, this result shows greater skill and, especially, maturity in dealing with the problems, indicating greater commitment with their own learning.

Another result is related to the impact the PBL could cause on group 1, owing to the time they were exposed to the conventional teaching environment, thus affecting negatively their performance until they could develop new study habits, as pointed by [29] and [1]. Nonetheless, this impact was not verified in this research, on the contrary, the students involved with the instructional alternatives showed that, even with the use of the PBL method, they obtained good performance, and, in general, they also showed more interest to learn.

On the other hand, when referring to the practical application of the proposed problems, questions 2a and 2b, it is possible to notice significant differences between students who participated in the new pedagogical proposal and the ones who did not, as presented in Figures 2 by group 1 and Figure 3 by group 2.

Figure 2 shows a greater number of details with the use of procedures, suggestions, ideas and estimation, which generally suggests significant performance of group 1; keeping in mind the range and depth level of the responses. We also can observe that, at least, for the questions involving practical application, group 1 showed effective apprehension of the concepts worked at the subject, as it was perceived through the options and possibilities indicated. In addition, such as viable means of transport, offer and demand costs of the products that make part of the problems pointed, better routes, via land, air or water, problems for better ways of transportation, deficiencies, possible places to arrival and departure, expenses, etc.

Students also using the internet, searching previously information, such as transportation costs and services offered, distance between places, route indication based on road maps. Besides, the students took the initiative to get in touch by e-mailing to companies specializing in freight, to make possible the practical use of previously learned concepts and techniques. The ways that students adopted to solve the problems clearly reflect PBL method characteristics. This statement indicates the development of certain skills related to the method, because it is possible to realize expressive autonomy at the problem-solving process.

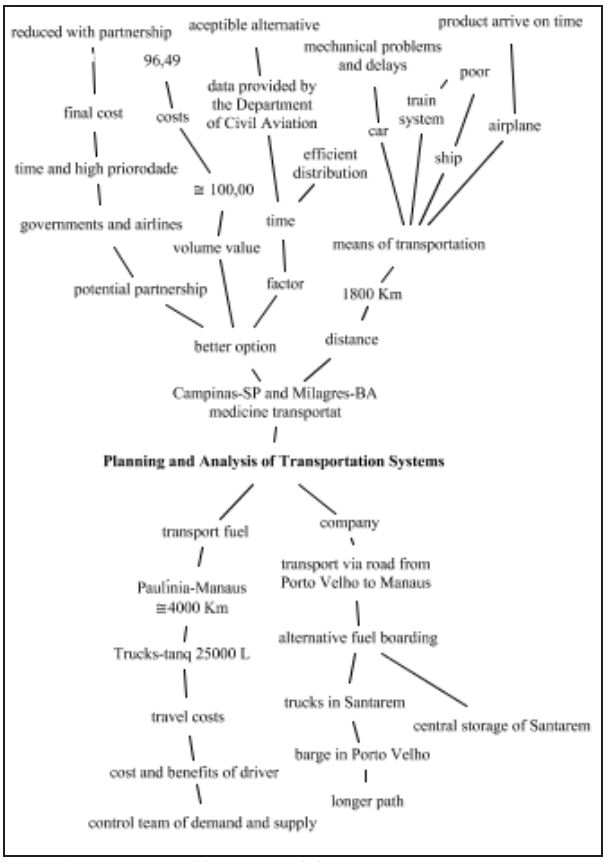

Figure 2. Cognitive map of the responses Part 2 - PBL

Students identified key issues, focused their efforts, and indicated the resources. As they applied their knowledge, they discovered and explained them for their classmates, thus developing new cognitive and social skills, responsibilities and comprehension, that is, they have leaned by doing, according to [30], about the students' learning and the PBL method characteristics.

The comparison between the maps constructed by group 1 responses showed in Figure 2 with the ones by group 2 showed in Figure 3, reveals that, although both groups find to attempt solving the problems, the responses of group 1 indicated the use of the knowledge and techniques worked within the experience, mainly the use of PBL method.

Certain differences can be noted, not only by the way the questions were answered, that is, the techniques used, but also by the solutions found, which were demonstrated as viable ones for the proposed problems, either generally or relating specifically to part 2 of the QLA.

As we have seen, although the students were exposed to the experience for a short period of time, only one semester, the new instructional design promoted greater levels of performance and the development of desirable behaviors and attitudes for the future professionals, showing the viability to implement PBL as a method in engineering education, in general.

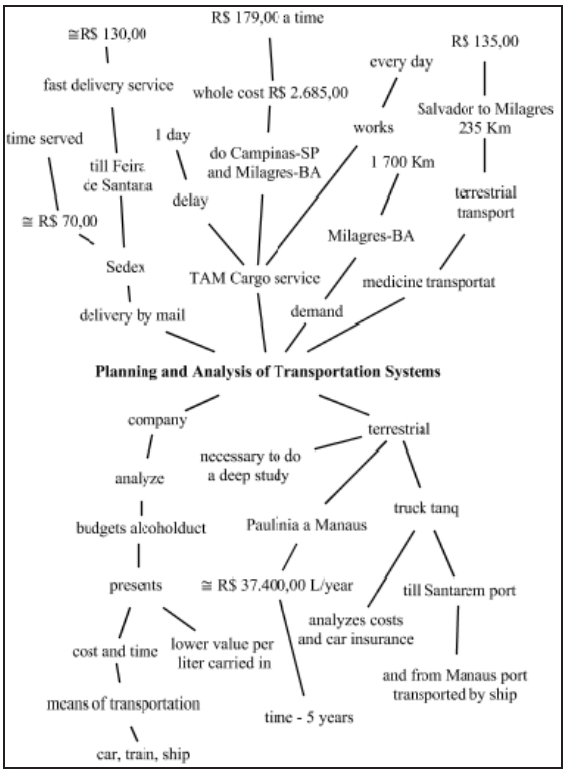

Figure 3. Cognitive map of the responses Part 2 – "Traditional"

5. CONCLUSIONS AND FINAL CONSIDERATIONS

This study aimed at investigating the effects of the PBL method among students who participated of the pedagogical experience, comparing their development to students who did not take part on the innovative experiences. In face of the results of QLA applied to both groups, the results showed significant effects at the students' learning, who taught through PBL.

The positive effects of the PBL method were related to the development of problem-solving techniques and point to students` commitment and responsibility considered to the learning, in order to suggest the development of a more fully understand. In this way, this finds shows a significant difference between PBL and traditional method. Even though the second method allows the accomplishment to the task of solving problem that, in general, it was only this, without the commitment with the learning, disfavoring the development of critical and creative thinking and interest with the own learning.

According to [18], as the PBL convergence point influences the students, they become constructors of their own knowledge. As a result, the fact that the PBL students showed commitment with their own learning demonstrates the development of differentiated behaviors and attitudes, favorable to the PBL students. PBL has shown as a viable method for education in engineering.

Furthermore, the implementation did not cause a negative impact in students' performance, as they were receptive and involved with teaching-learning differentiated methods and pedagogical innovations in the instructional environment, such as the ones demonstrated here and previously proved in studies as in [6] - [9].

Finally, this study suggests that the adoption of other methods and pedagogical alternatives to the education in engineering can provide teaching-learning processes more suitable to the professional profile that today's society needs, since conducted and evaluated with proper techniques and instruments.

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Digital Geography: ICT in Norwegian High-School Geography Curricula following the 2006 'Knowledge Promotion' (KO6) Educational Reform

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ABSTRACT

Subject specific Information and Communication Technology (ICT) skills were a main emphasis in the 2006 Norwegian educational reform "Kunnskapsløftet" (K06). By taking into account the main purposes of geography education; geographic alphabetization, bridging nature and culture and practicing spatial intelligence, remote sensing and Geographic Information Systems (GIS) stand out as technologies to implement and the impact of ICT on society and how we relate to space and distance as topic to be taught. The curriculum is written in terms that are provide little guidance in what must be included, neither does it use terms that emphasizes what can be achieved through ICT. This leaves much up to the individual teachers and their individual understanding of ICT and skills. This also leaves a significant part of the interpretation of the curriculum to the producers of learning materials.

Keywords: Geography Education, GIS, ICT, Curriculum, Digital Literacy

1. INTRODUCTION

In 2006, the educational reform "The Knowledge Promotion" (K06) introduced new curricula for all subjects in the Norwegian K-12 education. With an emphasis on ICT permeating the whole curricula, the reform was written against the backdrop of a debate as to whether digital literacy can really be defined as a fixed list of skills that a person must acquire or if it is something more [1]. A political desire for easy-to-measure, specified criteria stands against the developing practices and also against the durability and relevance of the curricula. Our understanding of ICT and the standards, opportunities, areas and the ways it is used are developing, changing and discarded at a merciless pace. And it is likely that the tension will increase as the technological advances in different fields are gaining more importance outside the school system. It is therefore important to ask what ICT use or digital literacy means in secondary geography, which is the level in the Norwegian school system where geography is first taught as a separate subject.

Taking a step back to look at the subject in question, this paper begins by asking: What is the general justification for teaching geography? By looking at geography as a subject, this section discusses the primary goals of school geography and what are the tools and perspectives geographers bring to education. In the second part, these perspectives are given a digital dimension while asking: What is special about ICT in geography and how can it be used with respect to the purpose of school geography? With this general position in mind, the last part of the paper looks at the K06 high-school geography curricula and discusses what they say about digitality and whether it is directed towards achieving the purpose of geography education.

2. JUSTIFICATION FOR SCHOOL GEOGRAPHY

In order to look at how we want to use ICT, it is pertinent to look briefly at the justifications for geography as a school subject and what stands out as the key technologies, practices and skills from academic geographers' and geography teachers' point of view. What benefit will the students gain from geography education that they will not easily get from any other subject? The Norwegian geographic literature mentions two main functions or perspectives; alphabetization and bridging nature and culture [2; 3; 4]. A third important aspect internationally is training spatial intelligence.

a) Geographic alphabetization

A very basic part of geography education is to teach the students names of places and main geographic features, what has been called "capes and bays" geography. In common language, in quizzes and in games, this emphasis on committing to memory detailed lists of rivers, mountains, capitals and islands is often understood as being what geography is all about, and this learning can often be quite tedious. However, being somewhat geographically literate is necessary, at least on a local level, to live a functional life.

It is perhaps a cliché that geographers see geography anywhere and in anything, or in the words of Golledge [5]: *"There is little point in attempting to list all the areas in which geographic knowledge is pertinent. It is used universally, in all cultures, in all regions, but it is important to understand why it is used universally."* Mikkelsen [4] mentions four main aspects of geographical alphabetization. The first is that it serves as a frame of reference, the second that it is an important tool for sorting, third it is an important element in communication and fourth, it is a tool for understanding. As a frame of reference, it helps us making sense of information, whether it is a place named in a novel, a video from a holiday or the TV-news. As a common frame of reference it serves to make sense of such basic human interaction as conversing about one's nationality, where one lives or give and receive directions. This process involves a lot of sorting, Golledge [5] writes: *"The human brain does not deal well with extreme diversity (chaos), but can handle variability. We do this in a spatial sense by searching for locational regularities that can be cognitively categorized and spatially associated so that information can be ordered and communicated."* While some of this process is intuitive, some phenomena are also grouped in arbitrary categories for practical reasons. This may be related to status (e.g. capitals), to levels (e.

g. country, state, county, and municipality) to size (e.g. city, town, and village), factors related to climate, location, shape, distance or a multitude of other criteria.

To have some level of geographic framework is a precondition to be able to understand almost every other subject. In secondary school, this process of alphabetization must be expected to include more complex elements than in primary school and as such serve as a base for further studies. Understanding differences and interdependence between places is also important for the students' ability to form an opinion and participate in democratic processes, whether it is about topics like poverty, conflicts, resource management or climate [4].

b) Bridging nature and culture

The second function or perspective on geography education is arguable; that geography is the only subject that provides a bridge between nature and culture. However, while this is one of the core debates in geography, and consequently not every geographer would agree, within the Norwegian school system and among geography teachers themselves, this seems to be a completely uncontroversial claim, and one that that has been made repeatedly. For example, this argument was brought forward in Norway in 1994, when the common core subject in geography suffered a reduction from three to two lesson hours per week. In the effort to protest this decision, several letters from geography teachers were published, emphasizing geographical alphabetization and the unique nature-society perspective of geography when it comes to the big challenges and issues of our time. This position was then confirmed again in 1999 by a large group of Norwegian geography teachers on a field-course in Tunisia. They declared that geography was *"the only subject that gives the students opportunity to shed light on, explain and understand human life and activity in light of both natural and societal conditions"* [4]. Internationally, in its list of major world issues, the *International Charter on Geographical Education* [6] lists a number of topics that have a geographical dimension, of these, few can be understood without combining a natural and a human dimension. [1] So while this debate may be of interest to the academic discourse in geography (where the teachers' position is not without support [2; 3]), this is a strongly held opinion among geography teachers, and it is a perspective they are likely to continue communicating to their students.

c) Spatial intelligence

A neglected perspective in the Norwegian debate over the purpose of school geography is training in spatial reasoning. Trying to state what is unique about the way geographers think and reason, Golledge draws upon the work of psychologists R. Beck and D.H. Uttal, who in 1967 and 2000, respectively, found that no other single academic discipline matched: *"the way geographers reasoned about space, and particularly their penchant for presenting complex spatial meanings in a clearly understandable form (spatially based maps, graphics, and images)."* [5] In the educational debate, this ability to interpret spatial meaning was brought into focus in 1984, when *spatial intelligence* was singled out as one of six particular sets of cognitive skills when Howard Gardner introduced his Theory of Multiple Intelligences [7]. Although the value and practical consequences of this theory has been debated for more than two decades and it has been amended and more intelligences added, the need for particular focus on spatial thinking in the school system has been widely recognized, and the most significant contribution has been published in the United States.

Through the work of an interdisciplinary committee, where geographers were represented, a Committee on Support for Thinking Spatially was formed to provide a framework for incorporating spatial thinking into the K-12 curricula. In their report they describe spatial thinking as: *"an amalgam of three elements: concepts of space, tools of representation, and process of reasoning."* [8] Elaborating on this, Bednarz & Bednarz [9] write: *"Spatial thinking is defined as the knowledge, skills and habits of mind to use concepts of space (such as distance, orientation, distribution, and association), tools of representation (such as maps, graphs, and diagrams), and process of reasoning (such as cognitive strategies to facilitate problem solving and decision-making) to structure problems, find answers and express solutions to these problems."* And again, Golledge [5], in his article *The Nature of Geographical Knowledge*, reviews several decades of publications in geography, compiling a list of eighteen types of thought processes and ways reasoning that he sees as being special to geography. So it is noteworthy that while *Learning to Think Spatially* [8] was written by a multi-disciplinary group, the skills, processes and tasks it describes are a close match to Golledge's list, underlining that training in spatial thinking is an important function of school geography, which should not be overlooked.

3. ICT AND GEOGRAPHY EDUCATION

So what is special about ICT in geography and how can it be used in respect to the purpose of school geography? I will propose that there are two approaches to ICT that need to be considered. The first is to frame geographical alphabetization in the way that it helps making sense of world that is increasingly digital. The other is to apply two available technologies, remote sensing and Geographical Information Systems (GIS), as a way to give an overview and particularly as tools to practice spatial thinking.

a) The geography of digital world

Digitality affects the way we organize our society and distort traditional patterns. What happens in "cyberspace" has "real world" impact. [10] For example will digitality bring in a new element to the decision about where to locate a business. It will affect where people live and the places they work. Digitality has special demands of infrastructure. It affects the relationships of distance between places and how quickly information spreads and in what form. It creates a divide between those who have access to the technology and those who have not, and this digital divide may not follow any previously established differences. Defining digital literacy broadly, ICT also redefines our social relationships and how cultures are created, mediated and spread through space. In secondary school, the effect of ICT should be taught as a part of the content within relevant competence aims, so that the cognitive patterns, categories and concepts can take these effects into account. In terms of content,

[1] For instance: disease, migration, extinction of plants and animals, deforestation, soil erosion, desertification, natural disasters, toxic and nuclear waste, climatic change, atmospheric pollution, water pollution, limits of resources, limits to growth and land use.

digitality is also creating new spaces for geography. The concepts of virtual worlds as spaces in cyberspace are only beginning to emerge, and it is not known where this development will take us. The coming years might provide us with new insights, opportunities and ways of understanding a digital geography.

b) Remote sensing

Remote sensing is not by any means a new technology in geography, but has been playing an important role in cartography and studies of different spatial phenomena for decades. Over the last 20 years, it has become the most prominent tool to make weather forecasts, in the surveillance of wildfires, for mapping deforestation, alterations in vegetation cover and the coverage of the polar ice-caps, as well as military surveillance and civil cartography. [11; 12] When satellite imagery was first introduced it sparked debate internationally. During the cold war with its spy-satellites, attempts to legislate who could photograph what, where and to whom the images could be distributed and so on were discussed with passion [12]. While absent for decades, this debate is coming back now, as better technology improves the quality of the remote imagery, at the same time as it is more freely distributed and combined with close-up imagery to a level where it invades the personal security and privacy of individuals. One example is the recent controversy around Google Earth's *street view* where children, private vehicles and pets are identifiable to any user world wide. These are issues that the students should know about.

The use of remotely sensed images in school geography is a long established practice, and its inclusion in the curricula has not sparked the same debate as GIS does. The widespread use of aerial photographs, and printed satellite images in schools makes the transition to digital imagery much easier. From a learning material point of view, the advantages of the access to large amounts of imagery on the internet are the availability of both international and local images and historical or actual images. Also, the format makes it possible to show on large screen or print multiple copies should make the digital development very welcome. But to simply use internet as a digital library of satellite imagery that can be printed or used as illustrations is to ignore key components of the digital opportunity. The opportunity to perform spatial analysis in the classroom, to adjust colors, enlarge sections, compare images and extract portions is fully achievable by the use of simple, free software. Remotely sensed images also provide a very intuitive way to understand several components of GIS, which is the other geography-specific digital technology.

c) GIS

While GIS has been around for nearly half a century, it remained a tool for experts until about fifteen years ago. Often placed within a positivistic tradition and predominantly quantitative approach, many geographers have been reluctant to welcome GIS as an approach or field within geography. Strong objections have also been raised about the ethical and social implications of a widespread use of GIS [13]. Following the arguments of Kemp et al. [14] for making geography the home discipline of GIS, Daniel Z. Sui [15] is the one who has most thoroughly presented a pedagogic framework that ties GIS to the core of geography. He makes a taxonomical distinction between teaching *about* GIS and teaching *with* GIS, understanding teaching *about* GIS as technical training in data handling and production of information, while teaching *with* GIS is the practical application of GIS knowledge in problem solving, and in its highest taxonomical level, reaching the formation of spatial intelligence. This perspective of learning with GIS rather than about GIS, is also advocated by Christine Drennon [16] through her use of GIS in Problem-Based Learning (PBL). She reasons that most new users – and this goes for the secondary school students as well - are non-geographers, and as GIS is rapidly becoming a 'megatrend', learning practicing spatial reasoning through problem solving will ultimately be more useful than technical training. This makes it clear that if approached in the right way, GIS can be used directly as a means to train spatial thinking, one of the main purposes of school geography.

So when considering whether to use GIS we have to ask as Martin [17] does; *"whether the use of ICT can provide opportunities for geographical study that are not available without its use…"* In his own answer, Martin looks at what geographers actually do, and using the example of remote sensing, he says [17]: *" …if the processing and analysis of satellite imagery is accepted as being 'good geography', then it follows that students who are not able to do it will be missing out on something. Quite simply, they cannot achieve this aspect of good geography if they are not given the opportunity to achieve it. The same argument can be made for the use of GIS and, to some extent, for other aspects of geography in which ICT can play a major and sometimes irreplaceable part."* Consequently, by looking at the number of courses offered in geography department everywhere and the amount of research going on. GIS seems to have established itself as an important aspect of digital geography. Also, when it comes to geographical alphabetization, some insight into GIS helps forming a framework of understanding that enables people to participate in shaping their own lives as collaborative GI-services become more common, as Longley et al. [13] states: *"Greater democracy and accountability, coupled with the increases spatial reasoning abilities that better education brings, mean that more people than ever feel motivated and able to contribute to all kinds of spatial policy."*

4. THE KNOWLEDGE PROMOTION (K06) CURRICULA

Three general trends characterize all curricula under the latest Norwegian educational reform, The Knowledge Promotion (K06). First, in accordance with the national program for digital literacy, one of the main trends in the new curricula is an emphasis on the use of ICT. Secondly, there are five basic skills listed in all individual subject curricula, and as a consequence of the first trend, digital literacy is one of those. [18] This means that all subjects have listed specific competences/skills that can be considered a minimum. By allowing some variation in what is regarded as basic skills, this is partly a shift from the 'general digital literacy' toward multiple subject-specific digital literacies, especially since these basic skills are not supposed to be trained separately, but are to be integrated into educational activities and teaching of the different competence aims. [19; 20] A third trend, particularly in the high-school curricula, is an emphasis on learning the research methods related to each subject. In the cases where this involves digital tools, it raises the bar much higher, being more demanding of both teachers and students as the basic user skills needed to access and work with digital information are expected to be in place. From a broader understanding of what it means to be digitally literate,

one can also assume that this means that the particular culture of the field must be communicated.

So with these perspectives in mind; what does the three new geography subject curricula[2] say about digitality? The structure of all the K06 curricula are the same, it starts with giving a general introduction to the objectives of the subject, then it outlines the main subject areas and describes the basic skills before it presents the detailed competence aims and ends with an overview of subject assessment. The details about digital competence are mainly found in the main subject areas, basic skills and competence aims, which will be examined first, while the introduction and assessment will be commented in light of these.

a) Basic skills

Table 1 gives an overview of ICT as a basic skill in the different geography curricula. While it is right to have some focus on critical use of sources and whether or not the information is correct and reliable in a formal education system, it would not be fair to say that this are skills that concerns only the understanding of geography. The students will have worked on exactly these skills during primary education; therefore the plan could aim higher.

Geography (common core subject)	Being able to use digital tools in geography means exploring websites, collecting relevant information and network-based communication on geographical topics, exercising critical use of sources and netiquette and learning about personal privacy protection and copyrights. It can also involve using geographical information systems and using digital tools to present one's own work.
Human geography (elective)	Being able to use digital tools in politics, individuals and society means exploring websites, critically evaluating, selecting and using sources and collecting information for social sciences from the internet. It also involves the use of different software to manage information and present it in tables, graphically and in maps.
Geoscience (elective)	Being able to use digital tools in geoscience means collecting, registering and handling information and presenting results digitally. Further it means using animations, simulations, digital maps and digital navigation systems.

Table 1: Definition of digital tools as basic skills in the geography curricula [21; 22; 23].

[2]From year 11, the students who chose a study program leading to a general studies admission diploma are required 1 year of the common core subject in geography. Some programs will also have a human geography elective and/or a geoscience elective. The teachers graduating with a practical-pedagogical licensing in geography are formally qualified to teach all of these.

The fact that GIS and presentation tools are presented as optional in the core curriculum (but not in human geography) makes it a lot less likely that all students will get this option. It is uplifting to see that geoscience defines the use of animations and simulations as basic, taking advantage of the opportunities that are unique to ICT. In a multi-dimensional subject like geography, one could wish for more visual elements being introduced as basic knowledge.

b) Main subject areas

Table 2 gives an overview of the main subject areas where methodology and research methods are described. Fortunately, more visual elements are included in both common core geography and in geoscience (these are not explicitly mentioned in human geography). Though it is 'possible' to include both pictures, map and statistical material without digital tools, the competence aims that will be studied below are more explicit. A feature that is new to the Norwegian school system is that all the three geography curricula mention the use of GIS. This was not achieved without resistance and received some international attention [24]. Being a digital technology, it is possible to approach GIS both as a subject specific ICT tools and as important research methodology. The Geoscience curriculum mentions several other digital technologies and as methods they are supposed to be put into practice.

Geography (common core subject)	The main subject area *geographical sources and tools* involves the use of maps, pictures, statistics and geographical information systems.
Human geography (elective)	The main subject area *tools and methods of human geography* focus on geographical approaches and levels. It is also about geographical information systems, map analysis and statistical materials.
Geoscience (elective)	The main subject area *the geoscientific toolbox,* means practical work with different geo-scientific tools. It is about maps and mapping, digital maps and Global Positioning System (GPS) Further the main subject area comprehends Geographical Information Systems (GIS) and other background information like statistics, satellite images, radar plots, weather maps and weather prognoses.

Table 2: Main subject areas related to research methods and tools in the geography curricula[21; 22; 23].

c) Competence aims

The skills that are outlined above are not specific competence aims, but are supposed to be applied while the aims are taught. Table 3 shows the competence aims that belong to the main subject areas in tools and methods, these are the two first bullet points in each curriculum, and the next two competence aims are those that have particular relevance to the practice of digital literacy. While digital tools are explicitly mentioned, the vocabulary chosen does not reflect the particular advantages of this type of technology. The digital maps are to be 'used' and information 'extracted' and 'analyzed'. The result should also be 'presented'. This vocabulary is practically stripped of words that reflect any multi-medial or multi-modal opportunities. In a

worst-case scenario, to 'use' information may mean to copy-paste it from a reliable source found in a digitalized book in a digital library. A more opportunity oriented vocabulary would use terms like visualize, multi-modal, animate, simulate, model, interactive and so on.

The only place such vocabulary has so far been used at all is the phrase *"use animations, simulations…*" as a basic skill in geoscience. As field specific digital tools, the strengths are not reflected in this part of the curricula. The other aims mentioned in the table are examples of competence aims that lend themselves easily to ICT-assisted learning. They are mentioned here because they all involve a practical aspect, which would let the students get involved. These are tasks that would be solved with digital tools outside the school system, and the students should therefore be allowed to use their everyday digital literacy in their learning process.

Geography (common core subject)	- Use digital maps and geographical information systems (GIS). - Find and present geographical information by reading and assessing text, pictures and statistical presentations from digital and other sources. - Read and use maps in various scales and undertake simple map analysis - Make observations and registrations of geographical features while on excursions or when doing fieldwork and use these to consider nature and society in relation to each other connection between nature and society.
Human geography (elective)	- Read, interpret and use the most important types of analogue and digital maps and do human geographic map analysis. - Find and explain geographic information systems (GIS), and use GIS in the work with topics from human geography. - Find, begin to use and analyze human geographic statistics and diagrams. - Formulate problems about societal development and analyze them by use of qualitative data and methods.
Geoscience (elective)	- Extract and analyze information from different types of geo-scientific maps, aerial photographs, radar plots and satellite images. - Acquire, process and present geo-scientific information by use of digital tools. - Plan and execute exploration of geo-scientific conditions on a continent… …with and without digital tools. - Make, present and evaluate a local weather prognosis, daily for a period of one week, by using weather maps, satellite images and radar plots.

Table 3. Competence aims where the 'digital tools' aspect is explicitly mentioned [21; 22; 23].

d) Objectives

The objectives outlined at the beginning of each curriculum are meant to place the subject into context. In general terms it outlines the values each subject is supposed to communicate, as well as giving guidelines to the cognitive development it can contribute to. Interestingly, none of the curricula mention spatial thinking explicitly. In relation to digital literacy, two lines stand out in the common core curriculum, it says: *"The geography subject shall contribute to understanding and mastering the great amount of information in our time. More knowledge motivates and stimulates the ability to analyze critically and understand comprehensively*" [21]. This is closely connected to the basic skills in digital tools. The purpose of this understanding is to prepare the students for participation in society. This is also clearly stated in human geography curriculum[22]. The geo-science curriculum stands out in this aspect. While it emphasizes knowledge, it places great weight on insights gained though practical, participatory activity[23].

e) Assessment

The new curricula say very little about assessment, and mainly outline the form of exam that each subject will have. That the assessment criteria do not say anything about ICT is important for two reasons. First, there are some subjects where a part of the exam is required to be taken by the use of ICT. This has not been chosen as the form of exam any of the geography subjects. Second, the lack of description or guidelines of the student products that are to be assessed means that there is no pressure to include multimodal, interactive or other untraditional types of media, and to leave mainstream information-reproduction assessment. Again, since geography is a multi-dimensional subject, with technologies that allow expression of spatial content-knowledge, these kinds of products would bring a new dimension to assessment.

5. CONCLUSION:

Digital literacy has developed into a key component of education, and as the importance of Information and Communication Technologies (ICT) increases, it is becoming even more important. By starting out with the general justification for geography education; geographical alphabetization, linking nature and society and training in spatial thinking, there are two central approaches to digital geography that stand out. The first is learning about how digitality influences spatial decisions and how digitality itself is a spatial phenomenon. The second approach is using the geography-specific technologies remote sensing and GIS, to help developing spatial thinking and help the students make use of the many GIS-based applications they meet in everyday life.

Looking at the curricula in use, they say nothing explicitly about digitality as a phenomenon that shapes society. This does not mean that it cannot be taught as a perspective on other competence aims, but this would again depend on the individual teacher to interpret it this way or the learning material to present it this way. The basic skills about netiquette, personal security, privacy protection and copyrights do to some extent fit under this heading, but as pointed out earlier, this is not a particular issue for geography and the topic might have been taught many times over a long time before the students reach secondary education.

For the reasons mentioned earlier, remote sensing is perhaps the technology that is best represented in classroom, though except for geoscience, which covers it extensively, the other curricula do not mentioning it explicitly. The challenge is to make the transfer from illustrative to interactive pictures. However, a case could also be made that for every practical purpose, remote sensing in school geography is a part of teaching with GIS. Compared to the rest of the curricula, the introduction of GIS into all three subjects is quite remarkable. While Norway is lagging behind our Nordic neighbors in the use of GIS in schools and in teacher education, the inclusion in the national curricula is a promising first step.

Unfortunately, the curricula suffer from a lack of vocabulary that reflects the interactive and innovative abilities in the use of ICT. By sticking to non-specific terms and shying away from definitions, the curricula can survive for many years, but at the same time it is too vague to provide any direction for what digital geography could be. This makes the interpretation and implementation of the curricula dependent on the individual practitioners' ICT skills, geographical understanding and their methodological knowledge. And if the teachers themselves do not have clear understanding of their own digital literacy and the opportunities of digitality (or the interest, motivation and opportunity to develop this), the power of interpretation and to some extent implementation will be left up to the producers of learning materials alone.

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WORKING STUDENTS
A South-Tyrolean experimental project aimed at the exploitation of the osmosis between industrial and academic education (which became a best practice on a national scale).

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ABSTRACT

The relationship and the synergies between university education and on-the-job learning are the motivation of this experimental project. On the background of a region dominated by sme, the project team tried to find an appropriate education model in order to maximize the osmosis between industrial and academic education. The elaborated model has the target to guide talented students to their degree in BSc in Engineering by combining the normal academic education with a programmed work experience and learning by project program. An ad-hoc apprenticeship contract guarantees a regular compensation for the students also in the university periods, while specific university and industrial tutors assure the regular synchronization between academic and professional steps. The results confirm the "working students program" as a suitable way to speed up students' careers, consolidate the relationship between university and industry and assure a better alignment of academic visions and industrial needs.

Keywords: working students, education and training, apprenticeship, company and university, trainee engineer, on-the-job learning.

1. INTRODUCTION

In Italy, the collaboration between the industrial and the academic world and especially between the regional universities and the local smes (small and medium enterprises) is quite difficult. The smes complain about the huge distance between the universities and the real local necessities, referring especially to very young universities with technical and scientific faculties located in regions dominated by medium, small and micro companies. [1]
The right alignment between the didactic contents and the corresponding competence profile of the graduands and the necessities of the labor market is crucial regarding regional contest characterized by specific professionalism and linguistic competences (like the region of South Tyrol) [2] [3].
Until 1997, the collaboration between universities and local companies in Italy was limited to the students' research of internship places aimed to the preparation of the degree thesis.
The Italian act nr.196 of 24th June 1997 regulates the promotion of the employment referring to the art.16 (regulation of the apprenticeship) and art.18 (regulation of educational and informative internships). This was the first governmental trial to promote the synergies deriving from the combination of instruction, education and employment. The art.17 is specifically dedicated to the reorganization of the "professional education" seen as an efficient instrument to improve the quality of the job offers, to increase the competitiveness of the production systems and to increase the occupational level by providing new ways of certification and recognition educational credit points.
The institutionalization of the internship was the first step in creating a regular connection between the university and companies. The restricted duration and the organization of the periods of presence in the company and the academic regulations didn't allow a bidirectional benefit exchange between university and companies.
The successive act nr.276 of 10th September 2003 introduced a new regulation of the apprenticeship taking into consideration the needs of the employment and labour market (act 30/2003):

- the distinction between three typologies of apprenticeships considering the different objectives, persons and durations
- the possibility of a company to contribute internally to the education of the people/students

This Recent legal reforms of the labour and education market have changed significantly the applicability of the apprenticeship (of second and third level): the apprenticeship can now be applied also for university students and the task of regulating and deciding about the duration of apprenticeship for the degree is assigned to the regions, in agreement with the regionnal employers' associations, trade unions and universities [4].
This topic gains in importance within a region with an economic and cultural background like South Tyrol, characterized by (the application field background):

- Full employment (rate of unemployment of 2,4% [5]), dominated by the public sector (28%) and followed by services (19%), industry (16%), commerce (14%), hotel and restaurant industry, artisanry and agriculture [6].
- High pulverized entrepreneurial landscape (over 90% of the micro companies have less than 10 employees) [1]
- High importance of quality, innovation and specialization of products and services as critical success factors for the local companies, because of the historic industrial development and the particular territorial and logistical characteristics (no scale economies). Thus, the human capital represents a critical success factor for the local firms.
- Regarding the whole population: a higher local literacy rate, conflicting with lower high school and academic education

rates compared to the national average (high school and academic: 20% local vs. 34% national [7]). These data demonstrate a correlation between the peculiarity of the local industry (full employment and very small companies - 57.000 micro companies where more than 50% have less than 2 employees) and the scarce familiarity of the South Tyrolean youth with the academic world.

- Regarding the companies' employees: over 50% of the employees have completed only the elementary or middle school, whereas the rest (about 45%) has a high school or university degree (less than 10%) [1].

How to create a much stronger connection between university and companies in these circumstances? How to ensure a better alignment between the didactic material and the necessities of the industrial world? How to render more interesting an academic study program for young people already working in a company (low unemployment and low diplomats)? Is it possible to really combinate the academic and industrial education?

2. IDEAS AND SOLUTIONS

Project Formula and innovations

The basic idea of the project is to structure the work experience and make it functional for the learning process through an innovative education model which foresees (the core characteristics):

- a Bachelor (BSc) study program in Logistics and Production Engineering elongated by 1 year (4 years instead of 3) in order to balance better the work-load of the students.
- a study plan (FIG 1) that follows the principle: "theoretic contents at the university, applicable contents in the company" and so round 40% of the time at the university, and 60% (FIG 2) of the time in the company (minimal duration of a period of 6 weeks defined from the beginning of the program on)
- a trilingual didactic: Italian, German and English (proportional relation 3 : 2 : 1), combined with a mainly bilingual (Italian and German) working experience due to the particular socio-ethnical South-Tyrolean situation.
- a regular compensation of 600€/month (increasing 100€/year) for each student also during the "university periods" regulated by a specific apprenticeship contract between company and students, developed with and agreed by the labour unions.

  The art.50 of 10th September 2003, nr.276 (apprenticeship for the obtainment of a degree and for high educational levels) extends the possibility of participation to the age of 29 and passes the regulation (educational aspects and duration of the contract) to the regional government, which has to act in accordance with the local industrial associations, the universities and the other educational institutions.
- the activation of university tutors who coordinate study-groups at the university after working time (Monday to Friday 6-9 PM and Saturday 8-12 AM) and promote and supervise the elaboration of case studies and applied projects in the companies in collaboration with the industrial tutors and the working students themselves (learning by practice and projects)
- A group of companies (from the industry, services and commerce) as project partners interested to recruit a working student (FIG 3)

FIG 1. Engineering BSc for Working Students - the original study plan

	Period	Title	Credits	cumulated
1st academic Year				
1	from beginning of October	Mathematics I	5	
		Physics I	5	
	in the middle of November	General and Inorganic Chemistry	2,5	
	3rd week of November	Exam session I		
2	from 3rd week of November	Mathematics II	5	
		Physics II	5	
	at the end of January	General and Inorganic Chemistry	2,5	
	1st week of February	Exam session II		
	second half of February	Internship nr. 1	4	
3	from beginning of March	Material Sciences	5	
	at the end of April	Technical and Industrial Drawing	4	
	1st week of May	Exam session III		
4	from 1st week of May	Management Accounting	5	
	at the end of June	Organisation of companies and markets	4	
	first 2 weeks of July	Exam session IV		
5	from the end of June	Summer period in the company		
	until the end of September			
	3rd week of September	Exam session V		47 CP
2nd academic Year				
1	from beginning of October	Statistics	5	
	in the middle of November			
	3rd week of November	Exam session I		
2	from 3rd week of November	Fundamentals of Mechanics	5	
	at the end of January			
	1st week of February	Exam session II		
	second half of February	Periodo in the company		
3	from beginning of March	Energetics and plants	4	
		(Mathematics III / Operative research)	5	
	at the end of April	Introduction to information science	4	
	1st week of May	Exam session III		
4	from 1st week of May	Fabbrication processes	5	
	at the end of June	Quality Management	5	
	first 2 weeks of July	Exam session IV		
5	from the end of June	Summer period in the company		
	until the end of September			
	3rd week of September	Exam session V		33 CP
3rd academic Year				
1	from beginning of October	Fundamentals of electronics	4	
	in the middle of November	Fundamentals of electrical engineering	5	
	3rd week of November	Exam session I		
2	from 3rd week of November	Production Systems	5	
	at the end of January	HR Management	4	
	1st week of February	Exam session II		
	second half of February	Internship nr. 2	4	
3	from beginning of March	English Specialized	4	
	at the end of April	Automatic control and actuation	5	
	1st week of May	Exam session III		
4	from 1st week of May	Industrial plants	5	
	at the end of June	(Operational business management / SCM)	5	
	first 2 weeks of July	Exam session IV		
5	from the end of June	Summer period in the company		
	until the end of September			
	3rd week of September	Exam session V		41 CP
4th academic Year				
1	from beginning of October	(Marketing / IT and ERP Systems)	5	
		(Production planning / Production logistics)	5	
	in the middle of November	Fundamentals of law for engineers	4	
	3rd week of November	Exam session I		
2	from 3rd week of November	Norms and Methods for Job Security	2	
		Job security and ecology	3	
	at the end of January	(CAD CAM / Distribution Logistics)	5	
		(Project Management / Transport Systems)	4	
	1st week of February	Exam session II		
	second half of February	Internship nr. 3	4	
3	from beginning of March	Final internship	11	
	at the end of April			
	1st week of May	Exam session III		
4	from 1st week of May	Final internship	11	
	at the end of June			
	first 2 weeks of July	Exam session IV		
5	from the end of June	Summer period in the company		
	until the end of September			
	3rd week of September	Exam session V		
		Degree Thesis	5	59 CP

Period in the company () Optional courses **180 CP**

- One central project coordinator for the initial orientation phase of the candidates, for the programming and management of the selection processes of companies and students, for the moderation of regular "synchro-workshops" between academic and industrial tutors, for the controlling of the academic performances of the working students and for the general trouble shooting.

Focus: the exploitation of the osmosis between industrial and academic education:

During the periods of the activity in the company, the engineer (student apprentice) follows an educational course on job which has been agreed between the academic and the industrial tutor and aligned with distance lessons according to the study program of that period.

The student defines, together with the academic and the industrial tutor, some practical projects that have to be implemented during the foreseen period. This ensures a regular, high relevant collaboration between the university and the companies in the middle and long run.

The activities ("learning on job") have to respect the regulations regarding the protection of young people in the work place (Italian act 977/67, modified and integrated with the decree 345/9 and the decree 262 of 18.08.2000.

FIG 2. Working Studenst: Presence at the university vs. presence in the company

Period			Weeks	Exams	Education at the university	Education in the company
1st academic Year						
University	start	October	19 weeks	4 exams	ca.1.120 hours	ca. 960 hrs.
	middle	February				
Company	middle	February	3 weeks	1 exams		
	start	March				
University	start	March	9 weeks	2 exams		
	start	May				
Company	start	May	21 weeks	2 exams		
	end	September				
					54%	46%
2nd academic Year						
University	end	September	31 weeks	8 exams	ca.1.240 hours	ca. 840 hrs.
	start	May				
Company	start	May	21 weeks	2 exams		
	end	September				
					60%	40%
3rd academic Year						
University	end	September	9 weeks	2 exams	ca.720 hours	ca. 1.360 hrs.
	end	November				
Company	end	November	13 weeks	3 exams		
	start	March				
University	start	March	9 weeks	2 exams		
	start	May				
Company	start	May	21 weeks	2 exams		
	end	September				
					35%	65%
4th academic Year						
University	end	September	9 weeks	3 exams	ca.360 hours	ca. 1.720 hrs.
	end	November				
Company	end	November	43 weeks	5 exams		
	end	September				
					17%	83%
Total			**Weeks**	Exams		
		at the UNIVERSITY	**86 weeks**	**21 exams**	**ca.3.441 hours**	**ca. 4.882 hrs.**
		in the COMPANY	**122 weeks**	**15 exams**	**41%**	**59%**

Other Rules and project-specifications:

- Age restriction: in order to participate at the project, the candidate for a working student must not be older than 28 years (due to apprenticeship national law).
- The selection: the candidate has to be selected by a company. The procedure of selection is similar to a normal, professional admission procedure (job interviews / aptitude tests).
- Working Hours: after the signature of the apprenticeship contract, the student has to respect the normal working hours (8 hrs./day) during the company periods as well as during the university periods (supervision guaranteed by an electronic clock in and clock out system at the university).
- Effort: compared to a normal (full time) student, a working student has to show more effort and determination. It is crucial for a working student to keep the foreseen alignment with the curriculum of the study (high exams success rate).

3. RESULTS

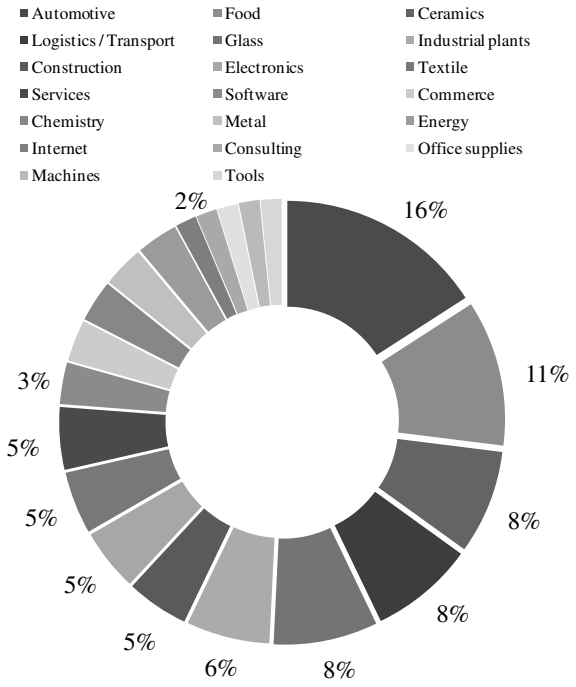
A first experimental cycle of 4 years (2003-2007) has not only allowed to verify the feasibility of the project tragets but has also clearly proved that the osmosis between the industrial and academic education obtains better results and advantages for students and companies.

Facts and highlights

From the academic year 2003-2004 on:

- more than 70 enrolled students
- more than 60 partner companies (among the biggest and most important companies of South Tyrol)
- more than 40 professors, assistants and researchers occupied with tutoring, configuration, coordination and coaching of the involved students and tutors and the elaboration of specific learning material for the distance learning
- more than 60 company managers involved in the process of coaching and introducing the working students into their organizations and focused on the development of applied educational projects (learning by doing projects)
- a compact and well coordinated group of stakeholders: university, industrial association, labour unions and European and ministerial funds.

FIG 3. The companies partner of the project sort by sector



The students value in the focus

In this project the connection between students' jobs and their studies is close. The companies "sponsor" their students to do the course. According to the literature, the most significant

sources of employee learning in addition to formal training and education, are the challenges of work themselves and interactions with other people in the workplace (e.g. Eraut, 2004; Eraut, Alderton,Cole, & Senker, 1998; Mumford, 1995; Poell, van Dam, & van den Berg, 2004). The main advantages for choosing the working students program are also that:

- the working student can achieve the Engineering BSc Degree
- the working student can gain a real, documented work experience (often in relevant positions) which is coordinated and structured by the educational project
- the student can finance part of the studies thanks to the regular compensation that he/she gets also during the periods of presence at university
- at the end of the studies, the regular student is 22 years old, trilingual (Italian, German, English), has completed an engineer bachelor program and has already a working experience of three years: a very high-potential profile (eye-catcher on the job market)

Regarding the students' academic and professional performance ,, the possible stress caused by the intense workload (university and work) could be analyzed comparing the academic performance of the "working students" and the traditional "full time students". The results of the analysis are very positive since there couldn't be found any indications of stress nor a study delay compared to the "classic / full time" student. Statistically, the academic results of the working students are similar to the results of the traditional full time students (average rating +2%, equal success rate). 90% of the students have completed their degree in time and above the total average rating.

The professional success of this education model can be proved by the fact that working students faster get a work position with responsibility (sometimes already before the termination of the studies) and find a better job offer after their degree [executives positions with a higher salary (+50%)].

The companies' value in the focus

Firms have different reasons for employing apprentices. The economic literature usually draws a distinction between a current production motive and an investment motive (Lindley, 1975; Stevens, 1994a). In the first case, the main reason for employing apprentices is their contribution to the company processes. The firm then substitutes apprentices for unskilled labour. This motive may be quite important if apprentices' wages are relatively low compared to the unskilled wage rate. In the second case, the firm trains apprentices to fill its future need of qualified workers. [8]. The second reason nominated is surely the main focus of the project "engineering working students": the company makes a low-risk investment in a high potential resource with a very short payback period (3 Years) and the chance of developing and hiring a 22-year-old trilingual BSc engineer ,with work experience and ready to obtain good results. The literature on training quality suggests a relationship between training motives and training quality (Ryan, 1994; Schlicht, 1996; Smits, 1997): The project results evidence that the acquired competences and the working students' professional appeal are very high since 80% of the partner firms have made an explicit job offer to the working student, and confirm the interest in the project by recruiting new students every 3-4 years.

Strengths and Weaknesses profile of the formula (from the students' and the companies' point of view). Over 80% of the graduates evaluate the project as good or very good.

FIG 4. Strengths and Weaknesses profile

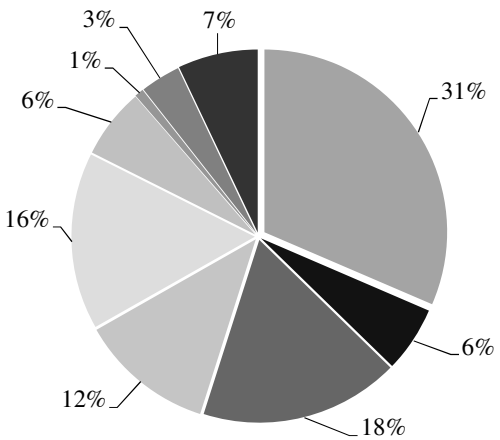
Strengths from the students' point of view	**Weaknesses** from the students' point of view
The connection of theory and praxis	Isn't a typical "college-life"
The work experience	Study and work load are not always easy to stand
The "added value" of application and experience compared to a "normal / full time" student	The rigidness of the periodical alternation between university and company
The regular compensation (also for the only university periods)	
The opportunity of personal development (career)	
The "applied" pluri-linguism (mainly Italian + German, also in the company)	
The versatility of the knowledge (job rotation)	

Costs / Investment Analysis

Starting with 2003, over 2,5 Mio.€ have been allocated by the European Social Fund and the Italian Ministry of Labour and Social Policies. The financed costs (project start&warm up 2003-2006):

- Promotion of the project (media, mailing, radio, newspaper, events)
- Elaboration of teaching material
- Tutoring hours organized by the professors for the students (after work and on Saturdays)
- Workshops in the companies (learning by project activities)
- 50% contribution of the students compensations (for the companies)
- Coaching hours beside the company-tutors
- Overall project management

FIG. 5 Project Costs Analysis
(Full Year - % values regarding 62 active WS)



The Project storyboard

2003

Initiation of the project "working students" by a team of experts consisting of the Industrial Association of South Tyrol, the Free University of Bolzano and the Polytechnic University of Torino through:

- Specific changes of the regional legislation regarding the apprenticeship and the following insertion of the professional profile of engineering apprentice in the list of the jobs of apprenticeship (with a resolution of the president of the local council)
- Negotiations and specific agreements with the four provincial labour unions which regulate the most important elements of the apprenticeship such as duration, compensation, periods in the university and in the company
- The preparation and presentation of the specific project in order to get the needed funding from the European Social Fund.
- The signature of the protocol of agreement by the stake holders: Autonomous Province of Bolzano, Industrial Association of South Tyrol, Polytechnic University of Torino, Syndicate for the Research and Permanent Education, Free University of Bolzano, Center of Technology and Management and the local labor unions.

2004

The experimental project is growing and now counts over 30 working students (the average number of engineering students in Bolzano per year is about 40).

2005

The European Social Fund and the Industrial Association of South Tyrol confirms the high quality, the high level of innovation and the good results of the project and manage to obtain a multiannual financing (1,5 Mio.€ until 2007) from the "Ministry of Labour and Social Policies" for the cost recovery of the project. In the same year, the education model is applied also to the undergraduate study program of Applied Informatics.

2006

The project concludes the quadrennial period of experimentation. The project "working students" is presented at the tendering procedure "Premio per la collaborazione pubblico-privato la catena della conoscenza della fondazione Giuseppina Mai". The Free University of Bolzano, the Industrial Association and the labour unions sign a protocol of agreement which guarantees the continuity and the integration of the project "working students" within the study offer and the organization of the Free University of Bolzano (Follow Up).

2007

The follow-up project is initiated. Meanwhile, the project is considered as best practice model for the public and industrial collaboration and the high level education of apprenticeship.

The model is then slightly adapted in order to be implemented also within other undergraduate and graduate study programs.

The project "working students" is awarded winner of the tendering procedure "Premio per la collaborazione pubblico-privato la catena della conoscenza della fondazione Giuseppina Mai". The award confirms the high level of innovation and quality of the project on national level.

The first 14 students (matriculation in 2003) of the undergraduate program of Logistics and Production Engineering complete their degree (two of them with 110/110; the average rating was above 100/110).

The project is presented at the national symposium "Catalogo delle buone pratiche FSE" and inserted in the list of the best practices of the ESF.

2008

A delegation from Spain comes to Bolzano for an official visit of the Free University of Bolzano in order to get to know the project "working students" considered as best practice model for high professional education. The similar characteristics of the two countries (South Tyrol and Basque Regions) regarding demography, culture, economy and society offer the interesting possibility to "export" the model.

The "working students" inaugurate their personalized official web page (http://www.working-students.case.unibz.it).

The last students of the matriculation year 2003 complete their degree and conclude hereby the first project cycle confirming the feasibility of the study load within the programmed time.

2009 until now

More than 30 degreed working students (average rating 100/110) and an average rating of the working students above the total average. 90% of the students completed their degree in time. more than 75% of the working students kept on working for the company they were working in, on a hierarchy level beyond the average, while the remaining 25% of the students decided to go on with their academic career at other Italian or German universities.

4. DISCUSSION

The project as "best practice" (critical success factors, transferable elements, expertise and lesson learned)

Generally:

- The capacity to concretize and stabilize the osmosis of the academic (public) and the industrial (private) world → element of innovation
- The didactic offer which tries to maximize the results of 4 years of academic career (bachelor degree, trilingual study, work experience and intermediary compensation → success factor

Specifically:

- A personalized apprenticeship-contract agreed with agreed with the different labour unions (salary scheme, program of alternation) → Element of innovation
- A limited number of students (less than 20 students per year) which guarantees a high level of didactic and organizational quality → success factor
- A high managerial flexibility → success factor

Awarding

2007: The project has been awarded by the Foundation "Mai" of the Italian Assoindustriali

2008: The project has been published and inserted into a list of collection of the most significant projects ("the good practice") by the Ministry of Labour and Providence and realized on national or European level in the world of labour, education and professional training.

Other relevance and intents

The project has also a social relevance since it helps young people to finance their study career.

Project-Follow Up

After 4 years of experimentation financed by the European community and the Ministry of Labour and Social Policies, some fundamental changes have been made in order to guarantee the economic independency of the project from other source of finance and in this way the needed continuity. The

project is now independent and will be offered also in the future thanks to an agreement signed by the free university of Bolzano, the labour unions and the Industry Association. The new self-standing project has been optimized regarding the study-plan, the alternation-scheme, the work-load distribution and the cost-charging. After the project warm-up (2003-2007) the companies recognized the advantages of the project and offered their sponsorship to new young talents without any subvention. In the mean time, the university has better learned how to practice the necessary project push for companies and working students, and how to manage the project (without external support).

The next challenge

The next challenge consists in bringing the collected experience to an even higher level by focusing on collaborations with companies of high potential (over 30). The project will become a post-university education model of a high level ("lifelong learning") which gives local companies the opportunity to form and educate the own talents in order to generate innovations and further developments in a very systematic way. The project will start with a comprehensive local survey.

5. CONCLUSIONS

Knowledge about practical methods that can be used to improve on-the-job learning is scarce [9], and this research project and case study demonstrate the effectiveness of specific formula for the structural combination between university and industry.

Since 2003 the experimental project "engineering working students" contributes to:

- Make the university more interesting for high school graduates in South Tyrol
- Create an education model for high qualified employees (as the local industry have complained about their scarcity)
- Reduce the distance between the industrial and academic world
- Test and experience the new Italian apprenticeship laws.

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Self-Perceived Versus Actual Academic Performance: An Investigation of the Academic Self-Esteem of Candidates in a Teacher Education Program

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ABSTRACT

Academic self esteem is a variable that is frequently disregarded in educational research despite the fact that its effects can be far reaching. Distinctly different from self esteem, *academic* self esteem – the accuracy with which a person perceives his or her own academic performance - can potentially impact many variables in the learning environment and educational setting. This study-in-progress seeks to investigate and characterize the academic self esteem of candidates in a teacher preparation program. It is believed that an investigation of this nature will bring to light information that can be useful for modifying the curriculum, designing instruction and /or fostering effective interpersonal interactions with the candidates. Having the ultimate goal of improving or enhancing candidates' actual academic performance, the benefits of such modifications can be extensive.

A total of nine correlational analyses of academic self esteem indicators were conducted. None of the nine analyses found a strong relationship to exist. Several of the analyses found a moderate relationship between the indicators suggesting that the participants have only a moderate level of academic self esteem. None of the analyses indicated significant differences in levels of academic self esteem with regard to gender or age.

Curricular, instructional, and interpersonal implications are discussed along with the future of the study and recommendations for related studies.

Keywords: Self Esteem, Academic Performance, Self Perceptions, Teacher Education, Teacher Preparation

INTRODUCTION

How often do educators hear their students say, "I thought I had done much better on this test!" or " I really thought I had bombed on this one!"? The academic self-esteem of students is an intriguing yet often neglected variable in the field of educational research. A large percentage of educational research involves using students as the subjects of the study; however, few studies factor in the effects of students' academic self-esteem. Regardless of whether they are K-12 public school students or candidates in a higher education program, students' perceptions of their own academic performance can have a significant impact on other related variables.

For purposes of this study, academic self esteem is defined as the accuracy with which a person perceives his or her own academic performance. It is believed that academic self-esteem can affect an individual's actual academic performance long before the performance even begins. Individuals with very low academic self esteem will inaccurately perceive their true academic performance. Having low academic self esteem when approaching or completing an assessment or task can potentially negatively impact actual performance. Later discovering that one's actual performance on an assessment or assignment is drastically lower than perceived can also have a devastating influence on future performance. Additionally, discovering that one's actual performance on an assessment or assignment is drastically higher than perceived can serve as a huge boost to confidence. Individuals with very high academic self esteem will typically have a very realistic and accurate perception of his or her actual academic performance. Obviously, the effect of having high academic self esteem depends on whether the actual performance was met with success or not.

The academic self esteem construct can influence things other than current and future academic performance. An individual's self perceptions may influence, positively or negatively, his or her attitude toward the class and/or instructor, thereby introducing an interpersonal factor. For example, an individual who consistently perceives his or her academic performance as being higher than actual can sometimes create an uncomfortable relationship between that individual and the instructor. On the other hand, there is the individual who consistently perceives his or her academic performance as being lower than actual. Depending on the individual involved, such a situation could potentially lead to ideas of favoritism, or "charity" on the part of the instructor. It could also lead to the individual unfairly labeling the class as a "freebie."

It is also believed that the impact of *teacher education* candidates' self perceived academic performance is even more far reaching. Strong connections most likely exist between a teacher's own level of academic self-esteem and that of his or her current or future students. It is, after all, the teacher who assesses and evaluates the tests, assignments and other tasks of his or her own students. For these reasons, investigating the academic self-esteem of candidates in a teacher education program is warranted.

In summary, for teachers who are caring, competent, and committed to their profession, their interactions with students, approach to instructional design, and role in general may take on a completely different complexion once levels of academic self-esteem are revealed. The instructor's response to these revelations should occur all in an effort to ultimately enhance

and facilitate the actual academic performance of those same students.

DESCRIPTION OF THE STUDY

The purpose of this ongoing study is to investigate and characterize the academic self-esteem of candidates in a teacher education program at Cameron University. Participants include both graduate and undergraduate candidates enrolled each semester in selected courses beginning in the fall of 2009. The courses are EDUC 5103 – Introduction to Graduate Research, EDUC 5273 – Advanced Tests and Measurement, and EDUC 4653 – Classroom Assessment. During the first week of class, a pre-test is administered to each participant. The pre-test covers the general objectives and content of the semester-long course. Participants are informed that the purpose of the pre-test is to identify any prior knowledge that they may or may not already have so that instructional design can be refined as needed to maximize learning. This is the primary purpose of the pre-test. In an effort to relieve anxiety, participants are also informed that performance on the pre-test is in no way an indication or prediction of success in the course. The exact same assessment is administered as a post-test during the last week of class. As an incentive for participants to be present for, and do their very best on the post-test, for each item answered correctly one-half point is added to their total points earned for the semester.

For both the pre- and post-test, each participant is asked to rate on a scale of 1-10, with 10 being highest, his or her own performance on the assessment. Candidates who are not present for both the pre- and post-test are not included in the study. Details concerning the make-up of the participants may be found in Illustration 1.

Semester	Class	Number (n)
Fall 2008	Classroom Assessment	38
Spring 2009	Introduction to Graduate Research	7
Spring 2009	Classroom Assessment	32
Spring 2009	Advanced Tests and Measurement	13
Spring 2009	Introduction to Graduate Research	5
Fall 2009	Classroom Assessment (A)	18
Fall 2009	Classroom Assessment (B)	20
Fall 2009	Introduction to Graduate Research	16
	TOTAL	n = 149
Gender	Females 81%	
	Males 19%	
Level	Undergraduate 72%	
	Graduate 28%	

Illustration 1

The research questions that this study seeks to investigate are: What is the nature of the relationship, if any, between (1) pre-test self ratings and actual pre-test scores (2) pre-test self ratings and gender (3) pre-test self ratings and birth year (4) post-test self ratings and actual post-test scores (5) post-test self ratings and gender (6) post-test self ratings and birth year (7) post-test self ratings and learning gain scores (8) pre-test self ratings and course grade (9) post-test self ratings and course grade? A correlational coefficient was calculated for each of the research questions above.

FINDINGS

A correlational study was conducted on the data collected through the fall 2009 semester. A correlational coefficient was calculated for each of the study's research questions. Findings from those calculations are given in Illustration 2.

According to Gay, Mills and Airasian [1], coefficients between +/- .35 and +/- .65 indicate a moderate relationship between the two variables. Coefficients below +/- .35 indicate a weak relationship or no relationship at all as they get closer to zero. A strong relationship is indicated by a coefficient higher than +/- .65. These guidelines represent generally accepted standards for interpreting correlational coefficients in educational research.

Virtually no relationships were found to exist between pre-test self ratings and gender (r = .06), pre-test self ratings and birth year (r = .06), and post-test self ratings and gender (r = -.05). A weak relationship was found to exist between post-test self ratings and birth year (r = .17) and pre-test self ratings and course grades (r = -.10). There was a moderate relationship found between pre-test self ratings and actual pre-test scores (r = .32), post-test self ratings and actual post-test scores (r = .46), post-test self ratings and learning gain scores (r = .35), and post-test self ratings and course grades (r = .30).

The learning gain score indicates the percent of points the candidate actually gained, of the total possible points to be gained, between the pre and post test. The formula for calculating the learning gain is:

$$\frac{\text{Post score} - \text{Pre score}}{100 - \text{Pre score}}$$

It should be noted that of all the moderate relationships found, the post-test self rating and actual post-test score had the strongest relationship with a Pearson r of .46. The correlational coefficient for the relationship between post-test self ratings and post-test scores (r = .46) is higher than the coefficient for the relationship between pre-test self-ratings and pre-test scores (r = .32). Although very weak, there is an inverse relationship found between candidates' gender and post-test self-ratings and between pre-test self ratings and course grades.

Variables		Pearson r
Pre - Test Self Rating	Pre-Test Score	.32
Pre - Test Self Rating	Gender	.06
Pre- Test Self Rating	Birth Year	.06
Post - Test Self Rating	Post-Test Score	.46
Post - Test Self Rating	Gender	-.05
Post - Test Self Rating	Birth Year	.17
Post - Test Self Rating	Learning Gain	.35
Post - Test Self Rating	Course Grade	.30
Pre- Test Self Rating	Course Grade	-.10

Illustration 2

DISCUSSION

The research questions that this study seeks to investigate are: What is the nature of the relationship, if any, between (1) pre-test self ratings and actual pre-test scores (2) pre-test self ratings and gender (3) pre-test self ratings and birth year (4) post-test self ratings and actual post-test scores (5) post-test self ratings and gender (6) post-test self ratings and birth year (7) post-test self ratings and learning gain scores (8) pre-test self ratings and course grade (9) post-test self ratings and course grade?

Research Question One

A correlational coefficient of .32 was found between the participants' pre-test self ratings and their actual pre-test scores. This indicates that there is a moderate relationship between the candidates' rating of their own performance on the pre-test and the score they actually received on the pre-test. Although moderate in strength, as the candidates' self-rating increased, so did their actual pre-test scores. As their self-rating decreased, their actual pre-test scores did as well. This finding indicates that for the participants studied thus far, their academic self esteem is moderate in nature. The accuracy with which they perceived their own academic performance on the pre-test was moderate.

Research Question Two

A correlational coefficient of .06 was found between the participants' pre-test self ratings and their gender indicating virtually no relationship between the two variables. There appears to be no significant differences between the self ratings of the males and females studied thus far. Male participants did not rate their own performance on the pre-test significantly higher or lower than their female counterparts and vice versa.

Research Question Three

With a coefficient of .06, virtually no relationship was found to exist between the participants' pre-test self ratings and their birth year. As the birth year decreased (indicating older participants) or increased (indicating younger participants) no association was made with the pre-test self ratings. Younger participants did not rate their own performance on the pre-test significantly higher or lower than their more mature counterparts and vice versa.

Research Question Four

The correlational coefficient for the participants' post-test self ratings and actual post-test scores is .46. Although moderate in nature, this is the highest coefficient for the study at the present time. This finding indicates that for the post-test, as the participants' self-rating increased and decreased, their actual scores obtained also increased and decreased respectively. The participants studied so far have a moderate level of academic self esteem with respect to the post-test. Generally speaking, their perceptions of their performance on the post-test compared to their actual performance was moderately accurate. It is important to note that the post-test self rating/post-test score coefficient is twice as strong as the pre-test self rating/pre-test score coefficient. Although both are still moderate in strength, this finding suggests that the participants' academic self esteem greatly increased between the pre- and post test administrations.

Research Question Five

An extremely weak, inverse correlational coefficient (-.05) was found between the participants' post-test self ratings and gender. This finding indicates that there appears to be no association between the post-test self ratings and the gender of the participant. Males did not perceive their own performance on the post-test significantly higher or lower than their female counterparts and vice versa. It is highly probably that this finding occurred because of the significant difference in the number of male participants (n = 28) compared to the number of female participants (n = 121) at the present time. As the study progresses, it will be very interesting to see if this coefficient remains inverse and whether the strength of the coefficient increases or decreases.

Research Question Six

A weak relationship was found between the post-test self rating and birth year for the participants studied (r = .17). As the birth year decreased (indicating older participants) or increased (indicating younger participants) no association was made with the post-test self ratings. Younger participants did not rate their own performance on the post-test significantly higher or lower than their more mature counterparts and vice versa.

Research Question Seven

Although still moderate in nature, the second strongest coefficient of the study is that which exists between the participants' post-test self ratings and their learning gain score (r = .35). The learning gain score indicates the percent of points the participant actually gained, of the total possible points to be gained, between the pre and post test. It is an indication of the amount of learning that occurred between the pre- and post-test assessments. Findings suggest that for this group of participants, their perceptions of their own performance on the post-test are moderately associated with how much they actually learned between the pre- and post-tests.

Research Question Eight

Comparing self-ratings to grades in the course is believed to give an even stronger indication of the participants' level of academic self esteem. Because the final grade accounts for each participant's actual performance over a longer period of

time, rather than one single assessment, a number of extraneous variables naturally eliminate themselves. A correlational coefficient of .30 was found between post-test self ratings and grades in the course. This finding indicates that a moderate relationship exists between these two variables. There is evidence that as post-test self ratings increased and decreased, grades in the course moderately increased and decreased respectively as well. Because the content of the post-test (which is taken at the very end of the semester) spans the overall content of the entire course, this statistic is yet another indicator of the participants' level of academic self esteem. It is slightly lower than the coefficient found between post-test self ratings and actual post-test scores (r = .46); however they do both fall in the moderate category in terms of their strength.

Research Question Nine

A very weak relationship was found between the pre-test self ratings of the participants and their grades in the course (r = -.10). Although the relationship is quite weak, it is noteworthy that the coefficient is negative. As the study progresses and more participants are included, it will be very interesting to see how this coefficient changes, if at all. As suggested by the findings from research question four, academic self esteem seems to be highest at the end of the semester. Therefore, to some extent this particular coefficient gives insight into how the participants' level of academic self esteem *increased or decreased* over the course of the semester.

Of all the findings discovered thus far, perhaps this finding most warrants close monitoring in the future of the study.

IMPLICATIONS

Again, it should be noted that this is a study-in-progress. As more data is collected on a greater number of participants, the current findings may or may not significantly change. However, based upon the current findings several implications present themselves. The overall findings indicate that, for these participants, a moderate to weak level of academic self esteem exists. In other words, the accuracy with which the participants perceive their own academic performance is moderate to weak. These findings may impact instructional design in several ways. Using this information when grouping students for class activities, or group projects and assignments may prove beneficial. It is believed that grouping teacher education candidates who demonstrate higher levels of academic self esteem with those candidates who demonstrate lower levels of academic self esteem can foster a more accurate self perception on their behalf. The benefit in taking this approach can possibly go both ways. Those individuals who tend to underestimate their own academic performance will become enlightened and hopefully encouraged. Those individuals who tend to overestimate their own academic performance will receive a reality check. Perhaps the most significant part of this approach is that either way, the "correction" comes from a peer rather than the instructor. Generally speaking, such "correction" is much better received under these conditions.

Another instructional implication of the current findings is that there may be a greater need for the instructor to offer opportunities for the candidates to "self-check" their own performance throughout the semester. This "self-check" may be something as simple as requiring each candidate to score his or her own performance using an analytic rubric, or something more extensive like embedding reflective writing assignments into each course.

Because these findings support the notion that academic self esteem is higher at the end of the semester, the long-held tradition of presenting more difficult course material toward the end of the semester is reinforced as good practice.

Interpersonally, these findings reinforce the importance of simply knowing this type of information so as to properly and effectively interact and communicate with candidates. As previously discussed, an individual may typically under- *or* overestimate his or her own true academic performance. Clearly, for those candidates who tend to underestimate their actual performance, much positive communication, interaction, and encouragement from the instructor is beneficial. For those candidates who tend to overestimate their actual performance, perhaps close monitoring during class time, activities and discussions or direct invitations to visit during office hours is warranted. Frequent one-on-one communication and interaction with candidates who tend to accurately perceive *unsuccessful* academic performance would be beneficial in attempting to discover any personal or other issues affecting their performance. This time could also be used to redirect the candidate's pattern of behavior academically.

A study of this nature not only has instructional and interpersonal implications for the university instructor, but it can also shed light on the likely tendencies of the participants once they become fully certified, classroom teachers. It is the author's firm belief that there are implications for their K-12 public school students. It stands to reason that, just as the learning styles and multiple intelligences of teachers impact what they do and how they do it in their own classrooms, so too does academic self esteem. Most notably, the accuracy with which a candidate perceives his or her own academic performance can have a direct effect on grading practices. For example, it is argued here that an individual who consistently under-perceives his or her performance is more likely to grade his or her own students harshly. On the other hand, those individuals who consistently overestimate performance are more likely to grade their own students very leniently. As with the interpersonal construct previously discussed, the benefit comes in simply knowing what an individual's tendencies are when it comes to academic self esteem. Additionally, curricular implications definitely come into play in this instance as assessment courses within a teacher preparation program would be the perfect setting for addressing such issues.

FUTURE OF THE STUDY

As previously noted, this is a study- in- progress. The intent is to collect data for a minimum of 10 semesters before any definitive conclusions are made. Having more participants will make for much stronger findings and conclusions. In addition, teacher preparation programs are traditionally more popular with females than males; however, with more participants it is hoped that the number of male participants will increase to some extent.

Perhaps a second stage of this study will involve multiple indicators of academic self esteem. Rather than using only the pre- and post-test assessments, candidates in these classes could

be asked to self rate all assignments and assessments in the course prior to being informed of their actual performance. Another fascinating aspect of this study that could be expounded upon is the nature of the relationship, if any, between the candidates' level of academic self esteem and that of their own students. Perhaps collecting data related to the concept of academic self esteem could occur during the semester of student teaching. Another idea would be to expand the current study to include all classes in the Department of Education.

It is firmly believed that the study currently underway is only a starting point for a plethora of other studies that can conceivably spring from it.

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Education Materials for Interactive Communication Security
On the Educational Purpose and Effects of
Hikari and Tsubasa's Tutorial for "Putting Our Heads Together" about Information Security

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ABSTRACT

Nowadays it is becoming more and more important to inform everyone about the potential dangers of this means of communication. Especially it is most important for universities to teach the risk of internet society. This material is designed to develop these abilities through interactive engagement by presenting the information in a dialogue form. We have created a text with CD and a three-choice quiz to bring freshness to the educational materials.

1. PURPOSE OF THE MATERIAL

In contemporary Japan it has become standard for students to use computers, the Internet, and cellular phones. The Internet has become a useful means for gathering many kinds of information, interacting with others without meeting face-to-face, and shopping. As everyone is using the Internet, it is important to inform everyone about the potential dangers of this means of communication. These materials have been assembled to educate students about the dangers of the Internet. They are also aimed at people who have been using the Internet for several years, but may have certain fears about this new technology.

This education material was prepared by a group of researchers concerned with the construction of laws and rules for the prevention of Internet problems. Members include not only academics, but also IT industry employees. For several years, this group has been actively proposing network use and application guidelines and has created a sample of university regulations. The current project involves producing educational materials that explain to university students the information security points to check on 14 important topics.

Students use the Internet both at home and at the university, and encounter risks in both places. People who use the Internet via their cell phones also encounter many dangerous risks. "Information security" refers to the risk to computers that people encounter by using the Internet. Many different people enter and leave a university, and they use many different computers and computing systems. Moreover, people also learn many different ways of using the Internet from their friends. Therefore, it is difficult not only to establish regulations, but also to develop information security policies at the university. In addition, some university students have become victims of the Internet. Avoiding difficult discussions of law and technology, this book has been written with the intent of proving easy to understand explanations of problems and counter-measures.

2. Dialogue of 1st Chapter: Let's fight viruses!

The following pages present a more detailed explanation that quotes the actual text used.

2.2.1 Chatting Part

Figure 1: Question and Lecture

After Hikari catches a cold, it seems as though her computer is also not doing well, and she complains to her friend Shizuka. The computer also seems to be infected with a virus. She didn't take any anti-virus precautions after buying the computer. However, computers run the risk of virus infection wherever they are. They can even get infected if you exchange papers with friend by using a USB memory stick. What should Hikari do to prevent this? Then the "let's put our heads together" problem appears.

2.2.2 Question Part

【 Problem 】 What should Hikari do?	
A	Not worry because she has a firewall.
B	Think about it after her computer gets infected by a virus.
C	Install anti-virus software.

The correct answer is C.

C	Install anti-virus software.

2.2.3 Lecture Part

Why is the correct answer C?

It is important to install anti-virus software when you first begin to use a computer in order to protect it from viruses. Recently, many computers come with pre-installed anti-virus software, and the user is able to select which software he or she would like to use from the beginning. However, much of such software is provided as a 90-day trial version and it is necessary to purchase the complete software package before the trial period is over. Free anti-virus software has also appeared recently. It is extremely dangerous to connect to the Internet without anti-virus software. Furthermore, computers that have been infected by a virus can infect other computers as well, and it is important not to help spread the virus to others people's computers.

Why is A wrong?

Firewalls are only able to protect against illegal access by an external source. Because firewalls do not check the contents of transmissions over the Internet, they are unable to protect against infection by viruses in email attachments. They are also unable to check for viruses in homepages. For these reasons, choice A is incorrect.

Why is B wrong?

If your computer gets infected by a virus, it my erase important files and disrupt your computer's functioning such that it may become unuseable. Furthermore, your computer could infect other computers with the virus. Much labor and skill are required to remove a virus and return a computer back to its original state after it has been infected. Moreover, it is not always possible to return a computer to its pre-infection state. Therefore, choice B is the worst.

2.2.4 Words and Columns

What should Hikari do?

The first time a computer is used, the anti-virus software and firewall become activated. This software should always be updated with the latest version. Furthermore, you should check about once every two weeks whether the computer has been infected by a virus. It is also good to occasionally check the computer using an online virus scanning service from a company different to that of your anti-virus software.

Terminological expressions: virus

Viruses are programs that hide in other programs or files and carry out malicious activities such as erasing or controlling files. In addition to viruses are spyware, which steals information from a computer, and worms, which spread through the Internet and are not involved with files. All of these forms of malicious software are called "malware."

Column 1: Trends in viruses

Computer virus research has been carried out for over thirty years and has an over twenty-year history in Japan. Understood as a broad set, viruses, their methods of infection, and their forms of damage have changed greatly over the past several years. Virus programmers' work evolves, following changes in the styles of computer usage and the spread of anti-virus measures. Therefore, simply updating old anti-virus software is not enough to protect against new viruses. It is important to periodically upgrade to new software.

Always use the latest anti-virus software

Every year hundreds of thousands of new viruses are discovered. Each day new technological developments emerge as virus programmers create clever ways to infect computer. These problems are compounded by the spread of criminal activity using viruses to illegally take money. In order to combat these trends, it is absolutely necessary to always maintain the latest version of anti-virus software that can deal with the latest developments in viruses. When the expiration date of the anti-virus software that came when you first purchased your computer approaches, you should quickly upgrade or update the software.

Column 2: Virus damage

Most computer viruses inflict some sort of damage if they infect a computer. Current viruses and spyware generally infect a computer unnoticed, disclose information unnoticed, and embed malicious devices within a computer. Accordingly, it is dangerous not to scan your computer regularly to see if a virus has infected it. Saying that scanning slows down the computer is not a good excuse.

Viruses sneak in stealthily

Recent viruses tend not to disrupt the functioning of the whole computer. Most are created for criminal purposes, and if a user does not notice that the computer is infected, the virus may stealthily steal personal information. Furthermore, viruses can be used to take over and manipulate computers with the Internet. If someone takes over and manipulates your computer, he or she may be able to make you appear to be a cyber criminal. Even people who say they "do not place important information in the computer" still should not forget to use anti-virus software when they connect to the Internet.

3. HOW TO USE THIS TEXTBOOK

This textbook provides interactional instruction concerning information security through 14 dialogues. The four characters, university students, present the information as a story told through dialogues between two people, providing the readers with a natural way to acquire knowledge about information security.

As the story progresses, three-choice multiple choice problems appear. If the reader thinks that the answer is correct, he or she clicks on the "correct" button. If it is correct, a ○ appears; if not, a × appears.

× When the answer is incorrect, the two characters explain why through talking with each other. Through their discussions of the risks that emerge when not following information security measures, readers learn in detail the reasons behind the mistakes.

○ When the answer is correct, an explanation of how to do things safely is given through the characters' talk. The dialogue enables the readers to learn correct security measures.

If the correct answer is given, "study points" are shown on a blackboard screen. Furthermore, the blackboard screen is divided into a column 1 and a column 2 section, enabling a detailed explanation to be given.

The materials address the following 14 points as dialogue topics.

The 14 topics addressed are organized to enable adults to know what to do when using the Internet. That is, students who have learned the material will have gained knowledge concerning not simply the Internet, but how to determine what sort of action they should take from the standpoint of information security. This material is designed to develop these abilities through interactive engagement by presenting the information in a dialogue form.

	Dialogue Theme	Point
1	Viruses	To remember anti-virus measures
2	Phishing scams	Phishing scam counter-measures
3	Anonymous bulletin boards	Because they are anonymous, is it OK to write anything?
4	USB memory sticks	What if you lose your USB memory stick
5	Meeting people online	If you meet in real life someone you got to know on the Internet
6	Suspicious software	The dangers of getting involved with suspicious software
7	Fraudulent claims	Not becoming a victim of Internet crimes
8	Copyrights	Establishing private fan group sites
9	Email attachments	When an email with an attached file does not arrive
10	Are wireless LANs dangerous?	Wireless LANs are dangerous. What can be done?
11	Password management	How to create a safe and hard to forget password
12	Upgrading your OS and software	Always maintain the latest versions of your OS and software
13	When items purchased online do not arrive	When items purchased online do not arrive
14	How to dispose of your computer	What to do when disposing of your computer

4. CONCLUSIONS

This concludes my introduction of "Hikari & Tsubasa's Information Security Game." Instructors who have used the materials in class reported that they effectively motivated students to learn. The textbook is arranged in the same order as the CD content and provides more detailed explanations for the scenario problems and answers along with summary points and additional factoids at the end of each chapter.

The combination of textbook and interactive FLASH media is ideal for appealing to the interests of young students while at the same time accurately conveying the latest technological information available. It is also makes it possible for students to learn about information security effectively and accurately on their own, something that was difficult for the average student to do in the past. Our next task is to provide translated versions for the many foreign students studying at schools in Japan.

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The e-portfolio, record and evidence of the construction of a personal and professional project

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ABSTRACT

Today, the volume of information received and collected in professional and personal domains requires reflection on interpretation, apprehension, and comprehension, as well as the storage and traceability of this information [1,2].
This presentation deals with the means to manage, organize, and archive information within the specific framework of the personal and professional projects of students (PPP). The objective of the PPP is to prepare, as well as accompany, its creator-user, the student, along his/her professional path.
Meant to be, first and foremost, an introspective and structuring process of one's thoughts, it is also a tool for capitalizing on and exploiting collected information by structuring it [3].
The e-portfolio uses electronic technologies, such as a container and allows you to store items in numerous media (text files, scanned documents, audio, video, and graphics).
One of the functions of the e-portfolio is, therefore, recording and traceability [4]. However, a framework of good practices must be put into place to forward its use [5,6,7,8].

Keywords : e-portfolio, information, structuring, reflexiveness, traceability, personal and professional project

INTRODUCTION

In this paper, we present the tool and the method that has been developed at Université de Bretagne Sud, in France, to define and manage the personal and professional projects of students (PPP)l. The basic tool is an e-portfolio which keeps in memory all the results of the different activities involved in the construction and evolution of a professional project.
The method is based on a set of related activities, designed on one hand to acquire a better knowledge of oneself and one's environment, and on the other hand, to acquire the skills and key competencies needed to succeed in a professional project.

The basic tool is the e-portfolio which is original in that:
• it is present on the virtual learning environment. This environment remains available to students after they leave the university, and allows them to continue to manage their project throughout their lives: their accounts will be maintained.
• the portfolio is managed by e-mail.

The first part is based on the concept of the Personal and professional project of students (PPP).

The second part deals with the basic structure of the e-portfolio. It is composed of 5 main folios, each of which is made up of a set of sub-sections named criteria. The e-portfolio is a structure designed to record information. Initially, the structure is the same for all students, however the information stored in the portfolio will depend on the choices of each individual user. The student can modify the eportfolio's structure by adding or deleting criteria but cannot change the basic structure. The students are free to create their e-portfolio as they wish within the above-stated five folios.

They are then given full responsibility and autonomy to create sections in each folio to organize and personalize their e-portfolio throughout the elaboration of their PPP. This means that the description presented in this part is to be understood as a generic structure.

In the third part, the accompanying modules proposed to the students in the curriculum to build up their project are presented. Modules are developed to follow the project's design with a tempo of one module per semester, 10 modules for a 5-year degree course. The modules are designed to progressively build on the 5 basic folios of the e-portfolio.

In the fourth part, we explain how the e-portfolio is managed. It is based on the original use of e-mail allowing you to send in information in a simple, fast way [9]. A first section shows how e-mails are used to manage the information in the portfolio while a second section explains how to organize this management.

At least, in the fifth part, we answer the issues of e-portfolio use: Is the e-portfolio seen as useful, easy to use, and as an introspective tool for oneself?
An experiment was carried out at Université de Bretagne Sud to answer these questions.
It is based on an experimental approach with first-year students within the teaching unit "Personal and Professional Project".
It is meant to assess the use and management of the e-portfolio designed here as a professional development e-portfolio, appropriation by the students, and its relevance in the construction of their project and the enhancement of their competence.

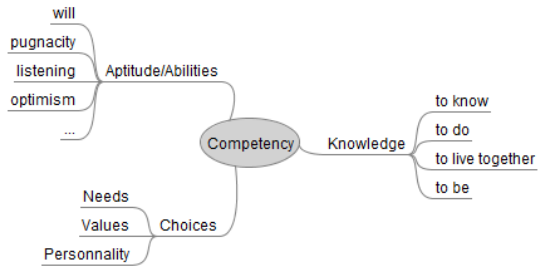
Finally some conclusions and perspectives will be given.

1 – PERSONAL AND PROFESSIONAL PROJECT OF STUDENTS (PPP)

Building a PPP is an essential part of student life. At that time he/she decides what he/she wants to become in the future and what place he/she wants to take in the society. To help himself/herself in this approach, the student must take information from his environment: on the economic situation, prospective situation, but he/she must also get introspection to know who he/she is. One of the underlying characteristics of introspection is understanding what competencies are.

One of the main objectives of the PPP is to characterise the competencies of the student.

We present in the following the retain definition of competencies.



In our definition, competencies are based on three notions: knowledge, abilities and choices The organization of the e-portfolio is closely linked to this definition of competencies.

Knowledge

Even if other classifications of knowledge can be found in the literature, we focus on four aspects: knowing, doing, living together and being.

Knowing: will allow the student to understand and predict his/her environment. This is roughly learned in school. The effect is to stimulate the discernment and increase curiosity.

Doing: will increase the quality and efficiency of the work. The side effect is that, in a team it will increase its the trust in people able to do efficiently.

Living together: is an introduction to human diversity. It shows similarities, interdependence, social and cultural diversity between people.

Being: this characterizes the way we are in society. Autonomous, communication, judgement, charisma are some of the master words of this.

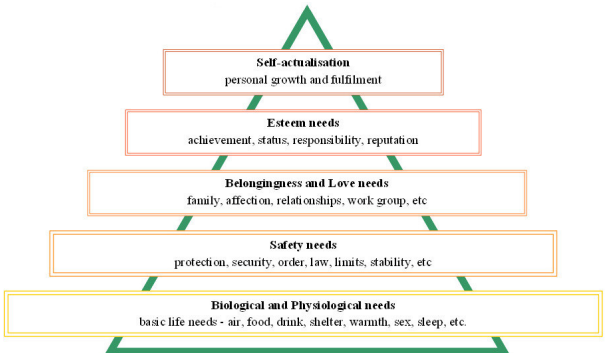
Abilities

Abilities are caracterized by the execution of aptitudes. Aptitudes are the personal features that makes us different from one another. Abilities are the use of these aptitudes; if someone does not train his aptitudes they may be lost. For instance aptitudes are; will, pugnacity, listening, optimism, concentration, memory …

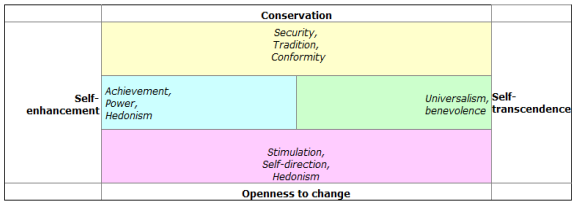
Choices

Even if we have a wide range of knowledge and a lot of abilities, if we are not able to use them in front of a situation then it is waste. The choices are motivated by three notions: needs, values, personality.

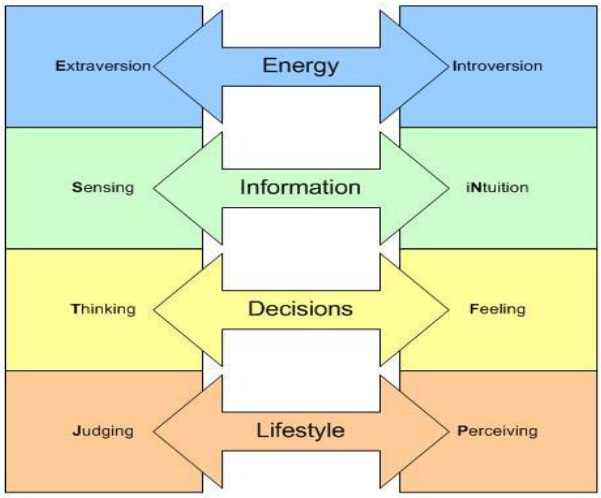
Needs: here we use the basic Maslow hierarchy of needs[10].



Values: are based on Schwartz's Value Inventory [11].



Personality: The underlying model is taken in Briggs-Meyer MBTI [12].



2 – E-PORTFOLIO STRUCTURE

To create and build a personal professional project, the e-portfolio has a basic structure of five folios: my uniqueness, my discoveries, my project, my competence, and my communication.

Section 1: My uniqueness

The goal of this folio is to identify and keep all of the student's basic information. It is divided into three different parts:

•Me: provides a global image of the person including his/her identity, acquired knowledge (with both "academic" and "informal" knowledge), as well as his/her personal preferences,

For example, being alone or in a group, being indoor or outdoor, or even how he/she searches for information.

•Experience: records all of the student's different work experiences.

Section 2: my discoveries

This folio stores the results of the different activities the student has done to discover the working world. It is divided into three different parts:

• Documentary research: gives a link to a general presentation of the working world. Jobs, sectors, etc. are defined.

• External view: reports on all the meetings, visits, conferences, forums, etc. in which the student participated.

•The student's personal network, which he/she will be able to

use for his/her future project.

• Complementary education: expresses the list of complementary skills or knowledge required to increase the potential of the student.

Section 3: My project

This third part defines all the criteria used to identify and manage a project. This section should be completed only after the previous two, as it is strongly connected to them both.

In the criteria formalization students can describe the main project with all the skills needed, the steps to be done, and the knowledge required.

Some possible alternative projects are also defined as acceptable solutions.

Section 4: My competencies

It is focused on the skill of the person. His/her competencies are first identified, their capacity to be used in other contexts is then studied, after which promotion and updating are defined, and finally, consideration of their evolution (past and future) is engaged. See [13] on this subject.

•Personality: gives the results of the MBTI personality test for those students who take it, development which reflects the choices the person had to make in life and how he/she was helped in those choices, motivation which is based on the Maslow hierarchy here, and values based on the S.Schwartz theory.

Section 5: My communication

In this part, we store all the information the student wants to use to share information with the business environment. It is organised in two parts:

Preparation: This first step is the preparation to external communication. It is done in the modules described in this paper. We want to be compatible with the requirement of Knowledge Tree [14] and Europass [15].

Production: This second step is the part in the portfolio which is public. It includes the CV, the cover letter for a particular sector, and finally, a blog for personal expression.

3 - MODULES CONNECTED TO THE EPORTFOLIO

The modules are teaching activities included in the student's curriculum. Because the French degree course is organized in 3 or 5 year cycles, the modules are constructed on the same schedule. The first 3 years are used to define and build the personal project, while the last two years are for acquiring skills and perfecting the project.

All the modules contribute to filling up the e-portfolio.

Each module is around 20 hours long and corresponds to one semester with roughly 2 hours per week. We developed 6 modules to cover the first three years of the university degree.

The modules are chaired either by a teacher, a professional from a company or a specialist in career counsellor (such as an education psychologist). Some activities are performed through online tests developed at the university.

The modules are organized as follows:

S1: **Self-knowledge, guided tour**. This entry point will include a presentation of the different services, inside or outside the university, which the student will use to construct his/her project, and an initial search into his/her past and reasons for being there.

S2: **Notion of competency.** This presents what is innate and not acquired through the education system. What is reviewed here is not only formal knowledge, but personal skills, as well as how to live in a group and interact with people.

S3: **Job discovery**. To formalize the student's future job, this module encourages the student to study the job and to meet a professional holding this position to learn more. During the meeting, the student fills in a report which is recorded in the e-portfolio.

S4: **Job and competency link**. This section helps inform students of the competencies required for various jobs. These competencies are listed in terms of knowledge, skills, abilities, competencies. A part of the module is used to determine if the projected training is in correlation with the goal, and if the student needs to train his/her personal skills for increased capabilities. At this point, the student writes his/her first CV.

S5: **Finalize the project.** In the third year it is time to prepare the student to begin his/her career. The student can search for a company that could provide the opportunity of acquiring the targeted profession. Methods to research companies, understand their activities and focus on the jobs can all be found here

S6: **Setting up a strategy**. The finalized CV, targeting the job has to be written, with a cover letter.

Interview simulations are offered to train the student. An assessment is done on his/her career project, to see how it has evolved over the 3 years of studies, and an evaluation of competencies is performed.

During the following 2 years, modules are used to improve the project and acquire the skills needed at the engineer level.

S7: The project's **strong and weak** points. A comparison is made between the project and the student's situation. This step aims at giving the student an outsider's point of view, as well as good judgement, on his/her project.

S8: **Work market**. A national and international survey of the economic and political situation is performed. Information is given on how to create a company and a simulation is made.

S9: **Professional insertion**. At this level, the student will often have to act as the manager of a team. He/she is thus trained in conflict detection and conflict avoidance. The issue of work organisation is also dealt with. Special interest is given to the importance of networks: private, business and administrative. How to build up a network, keep it alive, and activate it to prepare for professional insertion.

S10: **Internship**. For most of the students, the last part of the curriculum is internship. It is prepared to discuss the expectations and the target. At the end, a presentation is given to describe the time passed in the company.

4 - E-PORTFOLIO MANAGEMENT

section 1 = The e-mail tool to manage the e-portfolio

This section describes the method used to manage the portfolio. The originality of our approach is that all the portfolio management is done by e-mail. For instance, if the owner, Joe Martin, wants to add information (for example, a text file) in the "my experiences" folio of the "uniqueness" criteria, he will send an e-mail as follows:

To: eportfolio.joe.martin@ubs.fr
From: joe.martin@ubs.fr
Subject: uniqueness
Attach: PersonalFile.txt

Content: ADD my experiences

When the e-portfolio manager receives this mail it does the following:
- Checks if the sender (joe.martin@ubs.fr) is allowed to write something in the Joe.Martin portfolio.
- Checks the attached file (here a PersonalFile.txt)
- Interprets the contents of the e-mail. Here "ADD" is the instruction contained in the e-mail, meaning that the attached file "PersonalFile.txt" must be added in the folio "uniqueness" criteria "my experiences".

The content of the e-mail gives the instruction to be executed in the portfolio. The attached file specifies what information must be treated. The subject defines the section in which the information must be placed. To keep the e-portfolio simple, the amount of instructions is limited.

Section 2 = Levels of management of the e-portfolio

We can distinguish three kinds of portfolio management: information management, criteria management, authorized person management.

• **Information management** allows the user to add, move, delete information in the portfolio as described in the above example. There is also a set of specific instructions to organize the presentation of the information in the e-portfolio. For instance, it can be included in the text or linked to it.

• **Criteria management** gives a set of instructions to change the structure of each section of the portfolio. For instance, criteria can be added, removed, or put in a different place (see Figure 1). This is important if the portfolio is to be used in a lifelong project. We cannot determine what kind of criteria someone will need to add based on his/her professional and life consequently the list of criteria described in the above section is the standard one at the creation of the portfolio, but the student can quickly add or delete criteria experience to build up a personalized e-portfolio.

• **Authorized person** management is a list of people authorized to send information to the eportfolio. This list is managed by the portfolio's owner, no one else can accept someone in the list and allow them to write in a specific section of the e-portfolio.
This protection is necessary to guarantee the protection of the data. People writing in the e-portfolio can be: a teacher during studies, an employer during working life, or the user him/herself, for online self-evaluation tests (see part IV).

5 – HOW THE E-PORTFOLIO IS USED?

The e-portfolio experiment was carried out with science and humanity majors to have an idea of how they will use it, how they will appropriate it, and to see how useful it is to build the PPP.
These are the results of this experiment on the use of an e-portfolio.

The impact measurement was based on the following questions:

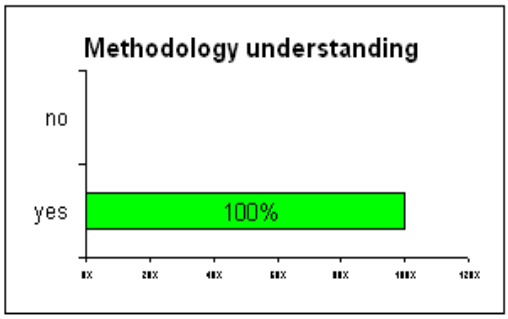
- Is it used?
- How is it used?
- Is it useful in the students' reflection upon themselves and society?
- Is it adapted to how students work?
- Is it seen as useful for organizing the information the student would like to record and archive?
- Is it seen as useful in the construction of students' personal and professional projects?
- Do they find a use for it?

See Annexe 1

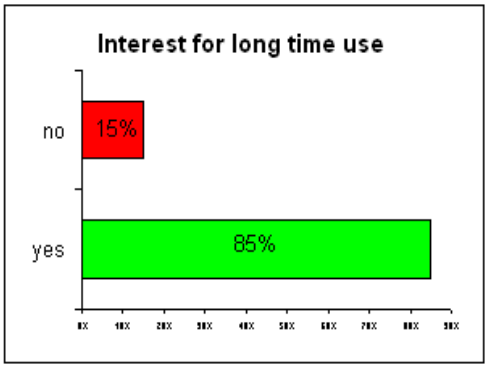
These are the main answers:

Overall, the students understood that it required introspection and the importance of self-knowledge.

Its use and the ease at which it can be used generally correspond to any type of use (interface mode or email mode). Among some of its most appreciated features is the freedom at which the information they add to it can be structured and organized.

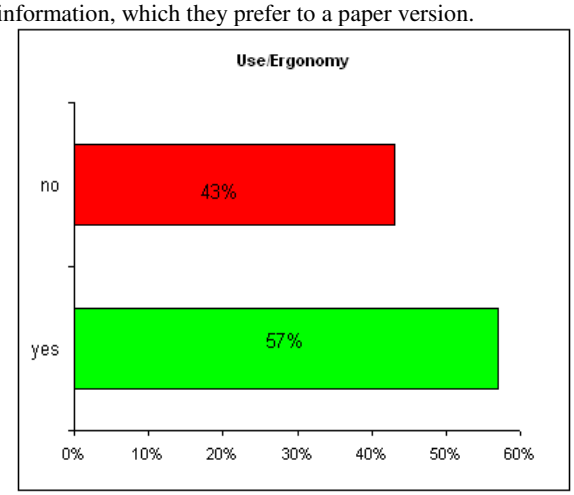


Its immediate short-term usefulness is not obvious, however they consider it rather interesting for a more long-term perspective.



Generally speaking, they like the digital organization of their

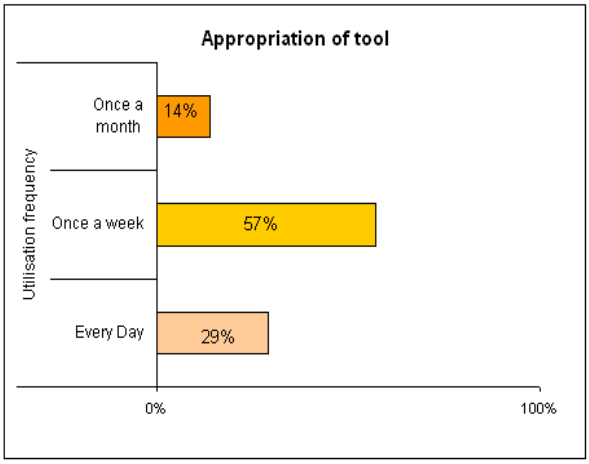
information, which they prefer to a paper version.



This short-term evaluation has not had much impact on their habits for the moment; they do not see its usefulness in relation to the construction of their project yet. They are currently not convinced of the usefulness of this tool, and consider that a non e-portfolio organization of their information would be just as efficient.

However, the time period in which it takes to appreciate the tool seems quite short, judging by use frequency and use reflexes.

Definitive conclusions cannot be drawn today due to the low number of students who did respond.



6-CONCLUSION

This presentation has described how Université de Bretagne Sud prepares students to build individual professional projects, as well as to learn how to manage them throughout their lives, by providing the organizational tools and training necessary.

The key element is the e-portfolio, connected to a set of modules designed to initiate the definition of the project. This personal e-portfolio is maintained by the university for lifelong learning

The evaluation in progress will last the entire academic year to assess the long-term use of the e-portfolio.

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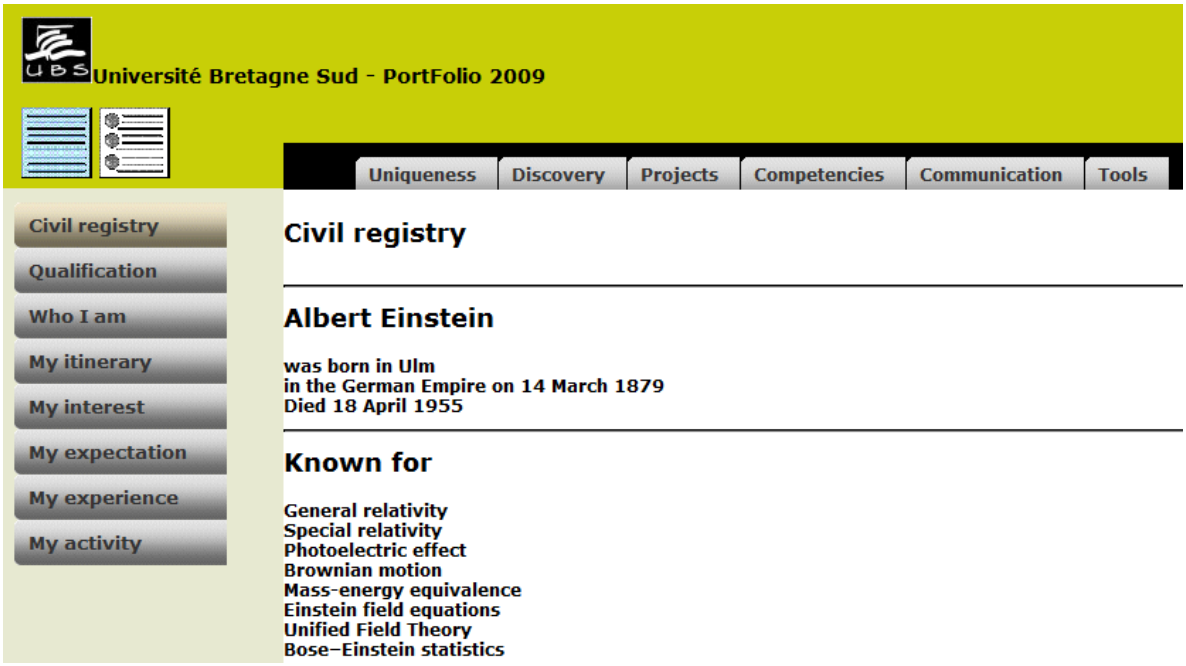

Hard copy of an example of the e portfolio

Annexe 1 Questionnaire on the use of e-portfolio/UBS 2009

Part 1: methodology1.1. What is a PPP?

1.2. Did you understand what introspection was?
1.3. What is an e-portfolio used for?

Part 2: Use / ergonomy

2.1. Did you find it easy to use?
2.2. Does the folio and section organization seem well adapted to the use of the tool?
2.3. Were you satisfied with the "interface" mode?
2.4. Were you satisfied with the "e-mail" mode?
2.5. Did you like the possibility of being able to structure and organize your input information?

Part 3: Usefulness / use

3.1. Does it seem useful to you?
3.2. Does it make organizing and structuring your information easier?
3.3. Did you like being able to structure your information they way you wanted to?
3.4. Is it comparable to a paper version? A file?
3.5. Would you have preferred to use a paper version?
3.6. Do you understand the titles of the folios? Do you have any remarks to make?
3.7. Does it change the way you deal with your information?
3.8. Does it seem useful in the construction of your PPP?
3.9. Does its use have meaning for you?
3.10. Do you see an immediate use?

Part 4: Appropriation of tool

4.1. How do you structure your information? Your sections? Please explain your organization by sections.
4.2. Do you have the reflex of immediately posting your information?
4.3. What often do you use the tool?

Part 5: what functions should be added?

5.1. What functions would you like to see added to the tool?

Part 6: other

6.1. Would you accept to show your e-portfolio to a career counsellor?
6.2. Who would you authorize to add information? Qui allez-vous autoriser à y mettre de l'information ?

Would you accept to give us your name?

Explaining primary pupils' differences in reading achievement by teaching patterns and social background. Reanalyses with the PIRLS 2001-data.

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ABSTRACT

This contribution presents the outcomes of multilevel analysis in the context of the Progress in International Reading Literacy Study (PIRLS) 2001 that are unique in Germany so far. The PIRLS survey 2001 revealed that in Germany especially pupils with a low socio-economic status (SES) and with immigrant background have a significant lower reading achievement of more than one school year compared to pupils with a high SES and without immigrant background. The PIRLS survey 2006 evidenced that, although this difference did reduce significant over the years, there is still a disadvantage for those pupils' reading achievement of more than one school year.

One of the main research questions of this work was, if there are certain concepts, strategies and methods of teaching, which contribute to a better acquirement of reading achievement of pupils from a low SES- and immigrant background.

As a result of the analyses certain patterns of teaching could be identified that contribute to a better reading achievement of pupils with low SES and with migration background.

Keywords: Reading Achievement, Social Disparities, Primary Pupils, PIRLS survey, Multilevel Analysis

1. INTRODUCTION

Already after the first measurement of the Progress in International Reading Literacy Study (PIRLS) it became obvious, that Germany is one of the countries with the strongest connection between the pupils' social background and their reading achievement [1, 2].

Taking into account the trend perspective and comparing the PIRLS 2001 results with the findings of the new PIRLS 2006 survey the connection between the pupils' social background and their reading achievement has changed not significantly [3]. Pupils with a low social background still have a deficit in reading competency of 40 points. In practise that means that those pupils have a deficit in their reading achievement of one school year!

That means that especially pupils with a low social background need a better support in school but of course also from their families. The results of the analyses from Klieme, Neubrand and Luedtke [4] with the German PISA 2000 data emphasize that. They found out that the connection between the social background of the pupils and their math achievement is negligible if their reading achievement is controlled. So reading achievement is an important key competence.

Also the German Action Board of Education appealed in its annual report 2007 that the empirical educational research has to examine questions of equal chances in education more intensively [5].

2. OBJECTIVES

This contribution presents the outcomes of multilevel analysis in the context of the Progress in International Reading Literacy Study (PIRLS) 2001. The main research questions were, if there are certain patterns, strategies and methods of teaching, which contribute to a better acquirement of reading achievement of pupils from a low social background.

3. THEORETICAL FRAMEWORK

The dynamic model of educational effectiveness [6] has been used as a starting point and as a theoretical framework for the analyses. The model is based on

three dimensions of school quality: Inputs (system preconditions, system and regional steering), processes (education on school and classroom level) and outputs (quality of student achievements, attitudes and behaviours) [cp. also 7, 8]. Also the social background of the pupils as an individual precondition is included in the model of Creemers and Kyriakides (ibid.).

4. METHODS

As a main research technique multilevel analyses with the software HLM [9] had been conducted. This technique makes it possible to have a separated view on the effects of the individual level (e.g. pupils' SES) and of the classroom level (e.g. special patterns of teaching) on the pupils' reading achievement.

The empirical analyses in this contribution had been conducted with the quantitative data of the Progress in International Reading Literacy Study (PIRLS) Germany 2001. The sample size of the primary pupils (individual level) was N = 5935, the sample size of the teachers (classroom level) was N = 308 and the sample size of the principals (school level) was N = 166.

5. RESULTS

As a result of the analyses certain patterns and elements of teaching could be identified that contribute to a better reading achievement of pupils with a low social background. Especially in subgroups with low SES or low reading achievement certain aspects have strong effects (up to half a school year) e.g. discipline / structure in classroom and building up reading strategies early. These results replicate the findings / models e.g. of Frith [10] and of van de Grift & Houtveen [11].

The results indicate that elaborated teaching patterns can contribute to a better acquirement of reading achievement of pupils from a low social background.

As a desideratum it can be stated that certain aspects of teaching have different effects on reading achievement, in consideration of pupil-composition in classroom and thus, more differentiated research on this issue is indicated.

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Managing Positive Stress for Change in the Implementation of Technology in Schools

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ABSTRACT

In the Information Age, faculty and staff in large institutions and schools develop transformative changes slowly. The implementation of technology as a tool for communication and in classroom integration for instruction is also slow for many educators. However, today there is an urgency to bring the most recent technology systems, applications, and strategies into the educational organization, creating an environment that requires knowledgeable leaders to manage the rapid change. With resistance to change eminent, leaders must orchestrate the right amount of stress to create a need in the staff to constantly evolve to a new level of technology implementation. The five positive stress inducing strategies for change, first introduced by DeVore in 1994, have proven to be used by highly effective leaders from elementary schools through college. With leaders trained in these key strategies, the likelihood of faculty and staff commitment to the needed changes in technology integration is greatly increased. Leaders can't wait for the experienced employee to consider using technology as a tool; even elementary students race past the limited and readily outdated technology skills of most teachers. Leaders must create the positive stressors to initiate change for technology in their organizations now.

Keywords: Leading Change, Stressors, Resistance, Technology Integration, Norm Discrepancy

1. INTRODUCTION

According to Lewin (1948) life merely exists on a continuum of change events that differ in the amount and type of change [1]. How true Lewin's view on change rings today when we are faced with very rapid technological changes in our personal and professional life. The pace of technology innovation is moving beyond the J curve of change as proposed by Harvey (1995) [2]. There is little doubt in our current time of fast-paced, spontaneous change within organizational systems that there is an increasing need for leaders to better understand their role in managing change for technology implementations (DeVore, 1994; Ambriz, 2008; Kotter, 2008) [3]. Jellison (2006) states: "Like a roller coaster, change frightens even as it thrills . . . the fundamental challenge of implementing change is how to help people through their fears and doubts so that they experience the joys of growth and success. Knowing how to deal with these human aspects of change is critical to one's success as a manager and leader" [4].

Bridges (1996) suggests that there are different stages of change, and they need to be planned for and managed [5]. It is the intent of this paper to address how change theory and

research by DeVore (1994), VanVooren (2005) and Ambriz-Galaviz (2008) can support leaders to implement the five positive stress inducing strategies to craft successful change in technology integration in an educational environment [6].

2. THEORETICAL FRAMEWORK

Volumes have been written on the theory of change over the ages. The birth of Organizational Development during the mid 1900's brought a greater focus on how to lead effective change episodes with an organization, teams and/or individuals. The process of change has been studied for many years and the body of research-based literature is great. Many models of change from the accumulated body of knowledge have been proposed over the years. A common factor across most change models is the need to overcome resistance.

There is clearly a need to understand the strong tendency of individuals to resist change if one wants to successfully implement a change initiative. Resistance to change is a "normal" act on the part of people being affected by the change, and needs to be embraced by the leader of the change episode (Coch and French, 1948; Harvey, 1995; Palmer, 2004) [7]. The concept of resisting change suggests an action on the part of the person or persons experiencing the change environment. Yukl (2009) implies the person resisting the change will actively try to avoid carrying it out [8]. The fact that resistance to change is common implies that the need to overcome resistance to change must be addressed by the leader to ensure success.

Hans Selye (1980), the "father of stress" research, developed a significant body of work illustrating the potential use of eustress or positive stress as essential to living and behavioral change [9]. Leahy's (2006) work indicates that a person with low or no stress will tend to stay in a state of status-quo; whereas too much stress or 'distress' can interfere with a person's productivity and ability to change [10]. Thus, the level of stress induced to create change and the perception of that stress has an effect on the amount of resistance that is developed. Although positive stress also creates resistance, this can be more easily managed.

Framework for Managing Positive Stress

DeVore (1994) examined the concept of managing levels of positive stress to orchestrate the implementation of various educational change episodes. DeVore proposed and conducted research using a five category positive stress-inducing framework. His study provided evidence on the existence and use by leaders of stress-inducing strategies or stressors.

The work of DeVore and the framework for managing positive stress was further studied by Van Vooren (2005) and Ambriz-Galaviz (2008). These research studies provided statistical evidence to validate DeVore's framework and the use of stress to craft change in various settings. The five categories of stress-inducing strategies or stressors are: 1) authoritative command; 2) evaluation; 3) norm discrepancy; 4) sanctions and 5) targeting.

Authoritative Command: This stressor implies that there is a positional power of authority between the leader and the changee. The use of authoritative command suggests that the leader of the change can affect or influence the change behaviors of others via a direct request or command. An example that illustrates this strategy would be the school principal or head administrator issuing a statement that all future internal operational communication will be handled by e-mail. This edict makes a large assumption that faculty has available technology and the skills to use it. Certainly those unprepared would get trained in the software and find a work station to receive messages as soon as possible to avoid conflict with the authoritarian leader.

Evaluation: The use of evaluation is a way of making a judgment, positive or negative, regarding the actions of a person/team the leader oversees, and providing them with

constructive feedback. Evaluation can be a very effective stressor if the leader is thoughtful about its use to support a change environment. For example, a distance education committee charged with establishing the standards of online instruction for the organization also assumes the responsibility of providing specific overview to individuals instructing the classes. The committee's feedback becomes part of the evaluation for the faculty member each year. This puts the stress on the faculty member to adapt his or her class to the established standards and requirements outlined by the committee in order to have a positive evaluation.

Norm Discrepancy: This stressor category has its roots in the difference between what is and what is desired. Research indicates that when people are presented with what currently exists versus a more desirable state, a tension or pressure exists to move towards the more desirable state. It is possible to develop a negative effective if there is an overload of the desired state and insufficient means of getting to that state. If one does not have the ability to move to the desired state, frustration sets in and the ability to change is impaired. An illustration of the norm discrepancy strategy is when a teacher or grade level develops a sensational webpage; others employees in the same organization see it, and soon most staff members have improved their web pages. People are naturally competitive and join in the race to improve when they see others doing well.

Sanctions: By definition, a sanction can range from mild forms of withholding a reward to very specific, stress inducing threats. A number of theorists (Margulies and Wallace, 1973; Lewin, 1951; DeVore, 1994) have demonstrated that forms of sanction can be used as a positive means to influence human behavior [11]. The stress-inducing framework is focused on the mild forms for withholding reward or opportunity to create a positive stressor. This type of sanction can also include withholding something the person/team likes to do, if given the opportunity. An example of this strategy would be a school district's request for the sites to implement the technology standards. Those schools that do not implement the standards would take a cut in their supplies funding. This type of stress motivates some to respond, while others might say that it isn't fair.

Targeting: Targeting can be used as a stressor by bringing recognition upon an individual or team with the intent to motivate and/or change their behavior [12]. The research project at the Hawthorne Plant of the Western Electric Company in Chicago in the late 1930's offers evidence of the power of targeting or recognition [13]. The researchers of this famous study concluded that the 'attention' the workers received actually caused a positive change in production. This phenomenon is now termed the "Hawthorne Effect". In current times, an example used by institutions would be the public recognition of innovations or creativity by a team or department in fulfillment of their organization's mission for technology implementation. The team or department is offered some type of recognition certificate, luncheon/dinner, or possible bonus.

3. HOW DOES IT WORK?

The research to date indicates that thoughtful leaders of technology change initiatives should be cognizant of the five category positive stress-inducing framework and craft strategies for the use of appropriate stress. According to the DeVore, Van Vooren, and Ambriz-Galaviz studies, the most frequently used strategies are *norm discrepancy* and *targeting*, while *authoritative command, evaluation,* and *sanctions* are the least likely of the strategy choices used by successful leaders. However, all five strategies are used to some extent in leading technology change episodes. The evidence confirms the importance of this framework in the educational setting and strongly suggests the importance of its use in other types of organizations.

The key to using the five category positive stress-inducing framework is to be mindful of the need for, and the degree of, using a particular stressor based on the current motivation of the individuals or team. The leader needs to "turn up the heat" gently to motivate, but not so high that it can impede the desired change. For example, in the K-12 educational field, the implementation of a particular technology in the classroom will call for the different use of stressors depending on the individual teacher. Newer teachers or employees that are technology "natives" will need less stress applied to adapt to changes in technology than a veteran teacher who doesn't believe the changes in technology integration will improve instruction.

Another example is the implementation of a new Enterprise Resource Planning (ERP) system, designed to address the problem of fragmentation of information in business organizations. The leader of this change episode should consider which of the five stressor categories will best work for the implementation given their staff needs. For instance, the use of norm discrepancy would certainly be an appropriate stressor given this strategy focuses on what is, versus what is desired. Evaluation and targeting could also be appropriately used with management level employees charged with carrying out the different steps of implementation for the ERP System.

4. CRITICAL DEMAND FOR TECHNOLOGY

Today's schools and organizations are challenged with tightening budgets, rising accountability mandates, technological advances, and the continuous demographic changes within the institutions. Engaging the younger student requires the integration of technology tools as part of the learning experience. The educational systems from K-12 and the State California Community Colleges have all presented rationale for the progressive use of technology integration by current educators. For example as early as 1997, the National Council for the Accreditation of Teacher Education (NCATE) claimed that the new professional teachers of 21st Century "should help students pursue their own inquiries, making use of technologies to find, organize and interpret information and to become reflective and critical about information quality and sources" [14].

Following the No Child Left Behind Act of 2001, the California Department of Education (CDE) began funding statewide services designed to promote effective use of technology in the classroom. Jack Scott, Chancellor of the California Community Colleges stated 2009-10 challenged instructional practices due to an eight percent state budget reduction, while serving a three percent state-wide enrollment increase. He views this economic downturn as an opportunity for "colleges to fully utilize technology as a resource during these fiscally stringent times" [15]. Dr. Scott encourages innovation by colleges, especially in the use of online instruction, computerization of basic skills instruction in math and writing, and the use of academic advisement through online resources. These new approaches will maintain access to post-secondary education as well as increase course offerings to colleges with reduced facilities.

In the midst of the Information Age, Draves and Coates (2004) reference the development of technology and its influence on every aspect of life, from national and global economics to the impact of the internet and related technology tools, such as Facebook and Twitter [16]. As educational organizations move toward prioritizing technology tools, they are faced with the diversity of perspectives and range of skills possessed by educators and students, increasing the need for change and the likelihood of resistance.

The organizational commitment and/or implementation of blended (partially face-to-face) or online learning environments require effective leadership, planning and fiscal

commitments from school districts and organizations [17]. An investment must be made on a continuous basis for the training of teachers along with upgrades to the technology such as servers, connections, protocols, and course management systems. When online or blended courses develop, the leadership of these organizations needs to manage the stress of change in order to implement the technology resources effectively with their stakeholders, communities, and students [18].

5. THE USE OF POSITIVE STRESSORS FOR THE IMPLEMENTATION OF TECHNOLOGY

Organizational leaders must assess the level of stress and resistance its employees could experience, while pushing the organization toward the technological changes needed to remain competitive. Morrison (1998) indicates that the use of proven strategies enables a leader to lead change, manage transitions and create momentum toward the desired change [19]. The leader is able to create a scenario by which participants can connect with the suggested change and begin to envision the change initiatives [20]. For example, the stress inducing strategy of norm discrepancy will help educators compare their practices with other schools and see for themselves that delivering their course content in a variety of options can lead to a positive outcome. This allows individuals to use peers as a resource and embrace the change to move forward toward the new and unfamiliar aspects of the technology integration change initiative.

The proper selection of one or more of the five stress-inducing strategies: authoritative command, evaluation, norm discrepancy, sanctions, and/or targeting by organizational leaders to facilitate change will increase the effectiveness of implementing technology tools for teaching and learning. Hesselbein, Goldsmith and Beckhard (1996) contend that "true leadership must lead to change that translates into social betterment" [21]. Earlier examples of the five stress inducing strategies took into account the leader's ability to select the strategy best suited for his or her circumstance and the level of stress the teacher can take in terms of readiness for implementation. Along with the acceptance that uniform solutions do not work for all employees, schools, or organizations, selection of the appropriate stress-inducing strategy for change reduces resistance and leads to increased success.

6. CONCLUSION

In summary, leaders in education and other organizations are confronted with a multitude of changes in the environment of technology implementation as both a tool for communication and organization, and a strategy for instruction. The amount of pressure put on the organization and its employees by the leader to adapt to new technology will directly relate to the resistance that forms around technology implementation. As DeVore's model for the five positive stress-inducing strategies are introduced into organizational environments, leaders must manage the resistance and facilitate the process for change toward the desired technology integration goals in our schools.

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Using the iClicker Classroom Response System to Enhance Student Involvement and Learning

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ABSTRACT

Classroom response systems are emerging as a novel technology to enhance involvement and learning of a new generation of students. In this paper, we describe our experiment of using such a classroom response technology in an introductory computer science course offered to students of all majors. The results of the experiment provide evidence that the use of classroom response systems positively impacts student learning.

Keywords: Classroom Response System, Student Involvement, Student Learning, Computer Literacy, iClicker.

1. INTRODUCTION

Modern society is becoming increasingly dependent on information technology. As a consequence, the demand for skilled workers who can understand and take advantage of the new methods of communication and information management is also growing [6], [9]. This trend greatly impacts the mode of higher education in the United States by requiring that a computer literacy course to be an integral part of liberal arts education [7], [8]. Although this computer literacy course is typically a very basic course that offers simple fundamentals of computer and information technology, teaching this course is particularly challenging for several reasons. The group of students taking this course is typically very diverse with students coming from various disciplines and various backgrounds. While some students attending this course may already know a lot about computers, some students can be absolutely illiterate about computers. Therefore, presenting course material in a learning style that is optimal for such a wide range of students and fully engaging students during class periods pose a great challenge.

At Columbus State University, the authors have been experiencing the difficulties mentioned in the previous paragraph while teaching the introductory computer literacy course (CPSC 1105) for last few years. Since the course is relatively easy and not related to any major, students often appear uninterested and tend to skip lecture periods. Even if students are forced to attend lectures by enforcing attendance rules, they do not pay attention to the lectures and engage in other activities instead. The authors have tried various quiz schemes. Too many graded quizzes in addition to regular assignments and examinations created additional pressure on students and additional administrative activities for the faculty. On the other hand, students did not take quizzes that were not graded seriously. In either case, quiz schemes did not succeed in enhancing student involvement or learning for this particular course. As a result, the authors sought a different solution and came upon an emerging classroom response system called iClicker.

In order to study the effect of this new technology on student engagement and learning, the authors implemented the use of the iClicker devices in two sections of CPSC 1105, while using two other sections as a baseline. At the end of each class, students were required to complete a survey which was carefully designed by us to extract the views of students on the use of this technology and on the course. The authors analyzed the results of the survey as well as students' performance at the end of the corresponding courses. In

this paper, the authors describe our experiment, the results of the survey and the analysis of the impact the devices had on student learning in detail.

The paper is organized as follows. The next section contains a brief description of iClicker system including usage and costs. Section 3 documents outlines of previous research related to education and technology. In sections 4 and 5 we describe our experiment and the results correspondingly. The paper is concluded in section 6.

2. CLICKER CLASSROOM RESPONSE SYSTEM

2.1 The Technology

iClicker is a flexible and easy-to-use classroom response system, invented in 2005 by a team of physicists from University of Illinois [5], that enables students to instantly provide feedback and answer questions posed by their instructors. It is used in the following way:

- The instructor and all students each possess a portable handheld device called a "clicker".
- The clicker device contains several buttons (A, B, C, D, E), which when pressed, transmit a wireless signal to a wireless receiver, which is connected via a USB (universal serial bus) connection to a computer
- An easy-to-use iClicker application running on the computer allows the data received by the receiver to be managed.
- By registering his/her clicker with the receiving device, the instructor is able to use his/her clicker to manage the iClicker application and the data transmitted by the student clickers.
- To solicit student responses, the instructor first presents a multiple choice or true/false type question on a Microsoft PowerPoint slide, then starts a timer which allows student responses to be recorded.
- While the timer is going, the students can select an answer by "clicking" on the appropriate button (A, B, C, D, E) on his/her clicker.
- When a button on a student's clicker is clicked, a wireless signal is sent immediately from the clicker to the receiver.
- The receiver, through iClicker's application software, logs and stores the data of each individual student. If a student clicks on multiple buttons, the last button clicked is recorded.
- Using his/her clicker, the instructor can stop the timer which then discontinues the recording of any further responses until the timer is started again.
- The instructor can then use his/her clicker to display the correct answer and the response results including individual percentages in a bar graph. If the instructor chooses, he/she can also display the response results dynamically in a bar graph while the timer is still going.
- The response results are also available for later analysis, grading, and exporting to any gradebook software or course management systems.

2.2 Benefits and Issues

The iClicker classroom response system provides the following benefits:

- It enables an instructor to test for student understanding instantly in the classroom, initiate class discussion and enhance the quality of interactive teaching.
- The instructor can integrate iClicker with his/her course management plan and save student responses for later analysis. The instructor can make a variety of statistical analyses on student performance data collected using iClicker.
- This system enables students to anonymously respond in the classroom so that they are more encouraged to participate in classroom activity without any fear of being embarrassed for making mistakes. While this is an advantage from students' perspective, it prevents the instructor from knowing individual performance of the students. Therefore, this classroom response system is not a replacement for quizzes, assignments or examinations.

3. RELATED RESEARCH

As an emerging classroom response system, the use of iClicker technology is in its infancy and is not yet widespread. A few reports have been published in 2009 Clickers in the Classroom conference [3]. Studies have been done on freshmen courses such as Introductory Geology, Communication, Psychology, Management, and Statistics in various universities across the United States. Issues such as student participation, anonymous response on sensitive issues such as gender bias or racial issues, teaching in a very large classroom were discussed in these papers. Dr. Terry Hancock, from College of Business at University of Louisville, documents his experiment with the iClicker system for managing large classroom and testing students' understanding of complex material in [4]. In [1], Dr. Leilani describes her experience with using the classroom response technology in Environmental Geology in order to enhance student participation in class. In [2], the author documents use of iClicker to enhance critical thinking in an atypical class on "Communication and Gender". All these experiments show that this novel technology positively impacts student learning.

4. ICLICKER EXPERIMENT AT CSU

4.1 Overview of the Course

Introduction to Information Technology (CPSC 1105) is an introductory, interdisciplinary course designed to

enhance students' knowledge of information technology. The course covers the nature of information, computer hardware, software, communications technology, and computer-based information systems. The theory is complemented by practical work aimed at gaining basic proficiency with different types of widely used application software including Microsoft Office (Word, Excel, PowerPoint, and Access).

4.2 Motivation for Using iClicker

The primary motivation for using the iClicker student response system was to enhance student participation in the classroom and actively engage students in the learning process thereby increasing student learning. As explained in the introduction, students who enroll for this course come from all disciplines at CSU with a wide range of background in information technology. Therefore, meeting demands of all students and engaging them in classroom activities is a great challenge. Schemes such as quizzes and classroom discussions have not yielded satisfactory results. Therefore, the authors sought a new solution with this novel technology.

4.3 Implementation

The study involved the two authors who taught four different sections of CPSC 1105 during the Spring 2009 semester. The course content, exams, assignment grading and other course material in the four sections were identical. The lectures delivered throughout the course were one hour and fifteen minutes in length and were based on the use of PowerPoint presentations provided by the textbook publisher. Except for individual instructor styles, the lectures were delivered in as much the same way as possible.

Unfortunately, the iClicker devices were not acquired until the second month of the semester. As a result, the devices were only used in the seven lectures following the midterm exam. Each instructor taught two sections of the same course – one in which the iClicker devices were used and one in which the iClicker devices were not used. Each instructor selected the weaker section with worse average student performance in the midterm for iClicker use.

The authors independently developed their own set of iClicker questions, ranging from 5 to 14 questions per lecture with a median of 8 questions.

5. RESULTS

5.1 The Survey for Students

Appendix A contains the survey (questions 1 - 20) that was administered to students in the two different sections of the course in which the iClicker devices were used. 43 students participated in this survey; 28% males, 73% females. Appendix A also contains the survey (questions 11 - 20) administered to students in the two different sections of the course in which the iClicker devices were not used. 50 students participated in this survey; 32% males, 68% females. To aid in comparing the results from the sections using the iClicker devices and the sections not using the iClicker devices, questions 11 through 20 of the survey administered to sections using the iClicker devices were identical to the questions 1 through 10 administered to the sections in which the iClicker devices were not used.

5.2 The iClicker Survey Results

Table 1 lists the mean responses for the survey questions administered to the two sections in which the iClicker devices were used based on a scale of 1 to 5. The questions are grouped according to the categories: Pedagogical Impact, Device Functionality, Delivery Methodology and Administrative Utility. The results from questions 2, 3 and 6 indicate the use of the iClicker devices had a significant impact on student learning, while the results from questions 8 and 9 indicate somewhat less of an impact though still positive.

Category	Question #	Mean Response
Pedagogical Impact	2	4.5
	3	4.2
	6	4.1
	8	2.6
	9	3.5
	10	4.4
Delivery Methodology	4	4.0
	5	2.7
Device Functionality	1	4.7
Device Utility	7	4.0

Table 1. Survey responses in sections in which iClickers were used.

As previously mentioned, the iClicker devices were used over a series of seven lectures. During the seven lectures, the number of iClickers questions asked ranged from 5 to 14 with a median of 8. According to the results from question 4, the students felt this number was appropriate.

In general, the type of questions asked was recall type questions. For example, "When a computer is turned on, the first step in the boot process is:". Although the results of the survey indicate the students felt this type of questions was relatively easy, these results need further investigating to evaluate their impact on student learning.

The results from question 1 clearly indicate the iClicker devices were easy to use. This information, however, would be more valuable in comparison to the use of other similar devices.

The final question, question 7, was designed to ascertain the student's willingness to accept the iClicker device as a method of taking attendance and earning grades. The results of the survey indicate the students would be willing to accept the use of the devices in this capacity.

5.3 Comparison Between Classes Using iClickers and Not Using iClickers

Table 2 provides the mean responses for the survey questions that were asked in all four sections of the course. As can be seen, except for the questions, "The course lectures were informative and helped me better understand the course material." and "I have developed a better understanding of the subject by taking this course.", the mean response in the sections in which the iClickers were used appear to be higher than the mean response in the sections in which the iClickers were not used. However, t-tests assuming equal variances showed that none of the paired values were significantly different at the 0.05 level of significance. The authors believe that the small amount of data and the assumption of equal variance contributed to this conclusion.

Question #	Mean Response in Sections Not Using iClicker	Mean Response in Sections Using iClicker
1/11	3.73	3.90
2/12	3.53	3.30
3/13	3.55	3.78
4/14	3.12	3.28
5/15	3.38	3.68
6/16	3.34	3.63
7/17	3.09	3.28
8/18	3.66	3.90

Table 2. Comparison of survey responses.

5.4 Impact on Student Grades

Table 3 lists the percentages of grade distributions in the two sections in which the iClickers were not used compared to the two sections in which the iClickers were used. The results are also displayed graphically in Figure 1.

As previously mentioned, the sections with worse average midterm performances were selected for iClicker use. Table 3 and Figure 1 show that while the percentage of students who received passing scores just after the midterm exam was higher in the sections in which iClickers were not used, the percentage of students who received a passing score at the end of the course was significantly higher in the two sections in which the iClickers were used. In addition, the number of students who received a passing grade decreased between the midterm exam and the final grade in the sections in which the iClickers were not used, while the percentage of students who passed the course increased in the sections in which the iClickers were used. Likewise, the percentage of students who received a non-passing grade was lower initially but increased in the sections in which the iClickers were not used, while the percentage of students who received a non-passing grade was initially higher in the sections in which the iClickers were used, but which decreased between the midterm exam and the final course grade.

	Without iClicker		With iClicker	
	Midterm	Final	Midterm	Final
A	11.5	40.7	16.7	14.0
B	50.7	31.5	35.4	42.0
C	24.4	11.1	29.2	32.7
Total Passed	86.7	83.3	81.3	88.7
D	3.8	7.4	6.3	6.5
F	9.5	9.3	12.5	4.8
Total Not Passed	13.3	16.7	18.8	11.3

Table 3. Results (values in percentage)

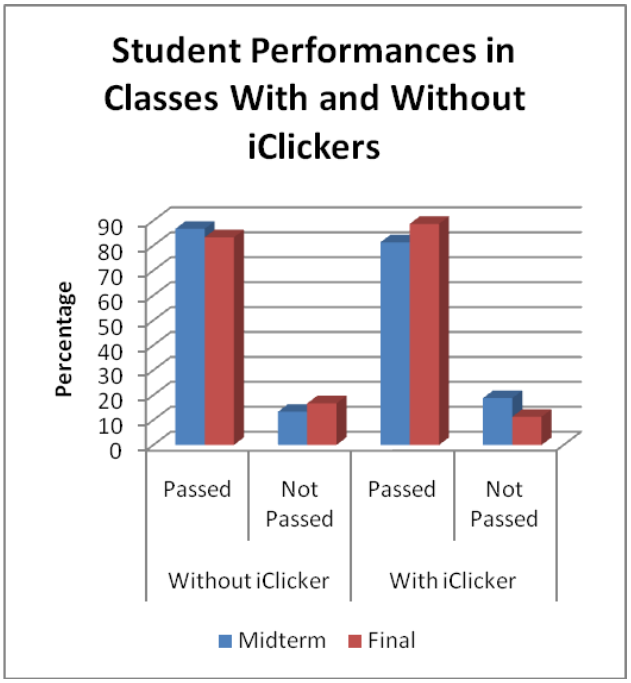

Figure 1: Performance comparison between classes with and without iClicker

6. CONCLUSION

The results of this study provide evidence that the use of iClickers positively impacted the students' learning during the course. These results are supported by the increased number of students who received passing

grades in the course in the sections in which the iClickers were used. However, these results are based on the limited sample size of four sections of the course, and are subject to numerous outside factors including possible instructor bias. Additional research is needed to substantiate these results and to provide clear evidence that the use of devices such as iClicker do indeed positively impact student learning. In addition, the survey results indicate that students preferred approximately eight questions per one hour and fifteen minute lectures. More data is also needed to support this finding as well as the optimal number of questions for maximizing student learning. Lastly, the type of questions asked during this study was general recall as previously mentioned. Additional research is also needed to support the impact of the use of different types of questions, including those involving teams.

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APPENDIX A
SURVEY ADMINISTERED TO STUDENTS

Questions 1 - 20 were administered to "iClicker" students; questions 11 - 20 were administered to "non-iClicker" students:

Question #	Question	Possible Responses
1	The iClicker handset was easy to use.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
2	The iClicker questions encouraged me to actively participate in lectures.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
3	Answering iClicker questions during the lecture helped me better understand the concepts in this course.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
4	The number of iClicker questions asked in class was:	3 = Too few | 4 = Just right | 5 = Too many
5	The iClicker questions asked in class were, on average:	1 = Very easy | 2 = Easy | 3 = Just right | 4 = Difficult | 5 = Very difficult
6	The iClicker questions helped me focus and pay more attention in lectures.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
7	Grades and/or participation points should be allocated for answering iClicker questions.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
8	The iClicker questions would have been just as useful if they had been presented in class without the use of the iClickers.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
9	The use of iClickers encouraged me to come to class.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
10	Overall, how would you rate your iClicker experience in this class?	1 = Very negative | 2 = Negative | 3 = Neutral | 4 = Positive | 5 = Very positive
11	The course lectures were informative and helped me better understand the course material.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
12	The textbook helped me better understand the course material.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
13	Assignments in this course were appropriate, reflected the course content and helped me to learn course material.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
14	The assignments in this course were:	1 = Too easy | 2 = Easy | 3 = Appropriate | 4 = Difficult | 5 = Too difficult
15	MyITLab is an effective learning environment:	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
16	Splitting the course into a lecture period and a lab period helped me to learn course material.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
17	The overall difficulty of this course was:	1 = Too easy | 2 = Easy | 3 = Appropriate | 4 = Difficult | 5 = Too difficult
18	I have developed a better understanding of the subject by taking this course.	1 = SD | 2 = D | 3 = N | 4 = A | 5 = SA
19	My gender is:	4 = Female | 5 = Male
20	Please provide any additional comments not covered above including suggestions for improving the course:	

Note: SD = Strongly disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly agree

Adding a Social Component to the Course Template for Teaching Asynchronous Online Courses

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ABSTRACT

In this paper we introduce the ongoing problem of how to best teach online courses in the computer information systems (CIS) field. Although it is generally thought that in most cases various methods should be used to extend traditional electronic communication tools such as email, discussion forums, and live chats, there is no universal agreement as to what those tools should be. The foci of this research are to 1) shed light on current teaching practices, 2) make suggestions for methods which augment traditional email, forums, and chats, 3) to provide some solid guidance to faculty as to what to use and how to use it, and 4) to increase stakeholder (student) satisfaction in part by increasing a sense of a virtual community in the online education being offered. Once the plan has been fully formalized, student feedback will be solicited to ascertain a measure of student satisfaction. Other outcomes, such as class participation levels, grades, and student interaction outside of "class" may also prove to be good metrics.

Keywords: Online teaching methods and tools, asynchronous teaching methods, sense of community, social networking, computer information systems education, virtual communities.

INTRODUCTION

Many university teachers are asked to teach courses as online courses, that they have traditionally taught in the classroom; under the assumption that methods, tools and approach will not change significantly. At F.I.T., as in many universities, faculty and students are given usage of a Learning Management Systems (LMS) and there are several to choose from. Mainly the LMS's are web site based, and offer facilities to exchange email, have discussion forums, hold live chats, and even offer virtual office hours. Some LMS's also provide gaming facilities, blogging, test taking facilities and drop boxes. If faculty want to provide media

such as video or audio, this is usually done separately with links to streaming media. With some faculty, video may be provided along with tutorials, links for learning resources, SKYPE, Powerpoint slides, and a wide variety of material to augment the text book for the course.

One thing universally agreed upon is that a component often missing from these teaching environments is a sense of belonging, student stakeholdership, and/or the sense of community that is inherent in face-to-face learning. With the bricks and mortar (BAM) or face-to-face classroom experience social interaction is naturally achieved by virtue of the fact that the students are physically already in a community and in a social environment in and out of the classroom.

The purpose of this research is to ascertain what our online faculty are currently utilizing in terms of methods and tools, what others are using and have found success with, and to propose some guidelines for online faculty to improve the current class template in use with CIS online classes. Concrete goals for this effort include 1) increasing student satisfaction and retention, 2) reduction of the disenfranchised or problem student by providing more (and different) communication options with classmates, professors, and other university personnel, 3) providing new places to house courseware services and resources, and 4) utilize social network sites to provide course materials outside of university LMS's and web sites. Finally, it is proposed that data will be collected to ascertain the effectiveness of any new social networking tools that are proposed by collecting data from students and faculty.

WHAT ONLINE FACULTY ARE DOING NOW

A voluntary anonymous questionnaire was given to the university's online faculty and 25 respondents were tallied. As a result it was ascertained that many or most of the faculty rely heavily on email and discussion forums for discussing course topics. About 75% of the faculty who responded also make available their phone numbers as a means of communication with students. All faculty have or currently use some sort of LMS such as Angel, Blackboard, WebCT, etc. 84% of respondents said they employed "forum" thread type discussion boards on the class's subjects. When asked if social networking types of phenomena were used such as Facebook, Myspace, Twitter, etc. roughly half claimed to use such tools and half admitted to not using these tools as part of the classroom.

The issue of student satisfaction with respect to the online course experience needs to be addressed, and it has been noted that the students of online classes are *far more likely to comment* on the teaching methods they experience in the online course, than in the face-to-face equivalent. Although it may be hard to prove, the general feeling is that adding a social component or extra multi-media set of components to a class may help in alleviating student issues and stress, for at least a particular subset of the student population.

WHAT OTHERS ARE DOING

The concept of including "the social dimension" for "Asynchronous Learning Networks" [4] is not new. In his work at the Centre for Language and Communication at The Open University in the United Kingdom, Wegerif "found that individual success or failure on the course depended upon the extent to which students were able to cross a threshold from feeling like outsiders to feeling like insiders."[4]

Since CIS is part of the computer sciences, there are topics such as programming, project management and development, and the design and creation of systems which might benefit from an increase of collaborative or social network based teaching methods. These topics, furthermore, are often best taught using teams or groups. Recently, several online teachers in the field find that social networks can assist in assembling and managing such teams within an online course. [1][2]

Wegerif defines specific stages in his courses for "a collaborative learning exercise" [4] where students were divided into groups of 3 and whose primary means of collaborative discussion was via email. He also mentions unstructured and structured collaborative learning.

Jim Waters at "The iSchool" at Drexel University, also has published some very interesting ideas with regard to managing group knowledge in an online learning system, and the role of the "thought-leader".[8]

STUDENT FEEDBACK

In [4], in-depth interviews with students revealed some interesting feedback. Some of these are listed below along with feedback accumulated by the authors:

- Missed time at the synchronous meeting points (like chats) was hard to "make up".
- No instant feedback as in a face-to-face learning environment.
- There were issues with not having speaking as a means of communication since the student got bogged down with writing (and typing) all questions and communiqués with other students and teachers.
- Students (and teachers) often feel overwhelmed with the perceived requirement of reading through emails and courses materials, almost on a daily basis, citing the time consuming task of "catching up" to emails and forums when posting, especially when communication speeds up.
- With CIS related topics, difficult or highly technical concepts related to computer hardware, programming, systems administration, various areas of mathematics or other specialized sub-fields like graphics, networks, databases, etc. can provide unique teaching challenges since they are part of a hard science and non-subjective by nature.

Some of the more positive feedback includes the fact that asynchronous learning and communication provides more of an opportunity for reflection for a student, than being called upon in a classroom, for instance. Working remotely at one's own pace, is another very common perk mentioned by the typical online student. All of the apparent benefits to online learning will not necessarily be listed here.

EXAMPLES OF SOCIAL NETWORKS

Online or 'virtual' social networks have been developing at an amazing pace over the past three decades [7]. Some examples include:

- Myspace
- Facebook
- Youtube
- Bebo
- Cyworld
- Twitter
- Flickr
- Yousendit
- Cyberchair
- Blogspot
- LinkedIn

Liccardi, et.al. define "social networks" as "a social structure of nodes that represent individuals (or organizations) and the relationships between them within a certain domain."[1] This definition also permits the idea of the strength of interconnections between the nodes in the network. This concept allows a measurement (or weight in a network graph for instance) of the strength of the tie between the nodes, or in this case the participants (usually students) in the network. It is also similar in concept to the "threshold" experience as told by Wegerif; which defines a student's success in collaborative online learning as satisfying the requirement of the student to cross a certain *threshold* "into full participation"[1]. He even concludes that those students who had "gained the most from the course" showed movement from the feeling of being an outsider, to being an insider. This measure of interconnection

might be a way to measure the buy-in of the student to the methods of teaching the courses that they participate in. In a sense this forced online collaboration through some type of social network is a sort of replacement of a face-to-face student who attends a course regularly and has a nominal amount of participation or interaction in the classroom and/or who builds relationships with students, colleagues, and teachers which are of a face-to-face social nature.

In their research at the University of Vienna, Figl, et. al. were able to get students to formally define their inter-student collaborative relationships (constructed in a virtual community) three ways: 1) as a "weak relationship" (as only "study-related"), 2) as a "strong relationship" which indicated that a friendship had developed with a study partner, and 3) somewhere in-between the two type of relationships.[2]

In [1] Liccardi offers up the example of the traditional "Software Engineering project groups" as another example. And Wegerif defines a "stage" in the course where the collaborative learning exercise is defined as groups of students (usually 3 in number) who are tasked to "work out responses to specific questions about online course design." [4]

AN AUGMENTED COURSE STRUCTURE

Let us propose a course structure for distance learning faculty that will include several components described below. Some (the first 3) are already standard and commonly used components and are in no way something new and are easily provided via the various LMS's in use. The last component, a social networking component, is to be the focus of this study. The usual components most online faculty use include as a minimum:

- course email (via LMS or other university server)
- "Live chats" via the LMS, (synchronous, and usually archived)
- links to and/or downloadable documents which include reading and reference materials such as texts, slides, papers, handouts, or other "borrowed" multimedia

Note that the above practices are considered somewhat standard practice currently at F.I.T. as a minimum for most CIS MS online classes.

The proposed augmentation is the following:

- A collaborative or social project that may or may not be team oriented that requires the use of some social networking tool or web site and purposely has the well defined goal of teaching one or more central topics of the course. This we will call the "social/collaborative component" of the course and is defined and explored in the next section.

The Social Component The social component is defined above as something that CIS faculty will be asked to add to their online course pedagogy.

Based on our experience, a common thread of dissatisfaction as expressed by students is often related to a feeling of isolation or of being an outsider looking in. Another is overall dissatisfaction with teaching methods within the online paradigm. Quite often this is coupled with stress or a feeling of being overwhelmed with the amount of interaction required via email as a communication means to ask questions or solicit help surrounding difficult topics in the course. This can be the case where course delivery relies too much on email.

Therefore, the addition of the social component strives to provide a better sense of community, while allowing for a new medium to present pertinent resources for the topics to be learned. Regardless of the details, this social component should have the following characteristics:

- The social component will strive to teach 2-3 central topic areas and the structure of the component may change based on the type of topics to be covered.
- Topic areas for the social component should be carefully chosen. They should be core areas of the overall course material or they may be "problem areas" which are defined as topics that students in the past have had trouble with.
- Deliverables and grading requirements for these components should be well defined and should take into consideration group work or team related activity if appropriate.
- At this time, the intent is to implement this social component outside of the course LMS.

There are different ways that learning pedagogies can be extended to achieve the above goals, and for the time being a Facebook page for MS/CIS students at F.I.T. is proposed. If it is later decided that another social network is better suited to meet aforementioned goals then it will be used; i.e. the authors are open to deliberation on the choice of the delivery site. For the purposes of this paper, Facebook will be used. In a sense, the BAM classroom setting is equated with the use of the LMS, and the use of Facebook here will simulate to a certain extent study groups, project groups, and/or other open forums to facilitate a more open and non-moderated environment. It will also be a collective resource site for materials not owned by the university.

Ways to use Facebook (FB) as an augmentation to the current online course template:

1. Implement a group project which crosses section boundaries. This would allow students to use FB to share information since LMS course sites are often section based. The actual FB page could represent "all MS/CIS students" or "all MS/CIS students in a particular class". The purpose of the FB page here would be to facilitate student interaction beyond class section boundaries and to provide an environment for students to problem solve or think tank like they would outside the traditional classroom.

2. Create FB pages which provide resources and links to specific multi-media artifacts (video, flash, podcasts, etc.) which tutor or teach specific topic areas of the class (see "central topic areas" mentioned above).

3. Assign students the tasks of creating courseware materials to be deposited someplace (like YouTube perhaps) with the intent of building a compilation of resources, not only with contributions by faculty, but also with content contributed by students.

Let us explore the above ideas further. With idea #1, where group projects are formulated which cross section boundaries several issues arose immediately. Firstly, administration and faculty need to buy in to these methods since it requires cooperation at a level above the faculty level. This can be problematic. Also, it is feared that one might create an environment for fostering unhealthy student collaboration (i.e. cheating).

With ideas #2 and #3, the intent is to provide a central and permanent point for resources which go above and beyond any particular LMS course site tied to a section. So for instance, a Facebook page for MS/CIS resources could be created with various links to web sites, tutorials, research papers, call for papers, etc. of interest to the typical CIS student. Artifacts and information can be submitted by students or faculty. The intent would be that there would be some sort of moderation so that items deposited would have content of merit; i.e. since there is a lot of unrelated and "off-topic" information that gets posted on web sites these days. Topical correctness, when it comes to posting student or faculty produced tutorials or materials on a particular course topic can also be an important issue; i.e. changing powerpoint slides is not an issue if course topic content is incorrect, but modifying incorrect audio, video, flash, etc. can be more problematic. Course projects may require that a student submit such artifacts, and these projects could be individual or group.

For example, if one wants to teach the IEEE standard (754) for representing floating point numbers (a core topic in our Computer Organization course), then some sort of collaborative assignment allowing students to create a tutorial on the topic with many examples of floating point conversions might be an example of a social component or assignment requirement for the course. Once tutorials such as this are collected and deemed correct content-wise they can be deposited on the Facebook MS/CIS page, and can be used for other sections of the class. This also supports the 'you learn it best when you teach it' philosophy.

CONCLUSION

At F.I.T. and under the authors' direction and management, CIS classes have been offered towards a Master's degree in CIS for 5 years now. Technological and educational breakthroughs now make it possible and imperative to constantly be upgrading communication media for online classes. F.I.T. is a university and not a business. So academic standards and contact hour equivalents must be part of the equation when designing an online course. However, in today's competitive market we are constantly striving to meet the demands of quality and well-meaning students who essentially are our customers. Furthermore, there can be no threat to academic freedom, so guidelines and recommendations for online courses must be chosen carefully.

A questionnaire for 25 online faculty was administered. Results showed that several LMS's are being used, but that most of the courses delivery methods tend towards email, forums, and live chats as the standard means of teaching topics. Different topic areas to teach in a class require different strategies for topic dissemination. We find that it is best to keep students busy and it is often the better approach to provide several resources with varying teaching styles which cover and explain the same topic. In the BAM case, these varying teaching styles may include 1 on 1 tutoring or interaction with student and teacher or it may include group projects or extensive discussion in class. With the online format, the intent is to provide substitutes for BAM methods.

Further research into other university efforts at the University of Vienna, the Open University, Oregon State, Drexel, and universities in the UK have shown some perceived success using collaborative or social networking type methods to help achieve a sense of a virtual community within and outside of the boundaries of traditional online classes.

As a result of this research, some guidelines for augmenting our courses with a "social component" will be created and implemented in 2010 and then finally will be reported upon based upon student and faculty feedback.

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The Effect of Instructional Technologies on the Socio-Cultural Competence of the FL Learners

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ABSTRACT

This study investigates the effect of instructional technologies on the socio-cultural competence of the FL learners. The study seeks to answer the following question:

- What is the effect of instructional technologies on the socio-cultural competence on the tenth grade students?

The sample of study consisted of seventy six tenth grade students in Al-Mamlaka private School for Girls in the first semester of the academic Year 2008-2009.

Section (A) consisted of (40) students. It was chosen as a control group, while section (B) consisted of (45) students. It was decided as an experimental group.

Data were collected within six weeks.

The pre-test and the post-test were of two parts; a written part and oral dialogues that test the FL students' ability to interact culturally, appropriately in communicative settings.

A- The results of the study have shown: There is a statistically significant difference in the arithmetic mean in the achievement test for the experimental group it means that the experimental group was better than the control group.

B- Using instructional technologies alongside the traditional method has great effect on the socio-cultural competence of the FL learners.

The researcher has recommended making many studies about the effect of instructional technologies on other competencies of language.

Key words: Socio-Cultural Competence, Instructional Technologies, FL Learners, Authentic Material, computerized FL Classes.

1. THE SIGNIFICANCE OF THE STUDY

The twenty-first century is a time of great growth in the development and an employment of instructional technologies in teaching.

In language teaching language should be taught with is culture because being linguistically competent does not guarantee effective communication: This can be achieved by using multi-media in our FL classes.

2. PROBLEM OF THE STUDY

A long experience of working as a FL supervision, curriculist , textbooks writer and teacher of BA, MA and ph. D students have shown that most of FL do not speak authentic English because they think in Arabic so what they speak is Arabic because language is the body and its culture is the soul.

This problem stems from the fact the English is at most taught traditionally without using any technology that gives student a chance to acquire English in real life situations.

The Significance of this study assimilates in the following points:

According to the researcher's best knowledge, it could be one of the few studies that examine the effect of multi-media on the socio-cultural competence of the FL learners.

The findings of the study might be officially a doubted schools use multi-media in teaching English.

3. Introduction and theoretical background

Foreign language learners should acquire a language with all of its competencies such as the socio-cultural competence through formal and informal instruction. This can be achieved by having films, maps, videos, LAPs, OHP, DVD, realia and tape recordings of language with all of its regional and social varieties, because formal instruction and giving rules alone is not enough.

Such indications will help foreign language learners comprehend the facial expressions, the body language, the air-stream mechanism and the musicality of sounds of the people of the foreign language that usually embody part of the meaning of messages. Moreover, these elements unquestionably vary from culture to another.

Exposure alone is not enough for having autoimmunization and internalization of the cultural content of a language. Besides much exposure, there should be much practice of the foreign language, because more practice leads to more proficiency and productivity in that language. This orientation is built on the psycholinguistic theory which emphasizes the view that language is speech.

This study deals with the EFL teachers' techniques while teaching cultural content Moreover, it suggests many practical techniques to improve the teaching of cultural content. Additionally, it examines the effect of such technology on the socio-cultural competence of the learners.

4. HYPOTHESIS OF THE STUDY

The study attempts to test the following, hypothesis 66, students who "study English language through multi-media are more socio-culturally competent than students who study English traditionally".

5. THE AIMS OF THE STUDY

The purpose of this study is to investigate the following research question!

1. Do instructional technologies have effect on the socio-cultural competence of the tenth grade students?

6. THE OPERATIONAL DEFINITIONS

Socio-cultural competence.

7. LIMITS OF THE STUDY

The study is limited to:

1.Students in the tenth grade in the first semester in the academic 2008-2009.

8. REVIEW OF RELATED LITERATURE

Hendon (1980) and Valdes (1986) state that EFL teachers' should become knowledgeable in the target culture. They believe that teachers' competence in a foreign language requires more than a good command of that language. It also involves understanding of the values and traditions of the people of the target language.

Hendon (1980) asserts that it is the responsibility of the teacher to clarify the cultural habits of the native speakers and bring them to the conscious level that the students can begin to realize their own cultural values.

Similarly, Brooks (1989) emphasizes the importance of the teachers' role in making cultural aspects explicit while teaching literature. She adds that teachers should

do anything possible to bring materials alive by utilizing pictures, films and any other resources. In this regard, Lado (1964:31) states that the teacher is responsible for guiding students into genuine experience in the foreign culture patterns and meanings. According to Barnett (1989:117) teachers must provide necessary background information for texts from unfamiliar culture backgrounds.

Likewise, Rinehart (1997) emphasizes the responsibility of FL teachers for teaching cultural aspects explicitly. She states that the focus on communication and interaction that characterizes foreign language instruction today demands that foreign language teachers be skilled methodologists and possess a high level of language and cultural proficiency.

Stroller (1990), Posthofen (1994) and Swaffar and Vlatten (1997) advocate the use of visual approach using photographs and video use of advancing technology such as interactive media to present audiovisual materials. They point out that visual approach enhances cultural understanding. Furthermore, it links linguistic performance, communicative and cultural awareness in the classroom. But, using films and videos as teaching tools requires careful selection, purposeful planning and extensive teacher preparation.

9. THE SAMPLE OF THE STUDY

The sample of study consisted of 121 students studying at Al-Shimasani Al-Karbi School for Gils. They were distributed in three sections. This School was randomly chosen from the total number of schools in Amman Directorate. It was Al-Shimasani Al-Karbi School for Girls.

In that school there were three sections of tenth grade; section (A) consisted of (40) students. It was chosen as an experimental group.

It was taught via multi-media, section (B) was chosen as a control group. It was taught with traditional method and it consisted of 45 students. Section (c) consisted of 36 students. It was decided for the pilot study.

10. INSTRUMENT OF THE STUDY

The researcher used a pre-test and post test technique. All sections (A,B,C) were taught by the same teacher. Classes were taught on the same days (Sunday, Monday, Tuesday and Wednesday). All students have never visited a country from the English language community.

Section (A) that was assigned as an experimental group was taught via multi-media where they were exposed to authentic English in authentic real life situations where by students can witness native speakers of English interact within their cultural world.

Additionally, after watching films and videos, students are involved in communicative oral activities to internalize what they have watched through the multi-media. Moreover, Students of section (A) were free to watch the videos out side of class at home.

While, section (B) what way chosen as a control group were taught traditionally without using any technology.

The pretest and the posttest were scored in the same manner. They were interviews in the pre-test and post test by native speakers of English on topics that are related to the culture of the English language community. The average mark given by the examiners for each examinee was taken.

11. POCEDURES

To assess the effect of multi-media on the socio-cultural competence of the FL learners of the tenth grade. FL students in both sections took a multiple-choice test and an interview at the beginning of the first semester of the academic year 20008-2009 to determine their actual socio-cultural knowledge before starting the experiment. After six weeks, an identical posttest was administered. The teacher informed the students that neither the pretest nor the posttest would count to their final grades in the class. The pre/ posttest was contracted based on the cultural information contained in the multi-media. The test examines the learners' ability to function in a native community of English; communicate in a cultural context. Social patterns and situations with social institutions (e.g., education, government, transportation, religion, history, geography, national products, literature and fine arts.

12. RELIABILITY OF THE TEST

To assess the reliability of the pre/posttest instrument, a reliability sample was constituted. Tenth grade section (c), in the same school was decided for the pilot study to assess the reliability of the test. This section consisted of 40 students. They took the test twice in two different times with in a week. They were scored by two different teachers. Means and standard deviations for the two tests are presented in Table (1).

The results did not differ. Test performance did not increase from test one to test two.

Table (1)

T1	T2
0.63 (0.24)	0.62 (0.25)

By using Pearson's formula, the pilot administration of the test have shown that the correlation coefficient between students' ranks on both testing occasions were computed and found to be very close. According to Pearson's formula, the reliability coefficient of a test would be acceptable it is less than (0.50). they the test.

13. VALIDITY OF THE INSTRUMENT

Both tests with the interviews part were shown to four experts who were natives of English (one of them was an American the second was Canadian the third was British the fourth was an Australian). And they could therefore be well grounded in the target culture. All of the information on which students were tested could be found in what was presented using the multi-media. They gave suggestions to improve the tests, their recommendation were taken into account.

14. DATA COLLECTION PROCEDURE

All data was collected during the second half of the first semester of the academic year 2008/2009. The researcher gathered the necessary data to answer the question of the study by applying the pretest and the posttest on the groups of the study.

15. DATA ANALYSIS PROCEDURE

An independent-sample t Test was carried out to measure the gain scores of both groups on the pretest and then in the posttest.

In addition, to eliminate any possible difference, between the two groups in pretest, a One-Way Analysis of Covariance measured the gain scores of the subjects.

16. STATISTICAL MEANS

The researcher has used these statistical means, standard and percentages to find the difference between the arithmetic means according to the question of the study.

17.RESULTS OF THE STUDY

To assess changes in overall cultural knowledge by using multimedia and a traditional method, and by using the

proper statistical means, the researcher found out that there is a significant difference in the socio-cultural competence of both groups in the post test in favor of the experimental group, therefore the hypothesis which reads multi-media has a grate effect on the socio-cultural competence of FL learners is confined.

Table (2)

Results of the test of the Means of the achievement of the two groups on the pretest

Group	N	Mean	Std. Deviation	T	Sig.
Control Group	45	78.80	16.89	-0.161	0.873
Experimental Group	40	79.52	14.76		

Table 2 shows that the difference between the scores of both groups on the pretest is not statistically significant. Since there is no statistically significant difference between the control and experimental groups in the pretest, another independent-samples t test was conducted to determine whether or not a statistically significant difference exists between the two groups' performance in the posttest. Table 3 shows the results.

Table (3)

Results of the test of the Means of the Favor of the experimented of the two groups on the posttest

Group	N	Mean	Std. Deviation	T	Sig.
Control Group	45	78.80	16.89	-2.058	0.045
Experimental Group	40	93.00	.80		

Table 2 shows that there is a statistically significant difference between the performances of the two groups. This difference indicates that using the multi-media in English language teaching to tenth grade students has positive effect on the socio-cultural competence of the learners where the mean score for the experimental group is 93.00 while for the control group is 78.80.

18. DISCUSSION OF THE RESULTS

This study attempts to test the hypothesis, "multi-media has a positive effect on the socio-cultural competence of the FL learners". The results of the study have shown that there are no significant differences between the achievement of the experimental and the control group on the pre-test. This indicates that the two groups are equivalent in this respect. However on the post-test, the results have shown there is significant difference in favor of the experimental group.

The findings of the present study suggest that the tenth grade students of English have developed their cultural knowledge over two month of a semester through exposure to instructional technologies. At the beginning of the semester, students took a pretest on the socio cultural competence which they acquired through the multi-media during the semester. At the and of the study, they took the same test (posttest) and scored statistically significantly higher. This result confirms the hypothesis of the study.

By the end of the experiment, student of both groups were interviewed. They were put individually in cultural situations to which they were asked to react in English in a culturally appropriate manner. The cultural information contained in these dialogues can be found in programs presented using the multi-media. The test was taken at the end of the experiment. Students met individually into the room where they were interviewed by native speakers of English.

19. CONCLUSION

Multi-media has a grate effect on the socio-cultural competence of the learners, in the sense that it increased there overall cultural knowledge of the English language community. This competence should be highly considered in our FL classes because language can't be taught without its culture.

20. RECOMMENDATIONS

1. The researcher recommends making many studies about using multi-media and their effect on other competences of language.
2. The ministry of education may be called to hold training programs to assist teachers in attaining ability to tackle cultural content while teaching language.
3. EFL teachers should be encouraged to use different instructional technologies in the FL classes.

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Using LAMS to design Nursing Learning Scenes

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ABSTRACT

LAMS is the acronym of Learning Activity Management System. This system was created with open source and General Public License (GPL) that let share learning sequences experiences [1]. By a hand the information and communication technologies spread us each day more options to improve the teaching-learning process. In the other hand the semi-distance education has demonstrated its utility in the health sciences learning [2]. In this work we describe our experience in the use of LAMS to improve nursing learning like part of a semi-distance activity named: Classroom-workshop about care during normal delivery by using simulators.

Keywords: LAMS, graduate nursing education, nursing care, maternal and child nursing, education distance, clinical competence.

1. INTRODUCTION

LAMS is a revolutionary new tool for designing, managing and delivering online collaborative learning activities. It provides teachers with a highly intuitive visual authoring environment for creating sequences of learning activities. These activities can include a range of individual tasks, small group work and whole class activities based on both content and collaboration. LAMS isn't a distance course that the students do alone. The LAMS activities are designed to work in collaboration with the class partners and the professors. The aim is the integrated and interactive learning.

LAMS features and benefits [3, 4, 5]:

- Adapt and share collaborative sequences based in good practices.
- Intuitive tools and user interface
- Easily sequence collaborative learning activities online
- Web based
- Live monitoring of student
- Standards based
- Open architecture for implementation
- Comprehensive administration interface
- The students can see their learning progress
- The teacher can assess the students with several strategies, and access to a portfolio from each student.
- Each activity may include competence that helps us to

2. THE LEARNING SCENE DESIGN

The learning scene: Classroom-Workshop about care during normal delivery by using obstetrical simulators. It is a blended learning program on undergraduate nursing students' learning of delivery care. (**Figure 1**)

Activity planning

This activity was designed to improve the nursing students´ competence of "to care women during the normal delivery and postpartum periods".
This is a learning activity within *Maternal and Child Nursing II*, a subject in the second course of the Nursing Education Programme in Cádiz University.
This subject has got 7,5 credits: 3 theoretic credits; 4,4 clinical practice credits and 0,1 theoretic-practice credits (the workshop).
To plan the activity we had account the needs of the nursing students, the disposable resources and the assessments learning techniques.
The used methodology integrates face to face learning and virtual learning, simulating the care during hospital delivery and postpartum (**Figure 2**).

Face to face learning
Consists of a sequence of activities in the nursing workshop using simulators:

Initial assessment of the pregnant woman (role playing)
Genital exploration
Breast exploration
Cervical dilatation assessment
Leopold technique assessment
Epidural anaesthesia
Delivery simulation
Episiotomy simulation

Virtual learning
Consists of:

The LAMS activity. We added it into the classroom in the academic year 2008-2009 (**Fig. 3**), in order to perform the workshop. The version used was LAMS 2.2.

3. THE LAMS ACTIVITY DESCRIPTION

The sequence of activities includes (**Figure 4**):

Welcome activity, with the initial instructions of LAMS activity.

Share resources. The students share resources between them and comment the suggestive resources by the professor

*Assess pregnant***.** It is an activity with a virtual patient. The students learn What, When, How to ask, and what to assess in the first interview, when the pregnant woman comes to emergency for possibly uterine contractions. Finally, the students must do a test assessment.

*Vaginal cytology sample***.** Video to learn how to do a vaginal cytology sample, using the gynaecologic simulator (The students do this activity later in the workshop)

Breast examination. Video to learn how to do a breast examination, using the breast exploration simulator (The students do this activity later in the workshop).

Amnioscopy. Video to learn how to do an amniocopy (The students do this activity later in the workshop).

Female pelvis. Video to learn how is the female pelvis, the bones ant the muscles using the female pelvis simulator (The students do this activity later in the workshop)

Assessment tests: Several test about:

Epidural anaesthesia. Include a forum to comment the care during this type of anaesthesia during labor, too.

Cardiotocographic fetal monitoring. This test is support by an atlas of cardiotrographic images

Drugs frequently used during delivery

Postpartum care an breast feeding education

The student's role

The activity is compulsory for all the students. The virtual subject classroom has all the information for the students support: workshop guide, methodology and assessment of the activity.

Each activity was edited in order to insert all the necessary instructions and collaborative resources to the students (**Figure 5**)

The students can consult their progress, use the notebook tool and to share their opinions (**Figure 6**)

This activity is made by the students after the theoretic credits and before clinical practice, in order to improve the learning progress, to apply Knowledge in clinical practice

The activity assessment is the 10% of the final qualification of the subject.

The professor's role

In LAMS activity, the professor acts not only like a teacher but selection and elaboration of learning materials, tutoring and planning the work of the students.

4. CONCLUSIONS

Our first experience with LAMS has been satisfactory. The aim object was that the sequence activity was than real as possible by using the adequate tools and resources, with collaborative and interactive participation (**Figure 7**).

Disadvantages:

- This is our first experience using LAMS
- The version used was LAMS 2.2 that has no much compatibility with Moodle [6]
- Like all virtual activities, it would be better than the design were complete before the beginning

Advantages:

- The students see the sequence of activities as a whole
- The students can see their progress
- The activity adds interactivity
- The activity improve the communication between professors and students and between students
- Each activity lets feedback
- The activity has got an award by the University like recognition
- We can share the activity. In fact, the activity is free available in the URL: **http://lamscommunity.org/dotlrn/index**
- This experience lets us to get better next year, with LAMS v 2.3 [7].

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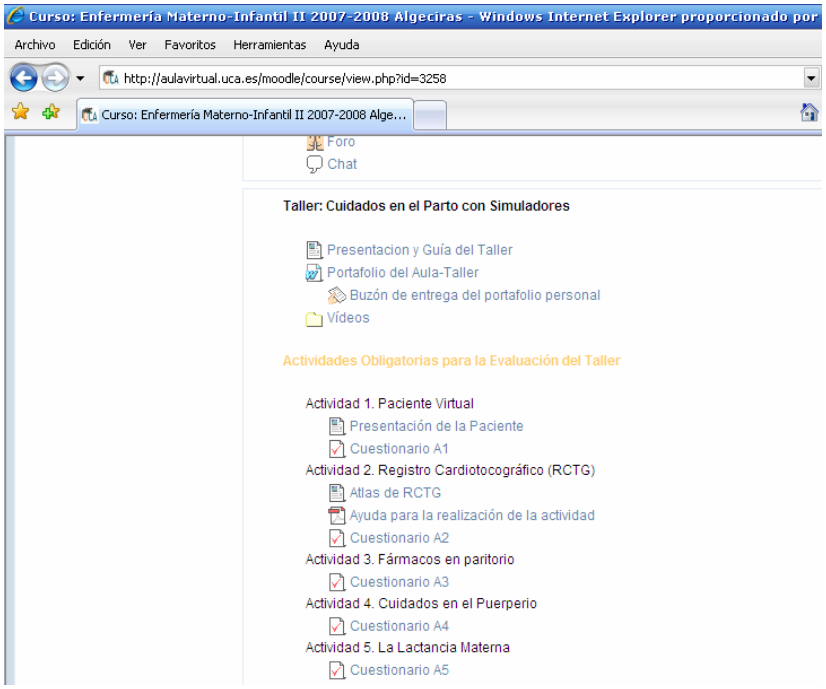

Figure 1. Workshop **"Care during normal delivery by using obstetrical simulators"**. Academic year 2007-2008. Information available in the virtual classroom of the Maternal and Child Nursing II (Moodle platform in virtual campus of Cádiz University

Figure 2. Web page with the guide of the workshop

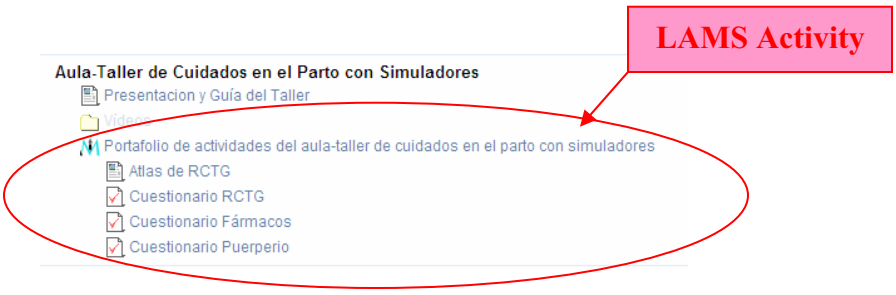

Figure 3. Design of Workshop "Care during normal delivery by using obstetrical simulators". 2008-2009 course. Information available in the virtual classroom of the Maternal and Child Nursing II (Moodle platform in virtual campus of Cádiz University

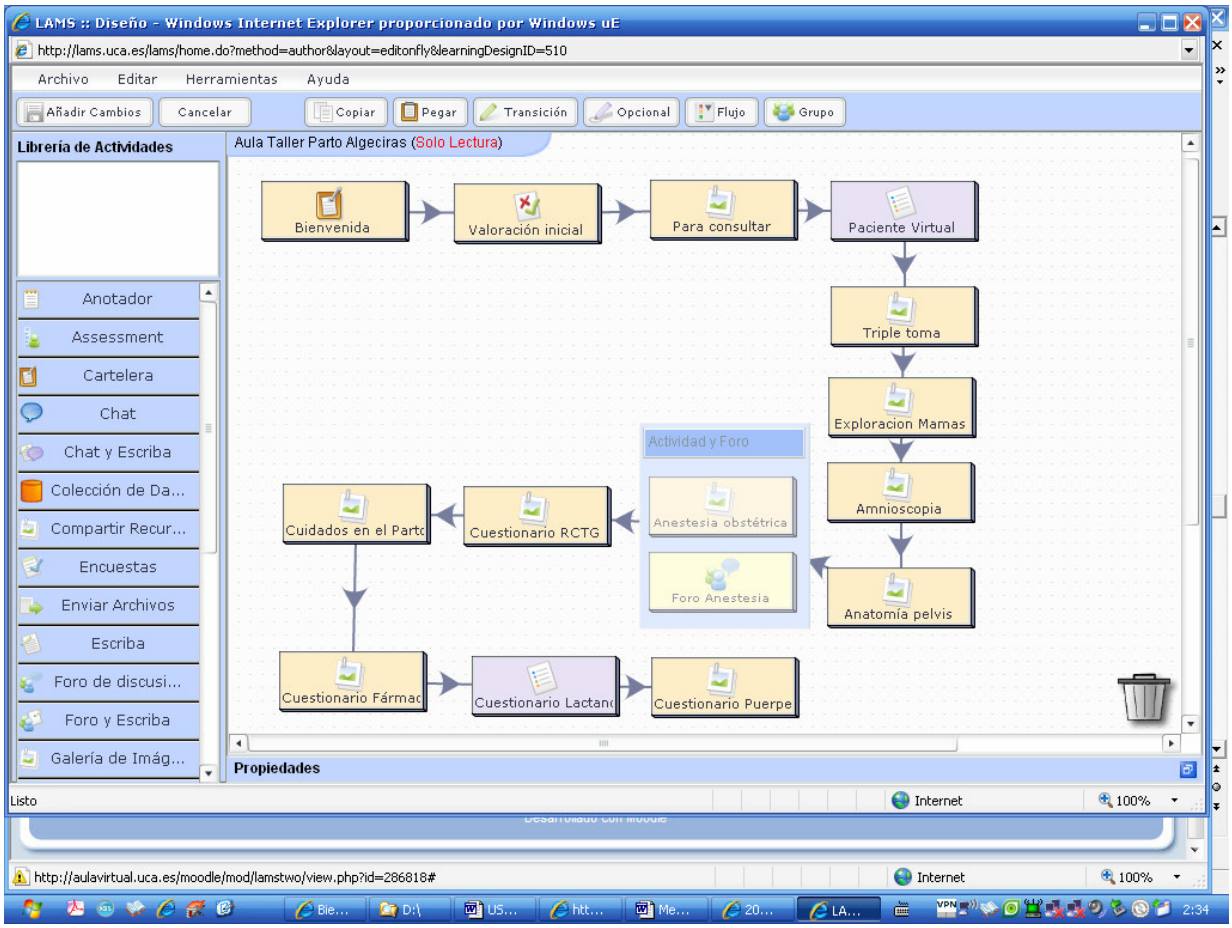

Figure 4. Monitor LAMS. Edition screen. Learning activities sequence.

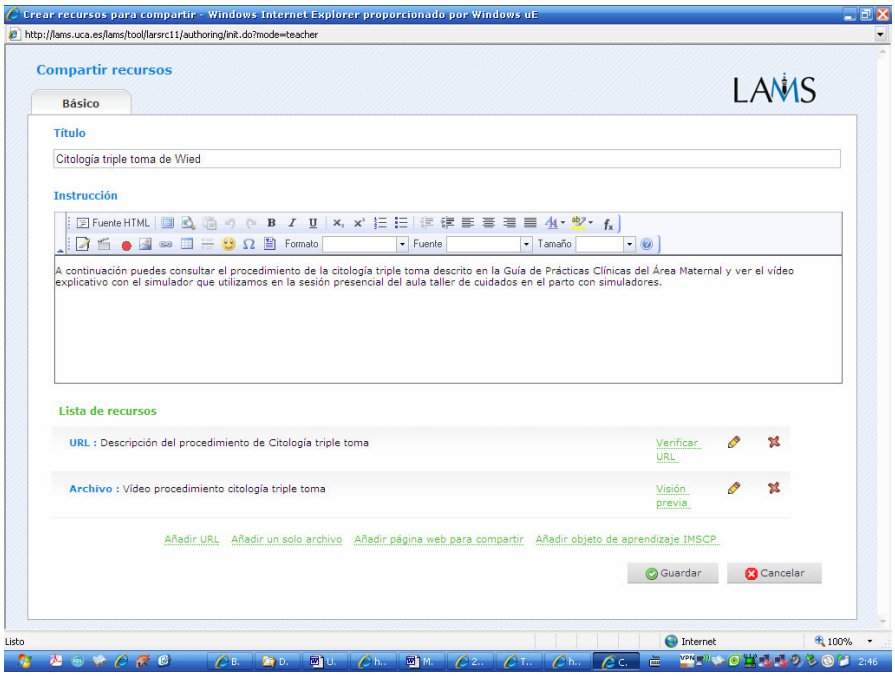

Figure 5. Editing the share resources tool

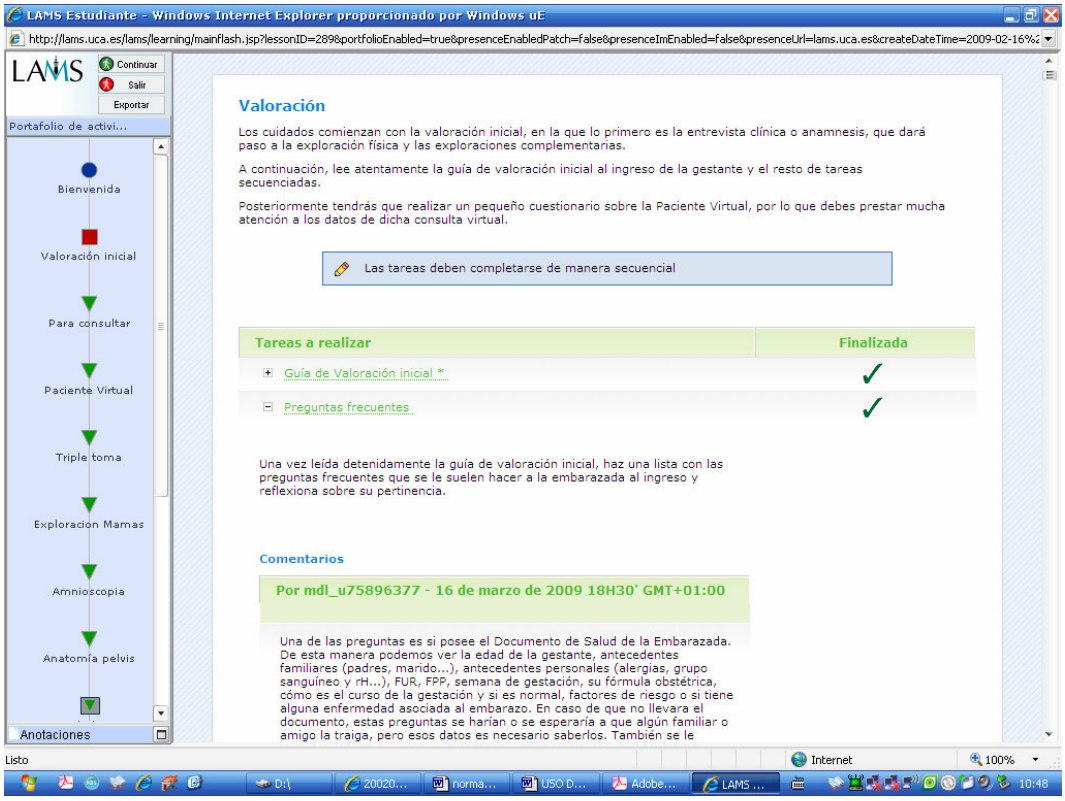

Figure 6. Learning activity: Initial valuation of pregnant woman: Student role. At the left column the students see the activities sequence and their progress: red square (actual activity); green triangle (the next activity); blue circle (the activities done yet)

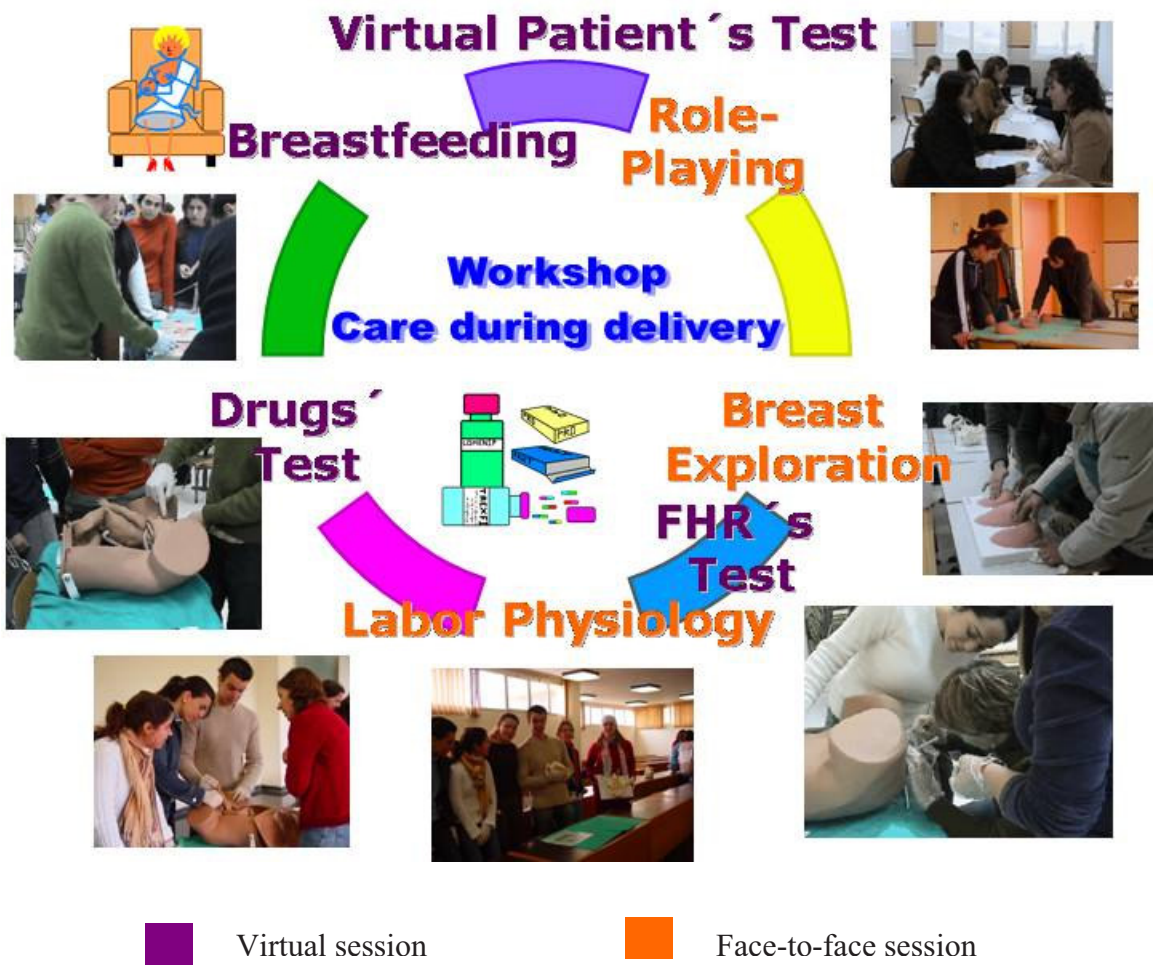

Figure 7. Scheme of the Workshop. The sequence of activities: Face to face session and virtual session

Design of a Network Management Course Using Virtual Machine Technology

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ABSTRACT

This paper reviews a recently redesigned undergraduate course in network management. By using virtual machine technology, a virtual network infrastructure that includes a set of virtual network devices is provided for students to gain practical experience in network management. The comparison between physical network management and virtual network management is described, and the course objectives and course lab design are explained. This approach has the benefit of cost saving, scalability, security, and easy maintenance.

Keywords: Network Management, Virtual Machine Technology

1. INTRODUCTION

Network management is a process of remotely or locally managing networks. A network administrator employs a variety of activities to detect, analyze, and resolve network problems in order to keep the network systems working properly. The activities include gathering the statistics of network traffic, recording network topology changes, adjusting network configuration, analyzing alert notifications, and monitoring any unusual events or equipment failures. By fine tuning these activities, the network can reach its greatest effectiveness.

Today's network infrastructures generally are complex and may include hundreds or thousands of network devices. For network management classes in an university, ideally students should have the opportunity to carry out hands-on labs in a real physical network such as the campus-wide network infrastructure. However this idea is unpractical because the result could be catastrophic if we dare allow inexperienced students to manage such a complicated network. A minor mistake could cause an entire network malfunction. For example, an incorrect change of a single network device or the misconfiguration of a software application may affect the usability of other network devices. Furthermore, it is difficult to create experimentally critical network scenarios for lab practice, such as tuning a router or a switch, rebooting a server, creating system events, or imitating malicious network intrusions. Hence the realistic solution of the network management course design is to create a virtual network environment that can reduce any possible hazard to the network. Any mistake can be easily fixed and the network can always keep up and running. In industry, virtualization has been used in many applications for training or for testing configurations or upgrades to avoid the possible damage to the production systems. Such examples can be found in medical simulators and flight simulators.

Instead of using an actual physical network, virtualization can also be applied in building networks by the use of virtual machines. Within a single physical host machine, multiple virtual machines are created and operated simultaneously. In each virtual machine, applications and services are implemented and the virtual machine executes the code just as a normal physical machine would. This virtualized approach provides not only an isolation environment from real physical system but also a safe environment where risky experiments can be designed. Hence, academic educators have increasingly adapted the concept of virtualization in developing on-campus computer courses to enhance student learning. The most recent examples can be found in the works of Hickman [1], Li and Mohammed [2], and Stackpole [3]. Hickman describes the current status of lab development using virtual machine technology at his school. With the use of VMware, labs of operating systems, data communications theory, information security, and computer forensics have been developed. For a course on intrusion detection systems, Li and Mohammed used VMware to create preconfigured virtual machines and network trace files for students' use. The students then installed those developed virtual machines and files in their own computers to conduct security related hands-on lab exercises. In the work of Stackpole, he describes his department experience in migrating from physical lab environment to virtualized lab environment beginning in the fall of 2005. He discusses various difficulties, such as manageability of imaging infrastructure and computing resource utilization that his department has encountered. However, the whole process proves that the direction of virtualization is correct and excited to both faculty and students. In the future, his department will continue to develop courseworks using virtual machine technology.

In this paper we present a method for a network management course using virtual machine technology. With a combination of VMware [4] and Dynamips [5], we design a virtual network infrastructure that includes a set of virtual

network devices. Its image is then uploaded to the Virtual Computing Lab (VCL) [6]. Students can then perform the activities of network management after they login to the VCL system. By using this virtualized network environment, advantages such as accessibility, cost reduction, scalability, individual laboratory networks, resource sharing, realistic environment, security, quick lab development and deployment, and maintenance minimization can be achieved [3], [7].

This paper is organized as follows. Section 2 presents a comparison between physical network management and virtual network management. Section 3 demonstrates the methodology. We then describe course lab design. Finally, we present the conclusions and future work in the last section.

2. PHYSICAL AND VIRTUAL NETWORKS MANAGEMENT

Generally five major categories have been defined in the field of network management tasks. They are fault management, configuration management, accounting management, performance management, and security management (FCAPS). They not only standardize network management activities but also provide functions to measure an organization's information technology infrastructure performance.

2.1. Fault Management

This provides methods to detect network problems and includes recording detailed system's status in log files and databases, examining recorded information to find system errors, defining possible systems' failures, and automatically generating alarms when actual malfunctions occur. In a real physical network system, administrators are notified only when real system errors occur and then they make proper responses. It is difficult to deliberately generate errors in a production network because the result could jeopardize the operation of the whole network system. However, system failures or errors can be safely artificially generated via a virtual network environment. For instance we can turn a router off, input incorrect authentication information when users try to access a system, change system time or the system contact person's data, and so on. Under a virtual network environment, the administrators do not need to worry that simulated errors will affect the normal network operation. By practicing these pretended errors, administrators can therefore gain experiences and make quick responses when real network problems happen in the real world.

2.2. Configuration Management

This includes both software and hardware configuration management. The former maintains the consistent performance of software when the software requires modification. The latter keeps track of information of all hardware components such as model names, physical locations, and links among devices. Both software and hardware configuration management provide a detailed up-to-date record of resources within the network. In a real physical network system, to add or remove a device such as a router, a switch, or a server, the network administrator needs to carefully setup both software and hardware links in order to make the entire network function properly. But when changing a virtual network environment, the hardware insertion or deletion is simple and no physical cabling is required.

2.3. Accounting Management

This function is to administer services of network systems, which include service usage maintenance, cost computation of services, and information notification of service usage to relevant users. In a real physical network system, to increase limitation of a service's usage may limit or block other services. However in a virtual network environment, the usage thresholds on services can be changed arbitrarily as long as the physical host capacities are not exceeded. According to the adjustments of threshold levels, the cost of resource usage can be calculated and the most economic setting can therefore be found.

2.4. Performance Management

This involves collection of data from network equipment for the purpose of system performance evaluation. After carefully investigating the collected information, the effectiveness of the network can be obtained and resolutions can be found to improve the overall network performance. In a real physical network system, the statistical information of network devices is collected by polling and requesting information from objects on devices only under normal system operation conditions. However, it is easy to simulate critical conditions in a virtual network environment to collect important system information. By configuring device threshold levels as well as generating traps from agent devices, valuable information can be collected and analyzed. Network performance can therefore be well understood.

2.5. Security Management

This involves the identification of threats from both external unauthorized intruders and internal legitimate users who are trying to exploit security vulnerabilities and misuse their assigned privileges. In real world modern computer systems and networks, hackers constantly develop new attack techniques to exploit security vulnerabilities of organizations. Not only are these attacks becoming more numerous, but they are also becoming more sophisticated. In a real physical network system, threats are difficult to anticipate and the network systems can be damaged when attacks are not properly defended. As attacks become more sophisticated, it is often difficult to discover the attacks until a system is compromised and damage as been done. Such damage sometimes can easily cause millions of dollar loss to an organization. But with the use of a virtual network environment as a laboratory environment, it is not necessary to be concerned about the attacks causing damage to the network. For discovering potential breaches of security and open vulnerabilities of systems, anomalous and

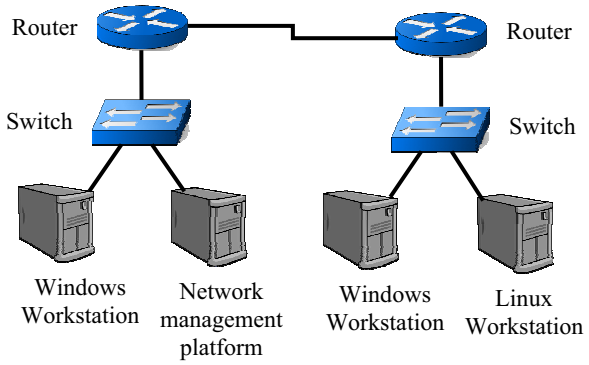

Figure 1. The virtual network topology

inappropriate activities within networks can easily be generated. After analyzing such attack behavior, the administrator can improve security policies and procedures. More secure mechanisms can be implemented and valuable information can be protected when the real networks are constructed.

3. METHODOLOGY

The virtual network used in the network management course is implemented incorporating VMware with Dynamips. VMware is a virtualization software application that allows multiple virtual machines run in a single host machine. Required software configurations, such as operating system, services, application software, and virtual hardware resources, can be installed in each virtual machine. In such way, a virtual network is created and its multiple virtual machines can be run concurrently inside the host machine. The concepts and implementation of Dynamips is similar to VMware solution that hosts multiple operating systems simultaneously on one physical machine. The only difference is that Dynamips is dedicated to emulate Cisco hardware and run the Cisco Internetwork Operating System (IOS). Using emulation technology, it virtually converts a personal computer into one or multiple Cisco devices.

By using VMware and Dynamips, two virtual routers, two virtual switch, three virtual workstations, and one virtual network management platform are created to form the entire virtual network. Figure 1 illustrates this topology. In the left subnetwork, one Windows workstation and one Linux-based network management platform are connected to a switch and the switch is connected to a router. In the right subnetwork, Windows and Linux workstations are connected to a switch and the switch is connected to a router. IP addresses 192.168.1.0 and 192.168.2.0 with 24-bit routing prefix are designated to the left and right subnetworks, respectively. Both subnet masks are set to be 255.255.255.0. Two routers and two switches are configured using Cisco 3640 IOS R12.4. Three virtual workstations are installed with Windows XP and Linux CentOS operating systems and configured using Network Address Translation (NAT) networking. With this configuration, virtual machines have the ability to communicate with each other inside the designed virtual network.

4. COURSE LAB DESIGN

Network management not only supervises the entire network operation but also monitors each individual network device such as router, switch, workstation, and server. Hence, in the hands-on network management labs are designed to help students understand both operations of the entire network itself and each individual device. Specifically, we expect the students to be capable of performing the tasks related to the following knowledge upon completion of the course labs.

SNMP operations: Simple Network Management Protocol (SNMP) is an internet protocol that includes three versions: SNMPv1, SNMPv2c and SNMPv3. These provide a set of operations, such as *get*, *get-next*, *walk*, *get-bulk*, and *set*. With the later versions authentication and privacy is provided for all communication allows administrators to manage SNMP capable agents. In the labs, students learn the use of these operations to retrieve information from agents by using both the command line and Management Information Bases (MIB) browsers download from the Internet. Both standard RFC-1213 MIB (that is implemented in every agent) and specific MIBs (such as cisco-memory-pool-mib and cisco-process-mib that are implemented in Cisco 3640 routers) are investigated. Figure 2 shows three users who belong to different groups and have different security levels after issuing SNMPv3 commands. In addition, students learn the technique to restrict SNMP access in certain MIB variables of routers. By issuing commands in telnet window of a router, read and write configurations of MIB variables can be changed. The skill of protecting critical SNMP information is important to students' exercise because malicious activities could possibly cause serious network problems if some of MIB variables in the router's configuration are maliciously modified. In addition, Wireshark [8] is used for students to analyze the actual bytes of SNMP messages. Figure 3 shows a screen capture of a snmpget message.

Events and traps: When an event occurs, a trap is generated from an agent and sent to the monitoring station. It provides a way that the manager can analyze that notification and therefore make an appropriate response. In the labs, an agent in the Windows operating system is configured to send SNMP traps when certain messages appear in the event logs (system log, application log, and security log). Also, both standard traps described in RFC-1213 and Cisco-specific traps generated by the routers are included. Figure 4 shows two trap messages shown on MIB browser trap window and router's telnet window.

Polling: Information from agents can be retrieved by using SNMP standard operations. However, in some cases values of specific MIB variables are needed to be queried frequently so that their information can be monitored regularly for guaranteeing network reliability. Hence, labs are designed for students to learn the techniques to retrieve

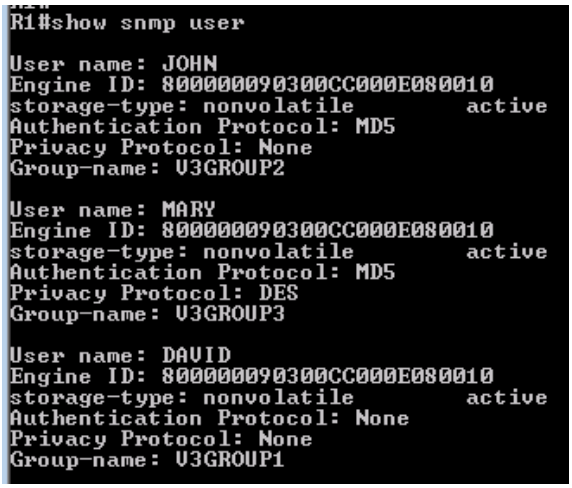

Figure 2. Three SNMPv3 users who belong to different groups and have different security levels

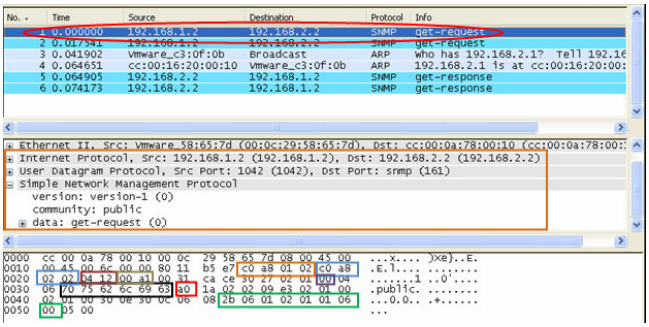

Figure 3. A snmpget message

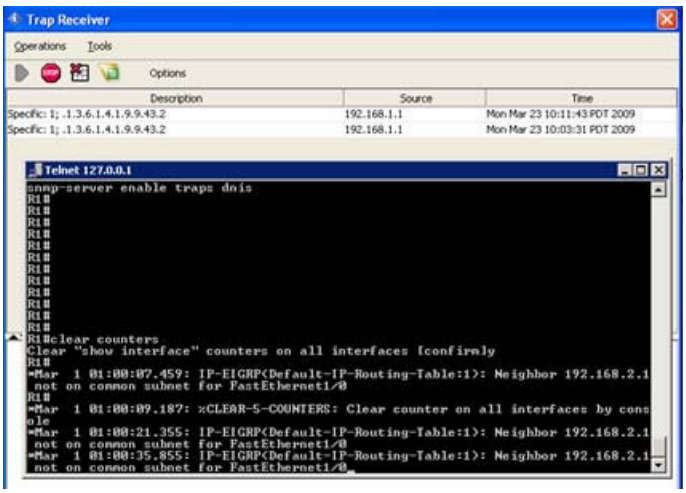

Figure 4. Two trap messages shown on MIB browser trap window and router's telnet window.

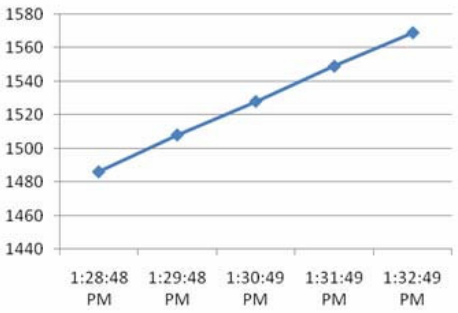

Figure 5. A polling diagram of an agent's interface

and display values of MIB variables at certain intervals. Students learn to write batch and VBscript files for recovering information from agents and storing them in log files for further analysis. Figure 5 shows the total number of datagrams received from an agent's interface by polling every 1 minute for 5 minutes.

Network management platforms: There are currently a variety of commercial network management software packages that integrate a variety of management activities, device interfaces queries, network traffic statistics measurements, network security violations detection, and alerts notification. In order to help students to get experience using network management platforms, we install two web-based network management platforms, Ntop [9] and Zenoss [10], for students to supervise the operation of our designed network. Also, each student is asked to research the information about current market network management software on the Internet and submit a project report on aspect of network management. The following are five examples of students' report topics.

- Cisco 4507 Environment Monitoring and Notification: Monitor Cisco 4507 network switch trap messages and create SMTP emails to notify specific personnel about the problems.
- Network Management and Remote Deployment Concepts: Use different types of software packages to remotely manage a computer in a Windows active directory domain.
- Network Management of Intrusion Prevention System Sensors: Research, proof of concept, configuration, and testing of SNMP on Intrusion Prevention System (IPS) sensors.
- Eastbrook Apartment Network Traffic Analysis: Analyze Eastbrook apartment network traffic over a period of five days for establishing a pattern of bandwidth.
- Exploring WAN Optimization and Acceleration Technologies: Discuss WAN acceleration technologies to increase efficiencies of data communications across a WAN environment.

5. CONCLUSIONS AND FUTURE WORK

In this paper, implementation of network management course is discussed. A virtual network is constructed for students to practice the operations of network monitoring, administration, and maintenance. The proposed approach provides an effective solution to migrate real physical

network devices to virtual ones. The result greatly reduces the cost in purchasing physical equipments, eases the load of laboratory network administration, and provides students a secure way to practice administering networks. Moreover, students can access to the designed virtual network anytime and anywhere, significantly improving the lab availability.

In the future, we will enhance the functions of our designed virtual network. We will increase the complexity of current network infrastructure by adding more routing devices, workstations, and servers. More network management platforms will also be added. In addition, more network management operations related to five network management categories FCAPS will be included.

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Individual Practice and Collaborative Inquiry

Instructional Configurations in a Simulation Environment

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ABSTRACT

Simulation and visualization platforms present many new challenges to educators and students. The change in modality of the teaching/learning environment begs many questions in regard to effectiveness and efficiency teaching practices in term of student learning. A key focus area is when and how collaborative activity should be used and structured. This is an especially important issue as collaborative work is being currently heralded as a solution to time and distance restraints with eLearning. This study used a randomized control group design to investigate individual versus group configurations and work product requirements. When there were no individual work products, individuals who were not involved in actively creating the work product had lower assessment scores than other groups. Results are discussed in terms of their implications for future research and classroom activity.

Keywords-collaborative learning, individual practice, simulation

1. INTRODUCTION

The advent of powerful, inexpensive computers has made new, rich simulations possible. Simulation tools have been used to teach everything from biology to statistics to driving. Although there has been some research on the general effectiveness of simulation tools [1], there has been a lack of research on the most effective ways to use simulation tools in the classroom. Research that does exist [2] suggests there are likely to be system tensions created by the introduction of a simulation into the learning environment. For example, four case studies, including three detailed analyses of student groups, examining the use of a simulation tool in a networking class showed classroom system tensions around learning to use the tool versus learning the course content, using real equipment versus the simulation tool, student-directed versus teacher-directed learning, and the forms of instructor guidance. This analysis used the lens of activity theory to examine the classroom system. The approach highlights the mediation of relationships between students (subjects) and networking problems (objects) between the aspects of the system including rules of interaction, division of labor, and tools (artifacts) [3]. Examination of these relationships reveals the potential for other tensions as well. Although there may be too many to enumerate, this paper focuses on the issues of students working individually versus in groups and the division of labor. In particular, it is unclear how to balance the potential benefits of collaborative inquiry interact with the opportunities for extra individual practice simulations provide.

Much of the use of simulations in the classroom occurs to encourage active learning, an educational approach that puts the pupils at the center of the learning process [4,5,6]. The common denominator in these educational theories is the emphasis placed on the activities of the individual learner that motivate learning process that occur inside the pupil's mind and for which he/she is responsible. The knowledge gained through active learning is constructive knowledge from active thinking and problem solving and is not knowledge of memorizing and doing exercises for the teachers or doing homework from books [5].

Project-based learning is commonly used to promote active learning. Adderley and colleagues [7] provide the following definition for the project method, which after a quarter of a century is still a valid definition

- Projects involve the solution of a problem; often though not necessarily, set by the student himself (or herself)
- They involve initiative by the student or group of students and necessitate a variety of educational activities:
- They commonly result in an end product
- Work often goes on for a considerable length of time
- Teaching staff are involved in an advisory, rather than authoritarian role

One instructional method commonly used within project-based learning is group work. Gultekin [8], for example, used a team-based methodology in project-based work. A control group of independent learners was compared against those working on a project based team methodology and results were compared on a standardized test. The results showed that there was a significant correlation between project based team methodology and learning. In addition, participants and teachers indicated that project-based learning increased the success by providing students with various skills and making learning more enjoyable and meaningful.

More than 20 years of research has demonstrated that cooperative study, team-based learning and projects help students learn more effectively [9]. There are a variety of reasons why theorists believe that cooperative study or collaborative learning is successful. For example, cognitive psychologists emphasize the value in helping students rehearse, elaborate, and organize their knowledge. Alternately, social constructivists believe that reasoning and comprehension originate in social interactions and are then internalized.

Collaborative inquiry may also provide a means for deliberation that helps students converge on a correct mental model or answer [2, 10]. Observation of students in both networking and science contexts suggests that the interactions that students have with each other, using simulations as a mediating artifact, can lead them to develop models that more closely approximate expert and/or correct models. Analysis of discourse reveals that students use a combination of language, gesture, and demonstration to communicate their developing understandings to each other, and attempt to unify discordant ideas [10].

There are many variants to collaborative learning research. Results are not as simple as indicating that group work is always better. Rather, results can differ based on activity type, team selection strategy, age, work methodology and a raft of other variants. For example, in a recent article, Kirschner, Paas, & Kirschner [11] argue that collaborative learning works best in situations where there is a high cognitive load imposed by the activity. Because we have finite resources with which to process incoming information, spreading these out across individuals in a group can increase performance over that seen with individuals. On the other hand, for simple tasks, the authors argue that there may not be as much benefit to group work.

Finally, there are challenges in the implementation of collaborative learning. Interestingly, Gultekin [8], in the study described above showing the benefits of teams, cited problems with arguments between teams and within teams. McCaslin & Good [12] report several potential problems with group learning, including: speed and finishing take precedence over learning, students support and reinforce each other's misunderstandings, students shift dependency from the teacher to the "expert" in the group, and differential student participation.

This last challenge is particularly important in both technical learning and e-learning environments where there tends to be a significant portion of time taken up with hands-on or simulated activities meant to teach procedural skills [13, 14]. In many cases students need to complete problem-based tasks, on either real equipment or in simulated environments, in order to gain the appropriate practice. A main benefit of simulation-type tools is the added practice they afford students [15]. We know that practice is important for establishing automaticity of important skills [3]. Experts use this automaticity to free cognitive space for more complex problem-solving activities.

The benefits of collaboration over digital artifacts are compelling [2, 10]. However, the potential benefits of additional independent practice are also important [16]. The focus of this research is the balance of collaborative learning and individual practice in a simulation environment. Do students working in groups lose some of this additional practice because they are sharing time with each other? In these scenarios are group work and active learning pulling in opposite directions with regard to student learning? This research will address these questions by examining the efficacy of collaborative learning when using a simulation tool. We will specifically look at the effects of assigning individual versus group work products and the effect of having only one group member have their hands on the e-learning tools.

The study first looks to establish the effectiveness of group work in comparison to individual work for students engaged in a simulation activity. It then explores the effect of the organization of the group work on learning. It addresses the questions of whether group work should be assigned such that each individual creates a work product or that the group as a whole creates one. It also examines the impact of having one student in a group who has all of the interaction with the simulation. The study compared learning outcomes between: 1) students who engage in individual work 2) students who engage the group work with an individual work product, 3) students who engage in group work with a group work product and are the individuals who engage the technology to create the product (i.e., "drive"), and 4) students who engage in

group work with a group work product and do not engage the technology to create the product.

The results of this study hold implications for education in general, and specifically within an e-learning environment where team, or group, activities are being heralded as a solution to distance and time difference of students.

2 METHODOLOGY

A. Participants

147 students from 13 classrooms in five countries participated in the study. Three of the classes were in secondary schools, 4 in technical/ community colleges, and 6 in 4 year colleges or universities. The students were all enrolled in the Cisco Networking Academy CCNA Exploration Routing Protocols and Concepts course. Exploration is one of two curricula that prepare students for networking jobs, and also teach the skills required to obtain a Cisco Certified Network Associate (CCNA) certification.

B. Materials

The materials developed for the study were appropriate for students who had completed the fifth chapter in the 11 chapter course. By this point in the curriculum students should have mastered cabling and device configuration, interface configuration, IP address determination and placement, RIPv2 configuration, and testing and configuration.

For the purposes of this study an activity was created using the Packet Tracer (PT) simulation tool. PT is a comprehensive simulation, visualization, collaboration, and micro-world authoring tool for teaching networking concepts [2]. The activity required students to create and configure a network using the skills listed above. Each of the participating classes had previously used PT for other activities.

A post-activity performance-based assessment was created for this study. Students were given another problem, similar to the one presented in the practice session. It was written by a subject matter expert and reviewed by two other experts. The assessment had 4 scoreable sections, preventing poor performance in one section from affecting the score in the other sections. The sections were: 1. Cabling and Basic device configuration, 2. Interface configuration and IP address placement, 3. RIPv2 configuration with default route redistribution, and 4. Testing and Verification.

C. Procedure

The research employed a three group randomized comparison design. The instructor for each participating class taught in their usual manner, including readings, classroom lectures, discussion, and/ or demonstrations. Following this, the students were randomly assigned into 1 of 3 groups. Each group completed the activity as follows:

- Group one: the students worked individually on the activities
- Group two: the students worked in groups of three on the activities and a "driver" as assigned. The driver was the leader of the group and, importantly, was the one who did all of the actual work on the simulation tool. This group had a group requirement to submit one result (a completed Packet Tracer activity file), rather than individual requirements to each submit a completed activity. It should be noted that the activity of the other members of the group was not regulated beyond what would be expected in a regular classroom. Their level of contribution and on-task work varied over time and between groups as it would during most classroom group work.
- Group three: the students worked in groups of three but no designated "driver" was assigned. Although they were working in a group to solve the problem, each student had the individual requirement to complete an instance of the activity him/herself. (i.e., a completed Packet Tracer activity file). In this way, they each had a chance to "drive."

After completing the activity, each student took the post-activity assessment individually. After each section of the exam, the instructor recorded the results and then provided the correct solution to the student. Each student thus began the next section of the exam with a correct solution from the previous section. The results of the assessment were scored with a routing scoring rubric.

3. RESULTS

Prior to making any group comparisons, we examined the overall distribution of scores. The maximum possible score on the post-activity assessment was 130. The scores were relatively normal in their distribution between 90 and 130, as seen in Fig 1.

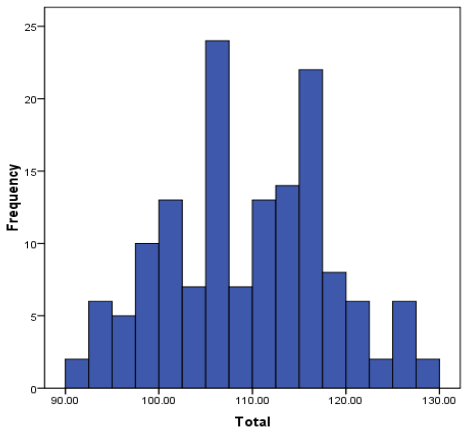

Fig. 1. Distribution of post-activity assessment scores

D. Effect of Group Work

Our first analysis looked at the overall comparison between the three groups in the study. A one-way ANOVA was conducted to evaluate whether there were

post-activity assessment score differences between groups 1, 2, and 3. The
test was not significant, F (2, 144) = 1.32, p>.10. Group membership accounted for only 2% of the variance in assessment score. Students who worked individually (M = 110.39, SD = 8.66, N = 49) performed very similarly to those who worked as a group with an individual completion requirement (M = 109.94, SD = 8.17, N = 50), and those who worked as a group with a group completion requirement (M = 107.69, SD = 9.42, N = 48).

E. Effect of Individual Requirement and Driving

The use of the overall group 2 score, however, combines two different groups of students: those who were the drivers and those who were non-drivers. Our second comparison separated these groups and examined the effects of driving a group and having an individual or group requirement. For this comparison, we were interested in comparing the post-activity assessment scores of: 1) the drivers in group 2, 2) the non-drivers in group 2; and 3) the group with individual completion requirements in group 3. A one-way analysis of variance was conducted to evaluate this comparison. The ANOVA was significant, F (2, 95) = 4.37, p = .02. It should be noted that the size of the relationship between group and assessment score, although significant, was relatively small, with the group factor accounting for 8% of the variance in assessment score.

Follow-up tests were conducted to evaluate pairwise differences among the means. As indicated by the Tukey HSD results, there were significant differences in the means between the group that was not the driver (M = 105.38, SD = 8.14) and the group that was the driver (M = 112.31, SD = 10.34). In this pairwise comparison, 12% of variance in the assessment score is accounted for by group membership. This corresponds to an effect size of .74 as measured by

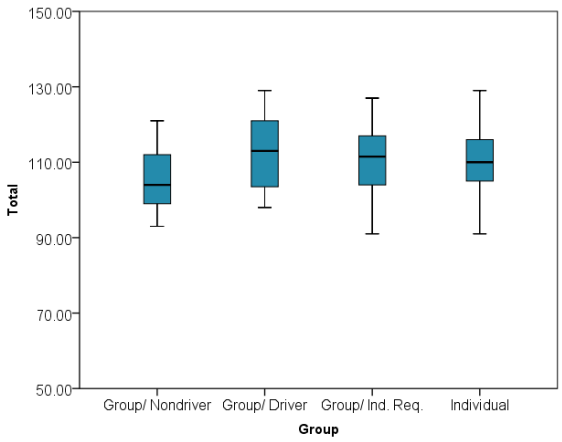

Fig. 2. Scores of individuals in each of the three driving comparison groups.

Cohen's d. There was no significant difference between the scores of the members of the group with individual completion requirements (group 3) and either of these two groups. These results can be seen in figure 2, with the nondriver/ group requirement students on the left, the driver/ group requirement students in the middle, and the group work/ individual requirement students on the right.

It should be noted that the driver/ group requirement had a relatively small sample size (N = 16), which may reduce the power of identifying any possible differences between this group and the group work/ individual requirement individuals.

4. CONCLUSION

The purpose of this study was to investigate the impact of various elements of collaborative environments on individual learning. Specifically, we asked 1) whether individuals who worked in a group, but produced individual work products had different results than students who worked individually and 2) for those working in a group, whether having an individual work product or a group work product resulted in different learning.

The results for the first question did not indicate any difference in post-activity assessment scores for individuals working by themselves versus individuals doing group work with individual work product requirements. This result contradicts the many proponents of collaborative learning, who would predict that the students working in the group would score higher than those working individually. It may be that there were particular features of the task used as a dependent measure, for example that it is a well-structured problem which may not allow for the full benefits of group work. It may also be that there were other benefits to the group work, such as attitude change and motivation, which were not captured in this particular skills-based assessment. Finally, a different arrangement of group work, for example one in which the group members have interdependent rather than identical tasks, would produce different results. These factors should continue to be explored in future research.

Second, the results also suggested that when working in groups with a group work product requirement, individuals who do not actively produce that product performed significantly worse than the individuals that did actively produce it. This finding speaks to the problem that often arises in classroom group work in which one person completes much of the work. These findings show that, even if the rest of the group may be engaged in conversation and problem-solving, if they do not actively work in creating the work product, they are likely to learn less. This is particularly important in technology settings where there may be limitations on how many people can actively have their hands on equipment or keyboards. The findings suggest one way around this, which is having each member of the group produce his/her own final product. The simulation environment makes this much easier than the real hands-on or remote access to equipment because each student can have access to their

individual microworld as long as they have a computer running a simulator.

It should be noted that the effect of group work assignment strategy, although significant, had a relatively small impact on the variance in assessment scores. Interestingly, the effect size, as measured by Cohen's d, is similar to that of other educational interventions, such as use of advance organizers and setting objectives [17]. The small percentage of variance explained by any one particular intervention indicates the complex interrelationship of factors that combine to explain assessment scores. Factors such as individual prior knowledge, the instructional practices used to initially teach the topic to students, and amount of previous experience with the simulation are only a few of the other factors that likely influenced individual test scores. By randomizing assignment to group, we have attempted to eliminate these factors as the cause of the group differences we investigated in this study, but they still affect the variability of scores across individuals.

In addition to this caution, there are limitations to the study. First, each classroom instructor implemented the study in his/her own classroom rather than in a lab environment. While this may increase the face validity of the study, it also introduces that possibility of error as different instructors may implement the study differently. Second, there was not a pre-test to verify the similarity of the groups prior to conducting the study. Ideally, the random assignment should average over the differences between the groups, but it would be good to provide a check for that.

With these caveats in mind, the study does provide some recommendations for classroom instructors. First, it suggests that collaborative learning is not always superior to individual work, and more research is needed to suggest the best ways to structure activities for collaboration, as well as the best activities in which to employ collaborative learning. Second, it suggests if collaborative learning is used, the work product should be managed so that all of the students are engaged, possibly by assigning individual completion requirements to each student. On a larger scale, the study points to the importance of continuing to investigate what we know about student learning in order to continue to clarify what instructional methods work best in what contexts with what content.

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Reducing drop-out rate of a technical oriented course by introducing Problem Based Learning – a first concept

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ABSTRACT

At the University of Applied Sciences (UAS) Technikum Wien one of the most difficult courses in the Bachelor degree program of Computer Science is "Database Systems and Database Design". Together with "Advanced Computer Programming" this course is mainly responsible for the high dropout rate of the degree program.

The authors have already gained experiences with Problem Based Learning (PBL), so they saw an opportunity to improve students' database knowledge by changing the teaching method to PBL.

The proposed paper describes the current situation, identifies its drawbacks and difficulties. It describes the new method and shows the first students' feedback to the new method.

Keywords: Problem Based Learning, reducing dropout rates

1. INTRODUCTION

At the University of Applied Sciences (UAS) Technikum Wien there are several database courses in different degree programs. The experience of the authors shows that these subjects are usually difficult for students not only at the UAS Technikum Wien but also at other universities where the authors got experience.

Partly these difficulties arise from the fact that the students cannot just learn databases by heart, they have to understand the subject comparable for example with mathematics.
In addition, the concepts that lay behind databases are sometimes very complex and it requires some engagement from the students to pass the course successfully.

For many years the traditional approach in teaching is a combination of presentation of the theoretical content of the curriculum and lessons where the students exercise the topics they have listened to in the speech.

If one looks at the grades the students get and the dropout rate one can realize this classic way of teaching does not work very well.

Since the authors were able to achieve good results with PBL in other courses, they tried to develop a concept of how to implement this technical orientated course using PBL.

2. THE FORMER COURSE CONCEPT

The course was divided into two parts and lasts for 2 semesters. One part is a lecture and one part is exercise. Both parts are held parallel with a little time shift so that the students first get a lecture about a new theme and then they have to exercise the new material.

For the exercises, the students receive tasks they have to solve outside the classroom. On the course webpage they have to sign which tasks they had solved before the next lesson starts.

Exercise lessons itself are held in that way, that one of the students who had solved and signed the first task is called to present his or her solution to all others. After presenting his solution he or she has to answer questions from the other students or from the lecturers. Then the next student is called and so on.

The main idea behind this process was that the other students compare their solution with the presented solution, try to figure out if they are right or wrong and which solution is better. Basically, they do a self check whether they did a good job or not.

The curriculum was divided in a way that the students first learned how to query data in databases and then how to model databases. In the following semester, the students learned how to program executable code stored in databases (functions, procedures, triggers, etc.). At the end of the course students were required to realize a project in groups, where they have to apply what they have learned during the past two semesters.

Disadvantages of the former concept
In fact this concept did not work very well because instead of comparing their own solution with the presented one, most students start to look at their next signed solution to prevent a bad presentation in case they will get called for the next one.

This bypassed the system and had no educational benefit for the students because in worst case they starred 90 minutes at their own completely wrong solutions.

Beside those few students who act like it was intended by the lecturer and those students who are called to present their solution have the possibility to learn from the exercise because they are getting a direct feedback on the presented solution by lecturers.

But bypassing the system is not the only disadvantage of the didactic concept of the old course. The students do not get the big picture. They learned for each task and it seemed to be very hard for them to get each part connected to the others to realize how aligned they are.
Only during the project at the end of the two semesters the students realized how everything they had learned fits together. This resulted in low motivation to adequately deal with the issues during the two semesters. This changes during the project which was always well accepted by the students but then it is much too late.

Another disadvantage was that the course did not support the students to work in teams. This is a drawback, because it would have been much easier for the students if they helped each others in the group to understand the difficult material and for sure it would have been more motivating for the students if they teamed up and solved the tasks together.

3. PROBLEM BASED LEARNING

Problem based learning is an instructional strategy teaching method for learning in groups which first got international attention in medical training. This method arose from the realization that it can be difficult to transfer knowledge acquired by students in lectures to practical situations in their later business life.

The procedure of the PBL process depends upon the different authors but it's always a sequence of problem presentation, problem discussion, individual learning phase and final discussion. Usually this process iterates several times and the problem gets increasingly complex.

4. THE NEW CONCEPT

The new concept design still divides the course into two parts. On part, the speech is nearly the same like it was, but now, not before the attached lesson with new content but after the lesson. But have a closer look at the whole concept first.

The problem
Based on the concepts of PBL the students are confronted with a problem – the project.
This project is much more complex than the project in the last weeks of the former course design was because the students do not have just four weeks to develop the project tasks, they have two semesters. The chosen project complexity is that high, that no student is able to solve the problem at the beginning of the first semester.

Like the project in the old course the new one is a group work, but now the group sticks together for two semester.

In our case we instruct the students to develop the database and all necessary components (database procedures, functions etc.) for an online game that simulates an economy. The players should start their own companies in the game, buy land start an industry, sell and buy goods, trade on the stock exchange etc.

All this requirements are provided to the students in a functional specification.

Sub-problems: Due to the aforementioned complexity and the long duration of the project, the problem must be further subdivided. In our case, we divided the problem into parts, which were chosen by the subject, the complexity and size in that way that they cover a particular subject of the course topic which the students can solved in 14 days.

This means, that the students already know the big picture which they cannot solve so far, but during 2 semesters they slowly will brought up to the solution by solving new sub-problems in a 14-day rhythm again and again and they gain knowledge by this.

The 4 Phases
The PBL process is divided into 4 phases. In the course one iteration of all 4 phases takes 14 days. During these 14 days each of the 4 Phases has to get be passed and then the new iteration starts. Each iteration is based on the previous iteration so the knowledge of the students on the course tropic rises every iteration (see Fig. 1)

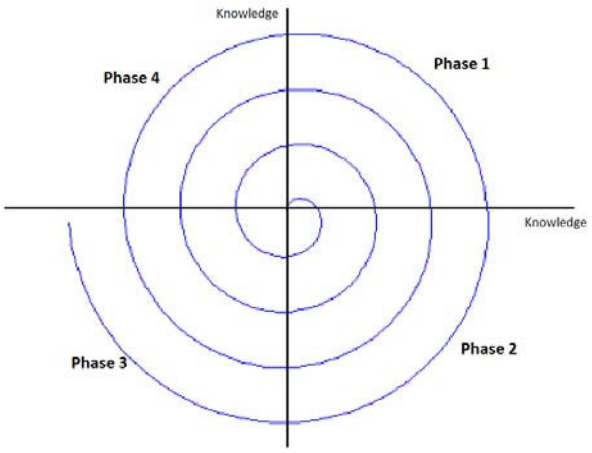

Fig. 1: Spiral model of the 4 Phase iteration

Phase 1
In "Phase 1" the students get the new sub-problem with its tasks. How the handle this first phase is up to the students, but generally they have to analyze the problem and discuss in group which parts they can already solve because of their knowledge from prior sub-problems and for which part they have to do research.

Phase 2
Phase 2 is the information research and group solution phase. First the students gather the information they need to solve the tasks of the sub-problem and then they provide their own solution. It's absolutely necessary, that the group works together because no individual solution is acceptable, only the solution of the whole group counts. (see Phase 3)

Phase 3
Unlike Phase 1 and 2 which get completed by the students through their own responsibility, phase 3 take place during the practice session with the class. In this phase about 7 to 8 groups are in a class which lasts 90 minutes. In the course there are 2 lecturers so each lecturer has about 20 minutes for one student group. These 20 minutes are call "a coaching session".

During the coaching session the lecturer acts as the project leader. In this session the lecturer calls for a status report from the students and demand the group solution for each task of the sub-problem. For each solved task the group gets the corresponding points. If the lecturer asks a student to show the group solution of a task and he or she is not able to show then the group gets zero points for this task. It does not matter if another group member could show the task solution; it is an all or none decision.
From this close link of the students to the group we expect the formation of a group intern tutor system where the better students in the group help the weaker ones.

In this coaching session the lecturer also gives feedback on the quality of each solution of the group and assistance for the task the group could not solve. The authors think this two objectives are very important for the learning progress of the group.

Phase 4
Phase 4 is the lecture phase. Here, the students get in a speech the compressed knowledge they should have researched in phase 2. This phase is used to achieve a consolidated level of knowledge for all students, where they can build up in the next iteration.

5. FIRST FEEDBACK

After the first coaching session we did an anonymous survey with the students where 38.8% of students in the course participated. Below some results of the survey which we think are very interesting.

82% of the participants said the course is difficult or very difficult.

When asked how their impression on the expiry of the course is, the students were more cautious. 46.4% thought they wait and see, 32% have a good or very good impression while only 3.5% said their impression is rather negative.

Asked for their first coaching session 100% of the interviewed indicated that this method is an interesting alternative to other courses.

The team building is also considered very positive by the students. 57.1% like this very much. 21.4% indicated that they prefer to learn alone and 21.4% really like teamwork but think they do not learn enough with it.

60.7% are of the opinion that the research is laborious, but therewith they learn more than in traditional courses with lectures. (see Fig. 2)

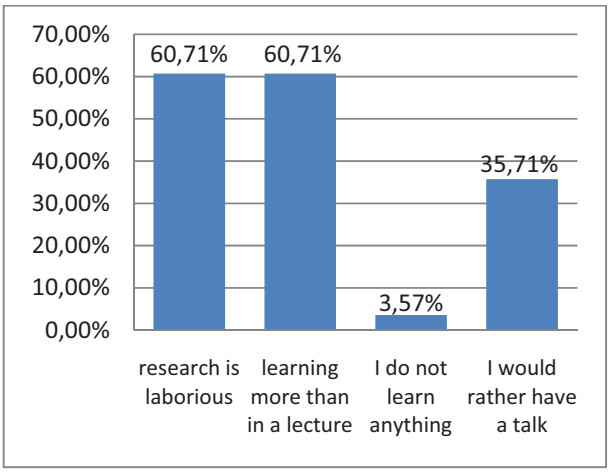

Fig. 2: How do you cope with the research?

6. CONCLUSION

The authors are convinced that due to PBL the learning success of the students will get better and more sustainable. The initial feedback of the students also shows that the new method is well accepted.

As a consequence of this the drop-out rate of students in the databases course will drop. This will happen due to the many changes in the Course.

By example:

- From the beginning the students can detect correlations of the learned knowledge better.
- The students move from a predominantly consuming in a more active role. This stimulates the students' progress
- The support for the student is intensified, with a constant time budget.
- Because of the successive sub-problems knowledge gaps can be quickly identified and closed.

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The use of social network analysis software to analyze communication patterns and interaction in online collaborative environments

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Abstract

Social network analysis software such as NodeXL has been used to describe participation and interaction in numerous social networks but has not yet been widely used to examine dynamics in online classes, where participation is frequently required rather than optional and participation patterns may be impacted by instructor requirements as well as participants' intrinsic engagement with the subject matter. Such analysis can be valuable in programs focused on teaching collaborative and communicative skills, including teacher preparation programs, to provide information about instructional practices likely to facilitate student interaction and collaboration across diverse student populations. This exploratory study used NodeXL to visualize students' participation in an online course, with the goal of identifying (1) ways in which NodeXL could be used to describe patterns in participant interaction within an instructional setting and (2) identifying specific patterns in participant interaction among students in this particular course. In this sample, general education teachers demonstrated higher measures of connection and interaction with other participants than did those from specialist (ESOL or special education) backgrounds, and tended to interact more frequently with all participants than the majority of participants from specialist backgrounds. We recommend further research to delineate specific applications of NodeXL within an instructional context, particularly to identify potential patterns in student participation based on variables such as gender, background, cultural and linguistic heritage, prior training and education, and prior experience so that instructors can ensure their practice helps to facilitate student interaction in light of each of these potential variables.

Keywords: social network analysis, online collaboration, teacher education, online learning, visualization

Overview

Without face-to-face interaction, learning in online settings occurs instead through a variety of interactions and experiences: individual readings and activities; asynchronous group discussions; synchronous chats; simulation activities in SecondLife or other virtual reality settings; and social networking [1]. In each of these varied forums, instructors, students and researchers may find themselves identifying new ways to measure student participation, interaction, connectedness with the group, and ultimate mastery of course outcomes [2] [3]. However, research has indicated that it is an ongoing challenge to foster collaboration and interaction among students in online courses [4] [5], as students and instructors must each accept new paradigms for online interaction while also interacting without the benefit of nonverbal, paraverbal and other social cues present in face-to-face environments [6]. For this reason, analysis of online learning must pay particular attention to issues of student engagement and interaction, as students' interactions with others help to determine not only the mastery of educational outcomes but the quality of the student's learning experience [7]. This work is particularly relevant to fields focused on development of interpersonal skills, such as teacher education, as participants in online courses must master collaborative, communicative and interactive skills as part of their efforts to meet professional standards for educational certification [8, 9, 10]. Therefore, collaboration and interaction are not just a means of instruction, but the object and goal of instruction as well.

In considering the role of student interaction in online learning, Slagter and von Tryon address the importance of collaboration and student interaction in constructing a theoretical framework for considering engagement and student "connectedness" in online learning [11]. Built on an overarching principle of constructivism [12], such a framework alludes to the importance student-constructed questions, responses, dialogues, and activities. This research is grounded in a similar belief that student interaction is a central indicator for learning within a constructivist paradigm, particularly one focused on a developmental context for interpersonal and social skills [13]. We refer also to another important construct in theorizing online interaction, social cognition theory, which

holds that an individual's learning experience will be shaped at least in part by the way in which he or she is able to process interpersonal interactions and communication [14]. As students encounter a new set of expectations in online learning, their own learning, as well as their perceptions of the online experience, will continue to be shaped by interactions with others, which therefore assume a role in distance learning which is as important, if not more so, as in face-to-face coursework.

In considering student experiences with respect to interaction and collaboration, social network analysis offers a useful way to organize inquiry and analysis. Social network analysis is an increasingly popular means of identifying patterns of interaction among participants in online networks, particularly variables such as degree (the number of members with whom each member interacts), centrality (how important or "central" each member is within the network), and clustering (the ways in which various members form cliques or groups). There are various measures of centrality, including closeness centrality (a measure of the direct or indirect connections between group members), betweenness centrality (a measure of the way in which each member helps to connect other members of the network), and Eigenvector centrality (the degree to which a participant is connected to other active participants) [15, 16, 17, 18]. Prior research has begun to identify social network analysis as an effective means of examining dynamics in the educational arena [19], and particularly as an instructional tool in online learning [20]. Previous research has also examined learning experiences as social networks; Calvino, Fine and Marcello examine social network analysis as a means of analyzing the quality of discourse in the learning setting using an add-on software to the Moodle learning suite [21].

Shea et al considered the dynamics of a social network in university coursework, finding that interaction among participants can be described in terms of qualitative and quantitative measures such as frequency of participation, quality of reflection evident in postings, and depth of analysis [22]. There are numerous means of conducting social network analysis of online course discussions, but the free program NodeXL, produced by Microsoft and compatible with Excel, is one of the most recent. Additionally, it offers significant benefits for researchers in fields other than computer science, as the program can easily calculate measures of participant interaction such as centrality within a network, degree of interaction with other participants, and closeness to other participants [18].

Despite its accessibility and potential as a tool for analysis of online courses, little research has been done, to date, to explore the potential uses of NodeXL in evaluating online coursework, particularly in collaborative disciplines such as teacher preparation, where learning environments must encourage participant interaction, collaboration, and involvement. This article describes an exploratory analysis of participant interactions, using NodeXL, in order to describe collaboration among participants in an asynchronous discussion forum offered through the Blackboard learning system.

Purpose

The purpose of this exploratory study was to explore ways in which NodeXL, a relatively new tool for social network analysis, could be used as an element in evaluation of online learning experiences, particularly in the field of teacher education, where the development of professional communicative and collaborative skills is frequently prioritized. The goal of the study was to identify ways in which this tool could be used to visualize and describe relationships among participants in an online learning forum which was geared toward developing multicultural competence and communication skills in inservice teachers.

Methods

19 participants were enrolled in a continuing education course, offered by a midsize research university in partnership with a local school system, focused on providing teachers with the skills to address issues of cultural and linguistic diversity in the classroom, issues of increasing importance due to changing demographics in the school system. Participants did not receive university credit but did receive relicensure credit from their school system upon successful completion of the university course. Nine participants reported their background as being in general education; seven participants reported their background as special education; two participants reported their background as being English as a Second Language (ESL). Four participants reported their current teaching assignment as being focused primarily or entirely in high school; five reported their background as middle school; eight reported their background as elementary school. The participants completed online activities, using the Blackboard learning system, which included discussion questions for each of six online modules, as well as evaluations of each of six learning modules after each module was completed. Participants interacted with the course instructor/ facilitator, as well as with the program director overseeing the project, throughout the program. Participants were required to post a total of three times in each online discussion forum, once as a primary response to the question and twice in response to other participants. The first online forum was an introductory forum where participants shared information about backgrounds and expectations for the course; subsequent forums focused on content presented during the continuing education modules.

For this pilot study, data was examined from a content-related forum in which participants were asked to read a series of articles on second language acquisition and post a response of at least 200 words summarizing their understanding of the second language acquisition process and sharing strategies which might be effective in meeting the needs of second language learners and students from culturally diverse backgrounds. The program director did not participate in this forum, but the instructor was an active participant. A social network analysis of the forum was conducted using NodeXL in order to determine whether patterns existed in participant interaction based upon professional background or current grade-level teaching assignment. A visualization of the forum was

generated in order to provide a graphic illustration of participant patterns. The visualization represented each participant as a "node" on the graph, with directional lines indicating interaction among participants. In addition, the analysis identified measures of degree (number of other participants with whom each participant interacts), centrality (the relative importance of each participant in the network or community), and betweenness (the degree to which each participant serves as a "link" or "bridge" among other participants) for each participant. [16, 17, 18, 19]. We reviewed each of these measures for individual participants and also reviewed average measures of degree, centrality and betweenness for groups of participants based upon professional background and current grade-level teaching assignment in order to determine whether differences existed among participation in the class for teachers from differing backgrounds. In addition, qualitative data was examined including participants' evaluation of their learning experiences in the module.

Findings

While the data set examined was not of a significant enough size to allow for generalizable conclusions, data analysis did reveal (1) that NodeXL was a useful tool in visualizing and describing social relationships among online participants and (2) that participants in this particular forum tended to interact in ways that appeared to be correlated with similarity in their professional backgrounds, particularly for those from a generalist, as opposed to specialist, background.

Visualization:

Metrics and visualization examination show that the instructor is the most central individual in the course. While online learning has been viewed as a platform which allows for greater student involvement [13, 21], this particular visualization demonstrates that in some online environments, the instructor remains the most central element, is responsible for initiating much of the communication between students and instructors, and comments upon the majority of online posts. Examination of metrics describing participant relationships also demonstrated this fact. In this visualization, each participant is assigned a "node" or vertex on the graph, with directed lines (edges) between the nodes representing frequency and direction of interactions. Edge width is associated with frequency of interaction among participants. Shape is indicative of participant role; size is indicative of betweenness centrality; shading is indicative of Eigenvector centrality. The visualization is produced first with the instructor in the center and then with the instructor removed, so that relationships can be clearly seen both in light of the instructor's involvement and independent of the instructor.

Visualizations Key: Circle: special educator. Triangle: ESL teacher. Square: general educator. Sphere: instructor. Size is associated in this graph with betweenness centrality (larger figures are more central), and shading is associated with Eigenvector centrality (darker figures are more highly connected to other connected members of the class).

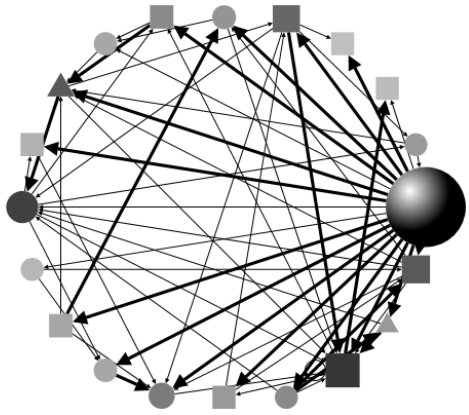

Fig. 1. Visualization of interaction among all participants and instructor, based on disciplinary affiliation. The instructor is the large sphere.

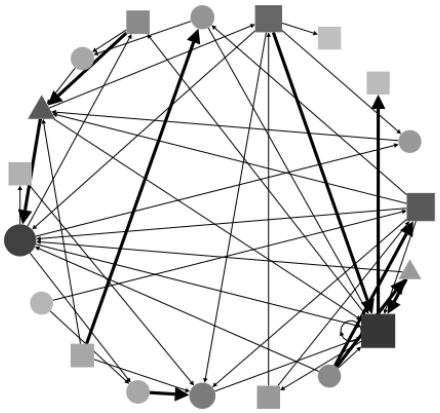

Fig. 2. Visualization of interaction among all participants, without instructor, based on disciplinary affiliation.

Measures of participant interaction:

Degree. The median measure of degree (the number of other participants with whom each participant interacted) was 4.5; the group's mean was 6.3. The instructor was the highest, with a degree measure of 19, indicating that she interacted with 19 other participants and potentially weighting the group average. Four participants had interactions with only two or three others in the group (including the instructor), indicating that they either did not meet or barely met the minimum standard for participation. Other than the instructor, the two individuals with the highest degree measures (indicating interaction with the highest number of participants) were a general educator (14) and an ESL teacher (11).

Closeness. Closeness centrality is a measure of the distance between each participant and all other participants (i.e., is a

participant connected directly to all other participants, or would information need to travel through a number of other participants in order to reach that individual?). In this network, closeness centrality is impacted in this network by the instructor's extensive involvement with all participants, as the instructor is a key link between a number of participants. For that reason, this exploration did not examine closeness centrality as a measure of participant interaction, as the instructor's extensive interaction with all participants ensured that all participants were connected to some degree by their interaction with her and made it difficult to conduct an examination of participants' closeness relative to one another.

Betweenness. Betweenness centrality, which measures the ways in which each participant is connected to all other participants, is a useful measure in this group of whether, and how, participants have formed connections among themselves, both with the instructor's facilitation and independent of the instructor. Betweenness centrality allows one to quantify how highly connected an individual may be to others in the network, whether through direct or indirect interaction. The mean betweenness score for the group was 0.09; the median betweenness score for the group was: 0.01; the instructor's betweenness score was 1.0. There is a fairly large difference between the instructor's "betweenness" score and the median and mean scores for the group, thereby reinforcing the conclusion that this was an instructor-driven forum and that, independent of the instructor's interaction, participants (with a few exceptions) tended not to form strong connections among themselves.

When betweenness for participants was calculated based on disciplinary affiliation, without the instructor being included in calculations, the following was noted: The betweenness score for special educators was: 0.024. The betweenness score for ESOL teachers was 0.081 (though there were only two representatives in this group). The betweenness score for general educators was 0.046. This data suggests that general educators tended to be more connected to all other participants in the network than did special educators. The two ESOL teachers tended to be most connected to other participants by discussion and interaction.

Eigenvector centrality. Eigenvector centrality is the measure of how much a participant interacts with other "connected" or highly interactive members of the group. In plain language, this might be described as whether a participant interacts with other active group members, or tends to interact with outliers and less active members. Eigenvector centrality can be useful in providing a snapshot of how group members interact, as the Eigenvector scores of different members or subgroups may indicate the degree to which they have formed strong relationships with other influential or active members in the group. In this sample, as with betweenness, Eigenvector centrality varied among those with different disciplinary backgrounds. The mean Eigenvector score for the group was 0.2; the group's median was 0.17. The instructor again had the highest Eigenvector score, with .45. Special educators, as a group, again had the lowest Eigenvector score, 0.17, indicating a lower average level of centrality than the group as a whole. The two ESL teachers again had the highest average, .232; general educators had a mean of .20.

Discussion

As indicated previously, the significance of this study is limited by the small size of the data set examined. In order to characterize interactions or conduct evaluations of online learning over the course of an entire semester or program, it would be necessary to conduct examinations of multiple discussions, to evaluate multiple courses, and to analyze interactions among a larger number of participants. Such a sample size would also allow for statistical analysis of variance in order to identify which differences had statistical significance.

However, this data provides a demonstration of the ways that NodeXL, a tool which has not yet been extensively used to analyze social interaction and networking in online learning in general or in teacher preparation courses in particular, can offer insight into the structure of group discussions, participant groupings and interactions, and instructor involvement. Based on the findings of this exploratory examination, the following trends may merit further research and investigation:

Instructor involvement. The instructor is deeply involved in a majority of interactions in the course. As Santovec [23] suggests, intensive instructor involvement demonstrates responsiveness to students but may also discourage students from responding to one another. Given the opportunity to provide qualitative feedback about the most helpful element of the first module in allowing them to meet the objective, only two participants identified the discussion forum as most useful. Qualitative feedback from one participant, in particular, identified the discussion as helpful, despite the complexity of multiple discussions and threads, primarily because of the opportunity it afforded to interact with other teachers: "At times, I thought it was a little difficult to keep up with the Blackboard discussion board because there were many different conversations going on at once. Each thread had a different topic being discussed and I had a hard time following/reading all of them. However, I still thought it was useful and helpful to learn what other teachers were thinking and doing in their classrooms. The discussion board is also a great place to post questions to other teachers. I took advantage of the reflective dialogue to find out other options about 'wait time' in the classroom."

Quantitative measures corroborate the perception that there is a wide gap between instructor involvement and importance in the forum and that of participants. In light of other studies, it may be useful to track betweenness and centrality measures for forums with varying degrees of instructor involvement in order to identify whether participants' level of involvement changes as the instructor's responsiveness increases or decreases. A lower level of instructor involvement may also increase the validity of closeness centrality as a measure of student

involvement, as a greater number of interactions will occur among students without direct intervention by the instructor.

Participant engagement and interaction.

As Gunnawardena et al suggest [2], students' engagement and interaction with one another is crucial to the successful implementation of collaborative online learning experiences. Particularly in the area of teacher professional development, development of collaborative skills is important not only in the theoretical framework of online learning but also as a required outcome of teacher education courses. In this particular forum, the data suggests that participants from general education backgrounds and ESL backgrounds tended to be more deeply involved with other participants in the forum than did those from special education backgrounds. This may be due to the structure of the discussion question, which asked participants to summarize a somewhat technical concept in second-language acquisition theory and then to discuss classroom implications. This finding is consistent with literature indicating that prior knowledge base can influence student interest and engagement [24]. Further research may be useful to identify the ways in which, over the course of a semester, different groups of students respond to different types of discussion prompts. In courses where participants come from diverse backgrounds, it may be useful to use heterogeneous small-grouping (splitting participants into smaller heterogeneous groups to force interaction with others) or to examine the phrasing of questions to ensure that the discussion question builds on prior knowledge for all participants.

Conclusion and Recommendations for Further Research

This exploratory data analysis suggests that student involvement, as measured by several quantitative indicators, may be influenced by prior knowledge of subject matter. The data analysis also indicates that social network analysis tools such as NodeXL may be valuable elements in program analysis, particularly in teacher education, as they provide graphical evidence of student involvement, provide quantitative measures of students' interaction with one another and each student's relative importance to the course "network," and provide a means to view each student's interaction with the instructors and with other students of similar and diverse backgrounds.

Given these findings, it is recommended that further research be conducted to refine a method for using NodeXL to analyze interaction in online courses; to determine whether participants in online courses interact differently with those of similar or dissimilar backgrounds and roles, based on their own backgrounds or roles; to determine whether students' relative "closeness" within a network is impacted by the degree of instructor involvement; to determine whether differences in participation levels among various groups of students have statistical significance and whether changes in instructional practice lead to significant differences in participation; and to determine, through qualitative as well as quantitative research, the extent to which varying types of discussion prompts may impact student engagement in online discussions. As social network analysis has the power to quantify dynamics of participation according to various factors, this method of analysis also can facilitate the important goal of culturally and linguistically responsive practice [25], as students' interaction and participation can be analyzed according to cultural and linguistic background to identify questions, discussion practices, instructional activities that facilitate optimal involvement for all learners, however that term may be defined within the context of a specific course, program or discipline.

Within the context of teacher preparation, as previously stated, students' quantity and quality of participation, and ability to interact with those of varying backgrounds, can be seen to have direct implications for the development of needed professional skills. Given the increasingly significant role of online coursework in higher education and in teacher preparation, we believe that social network analysis, including both visualization and quantitative measures, has an important role to play in helping instructors, course developers, and program administrators to identify factors and dynamics which can impact student involvement and mastery of course and program objectives.

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Attitudes toward Student-Customer Concept: Educational Level, Institution Status and Interdisciplinary Studies

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ABSTRACT

The study explores student attitudes toward treating students as customers in fundamental and higher educations based on three units of analysis–educational levels (undergrad vs. graduate), institution status (public vs. private), and interdisciplinary (technology, engineering, and business). It also examines students' opinions toward using the student-customer concept in higher education. Quantitative and qualitative data were analyzed to answer the research questions. The quantitative analysis results indicate that, in overall, students disagree to use the student-customer concept in fundamental and higher educations. In particular, undergraduate students disagree to use the student-customer concept more than graduate students do. Students in public and private universities have no significant difference regarding their attitudes toward using the student-customer concept. Engineering students have negative attitudes toward using the student-customer concept in both fundamental and higher educations more than business and technology students have. The qualitative analysis results indicate that some students prefer the student-customer concept to be used in higher education as universities/colleges will improve their service quality for students. In contrast, most students perceive that using the student-customer concept in higher education will degenerate instructor's attention and instructor-student relationship, alter the main objective of educational institutions, and negatively affect the society. The study reports the analysis results and discusses the findings, implications and limitations.

Keywords: education, student-customer, attitudes, educational level, interdisciplinary, institution status

1. INTRODUCTION

As a result of reduced government funding and increased competitiveness in the educational market, educational institutions are under constant review on the need of economic accountability and performance improvement. They have competed with one another to attack and retain students as well as regain trust from the public. Higher education institutions have reshaped their educational practices and adopted customer satisfaction perspective of total quality management (TQM) in the hope that it will be the key to survival as it happened in the business sector [1,15]. TQM is originally employed by businesses to improve organizational performance which aims to maximize levels of consumer satisfaction resulting in higher profitability for the organization. If educational institutions can not meet customer (student) satisfaction, they would face bleak enrollment growth and financial problems [15]. Many educational institutions, therefore, adopt the students-customers concept as the organization's policy and practice. It has been reported that the educational institution's policy directly affects teaching-learning environment in classroom resulting in student competency and institution's profitability [1,2,17,18].

Many academics are arguing the consequences of the student-customer concept in higher education under instructor perspectives [4,5,10,14]. Little or no research, however, has been empirically undertaken on the use of the student-customer concept in fundamental (primary/secondary) and higher (college/ university) educations under student perspectives, and investigated the effects of student characteristics (e.g., educational levels and major studies) on student attitudes toward using the student-customer concept in both educations. In addition, as the improper educational practices directed by the educational institution's policy can lead to the diminished student competency [17,18], it is important to understand how students who are directly affected by the institution's policy perceive the use of student-customer concept in their learning environment. Accordingly, this study aims to explore whether students agree to use the student-customer concept in fundamental and higher educations, and examines their perceptions regarding the effects of the student-customer concept on higher education.

The study addresses three following research questions. First, do student attitudes toward the student-customer concept significantly differ between higher education and fundamental education? Second, do student characteristics in terms of educational levels (undergraduate vs. graduate), institution status (public vs. private), and academic disciplines (business, technology, engineering) affect student attitudes toward treating students as customers in fundamental and higher educations? Third, why do students think higher education institutions (colleges/universities) should or should not treat students as customers? The first two research questions will be addressed by a quantitative data analysis while a qualitative data analysis will respond to the last research question.

The next sections provide literature review of the student-customer concept, research methodology, and analysis results. The discussions of the findings, implications and limitations of this study are provided subsequently.

2. THE STUDENT-CUSTOMER CONCEPT

Globalization has forced educational processes toward educational marketing and consumption [1,2]. Education is now governed by consumer orientation and teaching process geared to consumer satisfaction. Many educational institutions aim to treat their students as customers and restructure their educational practice based on the concept of market consumption. This includes the assessment of academics by student-customer, student-customer complaints and appeal processes, and procedural flexibility for educational institutions to tailor different group of student-customer [2]. Under marketing and consumption perspectives, the customer is always right. Instructors are expected to entertain students rather than challenge them to participate in classes. Students' appraisal of teaching provides indirect control over instructors. Instructors who have conflicts with students will have consequences for career prospects [2,5,10].While instructors attempt to avoid negative feedback from their students by providing grade inflation and other efforts to satisfy students, universities help students to obtain academic degrees as fast as possible by establishing interlinked campuses and offering distance learning and e-learning programs.

Higher education in Thailand is facing high competitive pressure. Many state colleges have been promoted to become accredited universities while many universities established their own private colleges and offered generic, fast-track programs to attack high demand in higher education. Education, therefore, becomes commodity product and more educational institutions become "McUniversities" providing fast and commodity product (education) for customers (students) [3,7]. In addition, most parents are willing to invest in their children's fundamental education (primary/secondary schools) while graduated students want to pursue higher education for their future career. With the high demand and competitive in educational market, colleges and universities have followed a business practice by embracing the customer satisfaction strategy as the key to recruit and retain students in their institutions. While universities deploy the student-customer concept for their management practice, students see themselves as customers because they have engaged in an economic agreement for buying services [8]. As service customers, students are given opportunities to express their wants and satisfaction with their learning environment. Universities, on the other hand, attempt to meet student satisfaction and value-for-money.

Under the student-customer concept, educational institutions are producers and deliverers of services. They need to manage operations, monitor efficiency, enhance delivery, and produce quality services that meet the student expectations [5]. On the other hand, students act as passive consumers of the university services [11]. They can make a purchase decision on the university's services and provide feedback either complaint or satisfaction to the university in the same way they purchase everyday products from the shops [5]. Furthermore, the student-customer concept undermines the student's sense of responsibility for their own learning [9]. Students shift the responsibility for their learning to instructors. They are motivated to learn only by their self-interest that results in disinclination to classroom participation and team assignments [5,12]. They will shop for the most comfortable courses which are easily to pass assessment, and expect good grades regardless of the amount of efforts they put on their works. They may penalize demanding instructors through critical feedback on teaching performance if they do not get the grade they expect [5,6]. Table 1 summarized the student-customer concept.

Table 1 Summary of the student-customer concept

Key issues	'Student as Customer' Concept
Reason	To retain its position and compete with others in the high competitive environment
Aim	Maximize student-customer satisfaction
University Metaphor and Roles	Metaphor: University is a service producer and deliverer. Role: To manage, monitor, and produce quality services that meet the student expectations.
Instructor Metaphor and Roles	Metaphor: Instructor is a service provider and entertainer. Role: To delight students and avoid negative feedback from students.
Student Metaphor and Roles	Metaphor: Students are passive consumers of the services. Role: To make purchase decision on the university services and provide feedback to the university in relation to their satisfaction with services consumed.

It has been reported that the educational institution's policy has a direct effect on teaching and learning environment resulting in the levels of student achievement and competency [17,18]. As a result, educational institutions should be aware of the adoption of the student-customer concept as the organization's policy.

3. METHODOLOGY

To address the research questions, this study was designed on the exploratory basic through a survey method. A questionnaire consists of closed and open-end questions. Participants were asked for their opinions whether colleges/universities and elementary/secondary schools should treat students as customers. These questions were measured by five-point Likert scales (1=strongly agree, 5=strongly disagree). The participants were also asked to explain their reasons supporting the previous question in an open-end question. Questions about the participant's age, gender, educational levels, institution's name, major of study, were also included in the questionnaire. Some responses obtained in Thai language were translated back into English. The data were collected from 239 students studied at four higher education institutions including a public college, a private university, and two public universities. The sample involved two educational levels (i.e., undergraduate and graduate levels) and various majors of studies which were grouped into three major disciplines-business (i.e., business administration, international business, business art, marketing, finance), technology (i.e., information technology, technology management, computer science), and engineering (i.e., mechanical and aerospace engineerings).

Several research techniques were applied in this study to improve the research's quality [13,16]. The study built a database that enabled the data collected to be documented and organized. This database facilitated analyses, and the evidence used in the study could be tracked to its origin through its reference codes. The informal interviews with some students were used to certify their responses to the questionnaires. Finally, the results were discussed with a proficient scholar to validate the researcher's conclusion of the qualitative analysis.

4. ANALYSIS RESULTS

The study deploys quantitative and qualitative data analyses to answer the research questions. To address the first two research questions, the quantitative analysis examined the statistical differences between mean of the participants' attitudes toward treating students as customers in fundamental education (primary/secondary schools) and higher education (colleges/universities). The analysis was based on three groups– two levels of education (undergraduate and graduate), two institution status (private and pubic colleges/universities), and three major disciplines (business/technology/engineering). The qualitative analysis then examines the participants' opinions toward treating students as customers in higher education responding to the third research question.

Quantitative Analysis Results

Table 2 shows the mean scores of participant attitudes toward treating students as customers in fundamental and higher educations in relation to each group of analysis. All group of participants disagreed with primary/secondary schools and colleges/universities to treat their students as customers (mean>3.0) excepting graduate level and business discipline groups that fairly agreed with universities (higher education) to treat their students as customers (mean<3).

Table 2 Participant attitudes based on groups of analysis

		Fundamental edu.		Higher edu.	
Demographics	%	Mean	SD.	Mean	SD.
Levels					
Undergrad	67.8	3.72	1.18	3.45	1.31
Grad	32.2	3.16	1.26	2.64	1.29
Status					
Private	56.9	3.44	1.18	3.04	1.35
Public	43.1	3.79	1.32	3.56	1.35
Disciplines					
Business	31.0	3.41	1.19	2.73	1.36
Technology	48.1	3.42	1.24	3.23	1.34
Engineering	20.9	4.02	1.16	3.76	1.17

Table 3 indicates that most participants fairly disagreed that students should be treated as customers in fundamental and higher educations (mean>3). It also indicated that the participants' preferences for treating students as customers between fundamental education and higher education had statistically significant differences (p<.000). Compared to higher education, participants more disagreed that elementary/ secondary schools should treat their students as customers (mean: 3.54 > 3.19).

Table 3 Comparison between fundamental and higher educations

Preferences for the concept to be used in	Mean	t	p
Fundamental Education	3.54	-6.042	.000
Higher Education	3.19		

Table 4 shows that the mean value of attitudes toward treating students as customers in fundamental and higher educations between undergraduate and graduate samples were significant difference (p=.001; p=.000). Undergraduate students disagreed on the student-customer concept to be used in both fundamental and higher educations higher than graduate students did (mean: 3.72 > 3.16; 3.45>2.64 in Table 2). Table 4 also shows that there are no significant differences between private and public samples regarding their attitudes toward treating students as customers in fundamental and higher educations (p>.05). In addition, engineering students had significantly different opinions from business and technology students in terms of their negative attitudes toward treating students as customers in fundamental education (p=.005; .004) and in higher education (p=.000; .018). Table 2 indicates that all discipline samples (business, technology, and engineering) disagreed on the student-customer concept to be used in fundamental education (mean>3). Engineering students had the most disagreeable value (mean=4.02) while business students had the least (mean=3.41). On the other hand, in higher education, business and technology students had statistically significant differences on their attitudes toward treating students as customers (p=.013). Technology students were more disagreeable that universities should treat their students as customers (mean: 3.23>2.73).

Table 4 Differences between samples' mean

Samples	Preferences for using the student-customer concept in			
	Fundamental Edu.		Higher Edu.	
	t	*p*	*t*	*p*
Undergrad vs. Grad	3.383	.001**	4.484	.000***
Private vs. Public	.061	.951	.803	.423
Business vs. Engineering	2.837	.005**	-4.355	.000***
Business vs. Technology	-.066	.948	-2.501	.013*
Technology vs. Engineering	2.902	.004**	-2.392	.018*

*p < .05, ** p <.01, *** p<.001

Qualitative Analysis Results

The qualitative analysis results are described in the dichotomy between participants who agreed and disagreed on the student-customer concept to be used in education institutions. Students who agreed on this concept to be used in educational institutions asserted that a good quality of desired services would be obtained in exchange of their money as they believed that a customer was the most important person and customer satisfaction was the first priority for any businesses. One student claimed that businesses (universities) obtained money from clients (students); thus they were liable to provide services to those clients. Some students believed that universities as businesses could not ignore market or consumer orientation. One student pointed out that "almost everything in the world is business". Another student supported that, "we are in the world of what we call market economy and society".

In contrast, most students who disagreed on the student-customer concept contested that money-product exchange and profit maximization in the marketing context were not appropriate to be used in the education environment. One student perceived that being treated as customers meant selling things to students. If students had no money, universities would not service them. Some students accentuated the concept of unfair treatment in education associated with the rights and equality to have education for those who have no money. The

relationship between student and instructor was concerned by some students if the student-customer concept was adopted by universities. In addition, some students were aware of their instructors' behaviors and teaching performances if those instructors treated them as customers because of the university's policy. Further discussion and conclusion of the qualitative analysis are provided in the following section.

5. DISCUSSION AND IMPLICATIONS

The first research question has been examined. The result shows that student attitudes toward using the student-customer concept in fundamental education and higher education are significant differences (Table 3). Students disagree to use the student-customer concept in fundamental and higher educations. In particular, they disagree with primary/secondary schools to treat their students as customers higher than colleges/universities to treat their students as customers. This might imply that students at primary/secondary schools are young and need to be substantially guided by the teachers rather than students at colleges and universities who are more mature and can select what they want to buy or learn. These young students-customers, if accepted, are more likely to select the wrong products (studies) than more mature students. One student contended that:

> "Because they are not adult, there's something they don't know what is good or not. They need to be protected, not treating them as customers" (grad/pub/bus)

The second research question has been responded. Based on the quantitative analysis results, Table 5 summarizes that the student characteristics based on educational levels (undergraduate vs. graduate), institution status (public vs. private), and academic disciplines (business, technology, engineering) have effects on student attitudes toward treating students as customers in fundamental and higher educations. Each of these effects is explained as follows.

Table 5 Attitudes towards using the student-customer concept in educations

Samples	Fund.Edu.	Higher Edu.	Differences
Edu.Level			Sig. diff.
Undergrad.	disagree	disagree	Undergrad >
Grad.	disagree	slightly agree	Grad.
Inst. Status			
Private	disagree	neutral	Not sig. diff.
Public	disagree	disagree	(on both edu.)
Disciplines			Sig. diff.
Business	disagree	slightly agree	Engineering >
Technology	disagree	disagree	Technology >
Engineering	disagree	disagree	Business

Educational level: Undergraduate students disagree to use the student-customer concept in fundamental and higher educations while graduate students slightly agree to use this concept in higher education (mean=2.64). In addition, graduate students disagree on the student-customer concept to be used in fundamental and higher educations less than undergraduate students do. It might imply that graduate students have more concern on their money. They expect their universities to treat them as customers to obtain the best services in return for their money. Unlike most graduate students who pay for their own education, undergraduate students are paid for their education by their parents. One of undergraduate students supported that "Parent is the one who pay money. Parent is client".

Institution status: Students in private and public universities disagree with the education institutions (schools, colleges, and universities) to treat students as customers, and there is no significant difference of their attitudes between the two groups of students. Interestingly, as most private universities are self-funding organization, students studying in private universities pay higher costs than students studying in public universities. However, students in private universities do not expect to be treated as customers the same as those in public universities. It might imply that students do not see the difference between public and private universities associated with the adoption of the student-customer concept in universities.

Interdisciplinary: Most students in the three disciplines (business, technology, and engineering) disagree that the student-customer concept should be used in both fundamental and higher educations. Students in business discipline, however, slightly agree with the student-customer concept to be used in higher education (mean=2.73). Students among three disciplines have significant differences of their attitudes toward using the student-customer concept in both fundamental and higher educations. Compared to technology and engineering students, business students have the most likely to accept the student-customer concept to be used in both educations especially in higher education. It might imply that students in the business major engaged in the economic and business environments from their class studies or their work experiences which enable them to handily accept the economic exchange of money and services associated with the student-customer concept.

The last research question has been responded by the qualitative analysis results. Students who agree that colleges/universities should treat their students as customers expect to get better services in return for their money the same as customers who choose to buy the best product. For examples,

> "Because service receivers are customers we have to treat them with *the best care…*" (grad/pub/tech)
> "Teachers might *give students more respect* as they are customers" (grad/pub/bus)
> "They will *treat you well* because a customer is the first priority for any business" (ugrad/pri/tech)
> "Must always bear in mind that a service receiver is *a customer who must be cared*" (grad/pub/tech)

On the other hand, most students who disagree on the student-customer concept contest that the student right to study is more important than the marketing perspective. Universities should treat students equally regardless of the students' social status. Some students support that university is a place for students to get educated, and not a place to get money. Others want their instructors to treat them like their family members or like parents who treat their own children. In summary, under the student perspectives, the student-customer concept might yield four negative concerns—institution's objective, instructor's attention, instructor-student relationship, and social issue as shown in Figure 1.

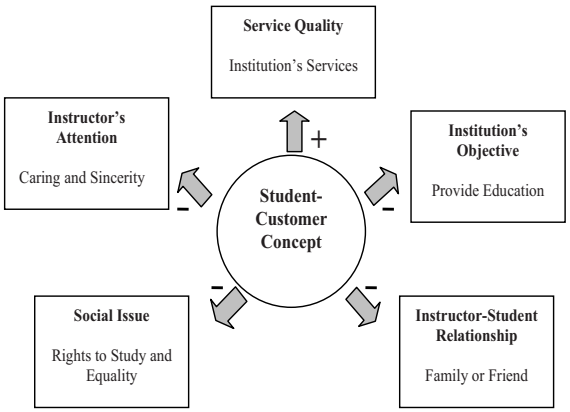

Figure 1. Effects of the student-customer concept on higher education under students' perspectives

Institution's objective: Students are afraid that an institution' objective to provide education might alter if they were treated as customers. For examples,

> " …. I don't think that we should be treated as customers because this is *only a place to get educated*…" (ugrad/pri/tech)
> "...should not treat as customers. Educational institutions have *responsibilities for giving education* ...." (grad/pub/tech)
> "Because the goal is *to offer them (students) the best quality of teaching* and not to please them" (grad/pub/bus)
> "Because those (schools and universities) should treat their service users *with the real objective of those places*, not for marketing objectives that the real purpose is to get more money from their service users" (ugrad/pri/tech)

Instructor's Attention: Students are aware of their instructor's attention. Instructors might not pay attention to their students. They might focus on the profits they can gain rather than the efforts they give for teaching. For examples,

> "…must *sincere* to teach students rather than only want to get money" (grad/pub/tech)
> "Because it is not the commercial and business services, but must have *willingness and sincere* in giving a service" (grad/pub/tech)
> "Teachers should *care* about students, not because they provide you money" (grad/pri/tech)
> "Student needs to be treated with a *good care*. Business satisfies customers only, not always care them" (ugrad/pri/tech)

Instructor-student relationship: Students also realize that relationship with their instructors may be changed if they are treated as customers. They expect to have a close relationship like family members and friends with their instructors rather than customer-provider relationship. For examples,

> "Students should be treated as *friends* because they can do better job" (ugrad/pri/tech)
> "Should be treated as *family members*, who really treat with heart" (grad/pri/tech)
> "Teachers should see students like *their child* who want to have knowledge" (ugrad/pub/eng)
> "I want them to teach us as *their children* like parents do. Money can not buy subject or grade" (ugrad/pri/bus)
> "Because it's *not customer relationship* but giving knowledge and help each others" (ugrad/pub/eng)

Social issue: If universities treat students as customers, students realize that some persons may not be able to study in universities as they don't have enough money to pay for. They expect everyone should have the same opportunities and the rights to get education. For examples,

> "Should not be treated as customers because it means that if someone does not have enough money they have no *right to get education*" (ugrad/pri/tech)
> "Students are the fundamentals of the nation, everyone should have *the right to learn* in what they want... not only people who have money" (ugrad/pub/eng)
> "Every one has *the right to learn* without payment" (ugrad/pub/eng)
> "Students should be treated *equally*" (ugrad/pri/tech)
> "Everyone has *equal status*, treating as customer…only mind in benefits (grad/pub/tech)

In summary, although students may obtain better service quality (e.g., facilities and administrative services) from their universities, they perceive some negative effects on their learning environment if universities treat them as customers. Educational institutions, therefore, should align the student-customer concept with an organization strategy efficiently. According to the findings, educational institutions should attempt to minimize the students' negative concerns about the student-customer concept by shifting the producer-consumer relationship to the instructor-student relationship such as establishing family and friendly environments, and enhancing instructor's concern about their students and teaching performance. Universities should retain their main objective to provide people's education rather than maximize profits. The important goals for educational institutions are to help students preparing for their future and to provide what they need rather than what they want. For the effect of using student-customer concept on the society, universities with some supports from government should provide funding for some students, who have no money but want to study, to have the equal opportunity to get education. Most governments provide some or full supports for fundamental education, but there are few supports for higher education.

6. LIMITATIONS

This exploratory study has some limitations. Firstly, the study only focuses on the students' perceptions of the student-customer concept. The perceptions from other staff such as instructors and administrators who involve in the student-customer practice might be different. Secondly, the validity of the measures may be questioned. Each student has more than one testing attributes. The effect of one attribute might overpower that of another one. Thirdly, the study was conducted in Thai colleges and universities. The national culture might affect the results as western and eastern cultures have some

differences. Fourthly, the generalization of the results should be done cautiously because the sample size is quite small for quantitative analysis. The study, however, was largely exploration and the small sample is not crucial for qualitative analysis [13,16]. Finally, the study is a cross-section study. Student's attitudes may change overtime. A longitudinal study should be conducted to keep track of this change and verify the study results.

7. CONCLUSION

The study explores the factors influencing students' attitudes toward using the student-customer concept in fundamental and higher educations, and examines the consequences of using the student-customer concept in higher education under student perspectives. Students are aware of applying the student-customer concept to fundamental education rather than higher education. The institution statuses (public and private) do not have significantly different impact on student attitudes toward using the student-customer concept in fundamental and higher educations. The educational levels and academic disciplines, however, cause the different attitudes toward using the student-customer concept in fundamental and higher educations. To efficiently align the student-customer concept with an organization strategy, educational institutions should understand why students in each group perceive the student-customer concept in different way. Perhaps, the institution's practice for this concept is unclear on the students' viewpoints. According to the study, some students perceive a benefit of using the student-customer concept in terms of the institution's service quality they can gain. Most students, however, dislike applying the student-customer concept to the education context because this concept yields negative effects on teaching and learning environments associated with instructor's attention, instructor-student relationship, and university's objective. It also has a negative effect on society in terms of people's rights and equality to have education. Although the adoption of the student-customer has several negative concerns, educational institutions might be unavoidable to adopt the student–customer concept in order to persist and retain competitiveness in the educational market. However, they should understand that 'educational customers' are different from 'market customers' who buy the consumer goods and simply pay money in return for their goods or services. They should not sacrifice educational quality and academic standards to accommodate students-customers.

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Academic dishonesty in a school of nursing

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ABSTRACT

Academic dishonesty within postsecondary institutions is a significant issue. As such, academic dishonesty has been the subject of more than 100 studies over the last 30 years. Yet, the data provided by previous research have done little to curb the academic dishonesty problem. The purpose of the study was to describe the meaning of academic dishonesty as perceived by the nursing students at an Ontario university. Using the methodology of hermeneutic phenomenology, 11 students were interviewed to determine their perceptions regarding academic dishonesty within the nursing program. The interview data provided rich details of how and why students were cheating as well as descriptions of their lifeworlds. This study suggested that situational factors found within their learning culture played a significant role in both why and how students in this nursing program were committing acts of academic dishonesty. The lifeworlds of the participating students had been described as being very stressful. Caring was interwoven into their learning. As such, for these students some acts of academic dishonesty were not considered cheating, but sharing.

Keywords: Academic integrity, cheating, plagiarism, nursing students, caring, curriculum, hermeneutic phenomenology.

INTRODUCTION

Academic dishonesty within postsecondary institutions is a serious concern. As such, academic dishonesty has been the subject of more than 100 studies over the last 30 years. Yet, the data provided by previous research have done little to curb the academic dishonesty problem. It appears academia does not have a complete understanding of the issue, particularly from the student perspective. One concern is the rate of cheating among nursing students. Cheating in classroom or clinical settings may reduce a student's competence and hence, put patients at risk (Daniel, Adams & Smith, 1994). However, the issue of academic dishonesty is more than just a student problem. We are living in a world of technological access to almost unlimited informational resources. Students report crushing workloads and impracticable timelines (Tanner, 2004; Parameswaran & Devi, 2006; Del Carlo & Bodner, 2004). They participate in a learning environment where individual scholarship is held as the model of true accomplishment, yet seeing the individual student is difficult in the crowded hallways and huge lecture halls. We are living in a culture that tolerates some forms of cheating while condemning others (Callahan, 2004). Social psychologists state that the increasing levels of academic dishonesty may be more indicative of flawed educational systems than immoral students (Kohn, 2007). As such, situational factors may have a significant influence on a student's decision to cheat.

Academic dishonesty is found at all levels of schooling from grade school to graduate school and is a growing problem at postsecondary institutions, particularly in schools of nursing (Bailey, 2001; Brown, 2002). Students acknowledge that many forms of cheating are wrong (Ashworth, 1999); for the most part, they say they know there are policies concerning academic dishonesty yet many choose to cheat anyway. In a 2005 study, 77% of students believed that cheating was not a serious issue (Center of Academic Integrity, 2005). Students within nursing programs in Canada are required to take courses in ethics as nurses may find themselves involved with ethical dilemmas in their profession. Yet, even with this education in ethics, nursing students are cheating at the same levels as other postsecondary students (Gaberson, 2007).

The purpose of the study was to describe the meaning of academic dishonesty as perceived by the nursing students at a university in Ontario, Canada. The data revealed that for these students some acts of academic dishonesty were not considered cheating, but sharing. Most of the cheating was accomplished through the use of technology as they tried to manipulate, or control, their environment to ensure they could continue to communicate and share with each other. As is found in many collectivist cultures, the students in this program demonstrated high levels of loyalty to each other where cheating for individual gain was frowned upon, but cheating to assist the group in the program was considered normal.

This paper includes excerpts from the larger, detailed PhD dissertation completed by the author in 2009.

BACKGROUND

The studies conducted over the past few decades have been mainly quantitative in design with students checking appropriate boxes to indicate their cheating behaviours (Ashworth, Bannister & Thorne, 1997). These self-reporting surveys have returned huge amounts

of data to confirm that cheating in postsecondary appears to be on the increase, yet this information has done little to illuminate the issue in an effort to resolve cheating in schools. What is particularly disconcerting is the finding that nursing students are cheating at the same rates as students in other disciplines (McCabe, in press). Nursing is considered an ethical profession where nurses often find themselves in life and death situations. Taken a step further, research has demonstrated that cheating behaviours in the academic environment are often carried over into the workplace and could have a direct impact on the heath of patients (Gaberson, 1997; Baxter & Bobbin, 2007).

Academic dishonesty is a highly complicated issue. Most of the previous studies in this area have been quantitative in design. By comparison, relatively few qualitative studies have been conducted, and those that have are beginning to provide insight into the quantitative data that have been previously reported. Some of the concerns with large scale quantitative studies are that they typically capture general traits and perceptions of students and faculty. The individual behind the statistic is rarely seen. For example, one study found that almost 88% of students were copying off the Internet (Scanlon & Neumann, 2002); another found that high school boys use crib notes at twice the rate as girls (California Dept. of Education as cited by McCabe, Trevino, & Butterfield, 2001); a third that students are cheating more due to the ease of access to resources on the Internet (Underwood & Szabo, 2003). The question is - who is the student behind those statistics and how does he or she understand the issue?

METHODOLOGY

The methodology used for this study was hermeneutic phenomenology. The central guiding question was "What is the meaning of academic dishonesty as part of the lived experience of nursing students?" Eleven students were interviewed to determine their perceptions regarding academic dishonesty within the nursing program, which included an examination of their learning culture. Students ranged in age from 18 to 50, one male and 10 female, and from different ethnic backgrounds. An email was sent to all nursing students at the school looking for participants. It was proposed that 10 to 12 students participate but as only 11 came forward, no random selection was done. Participants included representatives from each of the four years of the program.

Phenomenology is a human science where the researcher and the participant engage in a discussion to reveal the meaning of a phenomenon as it is understood by the participant. While traditional phenomenology focuses on the fundamental description of the phenomenon, hermeneutic phenomenon enables the interpretation of the description. The purpose of this hermeneutic phenomenological study was not to determine the cause of academic dishonesty, but to describe and interpret how these participating nursing students understood academic dishonesty based on their own lived experiences.

RESULTS

The researcher found that for all the students interviewed, with the exception of one first year, academic dishonesty was part of the lived experience of these students. If they were not participating in cheating, they had witnessed it in their postsecondary learning environment. Academic dishonesty is a complicated concept and it was apparent from this study that these nursing students had conflicting views. For example, all the 11 students interviewed said that they were honest students who did not cheat. Yet, it is the opinion of the researcher that all but two cheated on a regular basis. Their descriptions of academic dishonesty demonstrated that they had a limited knowledge of the scope of academic dishonesty and its associated policies and penalties. For these students, academic dishonesty was mainly associated with plagiarism. However, while academic dishonesty was considered wrong, many students were participating in behaviours that could be considered dishonest by university policies, such as collaborating on online quizzes and on the social networking site Facebook; they were sharing papers, assignments, passwords, and other materials. For these students, these behaviours were not academically dishonest, but took on another meaning.

DISCUSSION

Language plays an important role in the development of culture (Triandis, 2001). When analyzing the interview transcripts, it became apparent that "caring" played a significant role in the lives of these students. They are learning through a "caring curriculum," study textbooks on the philosophy of caring, incorporate and practice caring in their academic and clinical environments. It became apparent that parallels could be drawn between the philosophy of caring and what was happening as far as academic dishonesty in this program. For example, a caring nurse empathizes with patients; s/he sets aside judgments which might interfere with the care of the patient; does what s/he can to heal the physical and mental pain experienced by patients; plays a role in the recovery of the patient while respecting the autonomy of the patient (Watson, 1985). These caring traits were conspicuous when discussing the relationships these students had with each other and in the discussions surrounding academic dishonesty. One aspect of the study revealed that students were transferring the concept of caring from nursing situations to their fellow students where they commonly assisted fellow students

who were at risk. Caring and sharing were not considered cheating.

Some researchers say that students cheat because of a lower levels of moral reasoning, yet studies have found that students with high moral reasoning cheat as much as those with low moral reasoning (Tanner, 2004; Patterson, Taylor & Usick, 2003). Social psychologist Philip Zimbardo said that, "human behaviour is more influenced by things outside us than inside us" (as cited in Kohn, 2007). This study suggested that situational factors found within their learning culture play a significant role in both why and how students in this nursing program were committing academic dishonesty. The lifeworlds of the participating students had been described as being very stressful. While completing their studies, these students worked closely together in a program specifically designed for their future profession. As a result, they had little contact with students from other disciplines. Clinical practice integrated into their curriculum fostered deep bonds between students as they coped with the stress, and at times, trauma that can be experienced in healthcare settings. Their clinical experiences and isolated nature of the program assisted in the development of close working bonds between the students. Coupled with the stress, these bonds fostered interdependence among groups and their members. Students demonstrated traits of collectivist cultures such as loyalty to one's group and the priority of group goals over individual goals.

Students in this study appeared to be neutralizing their cheating behaviours. An important factor in decision-making is the necessity for people who make the decision to justify it (Beach & Connolly, 2005). When students justify cheating behaviours, it could be considered neutralizing or nullifying that behaviour. Neutralizing the acts of dishonesty enables students to continue to commit academic dishonesty without acknowledging that they have done anything wrong. For example, sharing papers with friends is not considered cheating, but helping another student. Researchers have found that the higher the levels of academic dishonesty, the greater the use of neutralizing statements (Murdoch & Stevens, 2007). The participants in this study did use neutralization to justify or nullify academic dishonesty. For example, several students said that sending passwords to quizzes was not cheating as it was not mentioned in the course outline, that the workload was heavy, that a particular situation was an invitation to cheat, that the professor doesn't care, that cheating only occurred on small assignments so it doesn't matter, etc. In Murdock and Steven's study, cheating and the associated neutralization are contextual meaning the dishonest act and the accompanying excuse are not a result of low morals, but of social conventions (2007). As such, academic dishonesty and its acceptance by both the cheater and those who witness it are dependent on the situation. For example, students are more accepting of cheating when it is done under duress than if it were done simply to get a good mark. In individualistic cultures, neutralization is an example of denial of the crime, the victim, and responsibility. However, the students in this program exemplify many traits found within collectivist cultures. Most of the academic dishonesty involved assisting group members. In collectivist cultures, assisting group members is an obligation and is not considered dishonest (Triandis, 2001; Chapman & Lupton, 2004).

While certain types of academic dishonesty were viewed by participants as wrong, for example, cheating to improve one's personal performance, for the most part, these students were tolerant of other's cheating behaviours. Students reported high stress levels where desperation, it was said, can drive even the best student to cross the line into dishonesty. Stress can impact a person's ability to make a decision and assess risk (Rettinger, 2007). Students were consistently sharing papers, assignments, quizzes, answers, and reflective notes in an effort to assist each other through the program.

People develop behaviours and attitudes in response to fulfilling needs, avoiding aspects like pain or dealing with their reality (Brill & Levine, 2005). These coping mechanisms may be conscious or unconscious (Brill & Levine, 2005). Watson (1985) frames coping as protection – people will use various mechanisms to protect themselves in stressful situations. In this study, students suggested that most of the academic dishonesty that occurred at their university was a result of dealing with the extreme stress levels experienced by these students. These students reported heavy course loads combined with the clinical components of the program. As such, students have developed numerous methods for coping with the workload, some of which could be considered academic dishonesty. In an effort to assist each other, many students were crossing the line where too much sharing became acts of dishonesty according to the policies of the university. For example, Facebook sites for completing assignments could be considered unauthorized collaboration. Sharing papers where students would incorporate another's ideas, "lift a paragraph or two," or copy references was not considered cheating, but helping fellow students through a tough assignment. However, most of the participants did not have a comprehensive understanding of the definition of academic dishonesty or the associated policies. As such, it may be difficult to determine where the line is between honesty and dishonesty, particularly when there is an interdependency between group members. It is the researcher's contention that most of the participants did not comprehend when "sharing" was

considered academically dishonest. By their own accounts, few participants were purposefully deceitful, in fact, they all said they were honest students. However, their coping mechanisms of sharing, their learning culture built on caring, provided opportunities for neutralizing cheating behaviours.

Participants in this study did describe academic experiences where they felt vulnerable with little input or ability to control their environment. When students were placed into groups where there are differing goals, the high achieving students felt vulnerable to the lower achieving students, the so-called 60 percenters. They were resigned that they would have to do a larger portion of the work than other group members. The frustration levels were reduced when students were able to choose their own group members for assignments. Students were vulnerable to the time pressures, to teachers and staff, to parents, and to patients in clinical. Their lives were focused around meeting the needs of others while ignoring many of their own needs. The students in this study did very little socializing. The groups of friends they developed at school were a cultural reaction to their place and time. For the most part, these groups were formed in response to the academic needs of the students and as such, members were interdependent. Group goals were extremely important.

Students were quick to take advantage of a professor who was not technically competent. Students tried to manipulate their environment to ensure they could communicate and share with each other. Students would express frustration when laptops were required tools for the program then faculty would try and control the use of the laptop in class and on assignments. As such, students would use their superior technological knowledge to thwart efforts by faculty members to ensure a secure test environment. In such cases, student use and understanding of technology was superior to that of the professor and as such, the students took control of some of the assessments and classroom activities. They would share answers through instant messaging, send each other quizzes or passwords, accessed materials from other sources to get the answers, or developed Facebook sites for completing assignments. The students were exerting their control over how the assignments were to be completed.

However, when Turnitin.com, the plagiarism detection service, was introduced, the balance of control went back to the professor. In response, students were dropping the course, writing assignments in such a way that wouldn't be flagged by the program, or choosing subjects for papers where the information would not be standard. Students expressed concern that if faculty members were going to use Turnitin.com that assignments be designed in such a way that it would be difficult to have similar papers handed in from the class. They were expressing their powerlessness in the situation where poorly developed assignments could lead to unintentionally plagiarized papers.

While most of the cheating was conducted through technology, it was apparent that even without the presence of technology, the cheating would continue. In conversing with students, when technology was removed, they would use traditional methods such as discussing tests and answers with those who had yet to write the test.

Students were in a collaborative program with a caring curriculum and as such were learning to be empathetic, responsive and develop relationships with people who needed their help. Caring was interwoven into their learning. As such, for these students some acts of academic dishonesty were not considered cheating, but sharing. Students were assisting one another in their overall goal of becoming a nurse by sharing papers, access to quizzes, assignments and more. In some cases, students understood that this was academic dishonesty, yet in other situations, they did not perceive their actions as cheating. To care means to be non-judgmental. The students in this study demonstrated tolerance of others who were committing academic dishonesty and in some cases, reported being sympathetic towards those who were cheating due to circumstances.

As is found in many collectivist cultures, the students in this program demonstrated high levels of loyalty to each other, particularly within their academic groups. Cheating to benefit the individual was not acceptable, but cheating to assist others in the program was considered normal. This study confirmed a recent quantitative study of nursing students which determined that for nursing students, cheating for individual gain was significantly lower than other disciplines while collaborative cheating was significantly higher (McCabe, in press.)

CONCLUSION

In an effort to better understand academic dishonesty, it becomes important to examine the issue from different perspectives. As such, this study, using the methodology of hermeneutic phenomenology, focused on the students' perceptions of their lives and the role that academic dishonesty played in their learning experience. These descriptions were then interpreted by the researcher through commonalities and themes. The curriculum was built on the theory of caring which students demonstrated in their interactions with their patients and with each other. They were sympathetic to the issues expressed by their fellow students. Students reported high stress levels and as such, developed numerous coping methods in an attempt to reduce their workloads

and stress levels, some of which could be considered academic dishonesty by the university. These nursing students used neutralizing statements to nullify their behaviours from being dishonest, and in some cases, did not comprehend that their actions could be considered cheating. As such, academic dishonesty becomes one tool students use to ensure successful progress throughout the nursing program. The meaning of academic dishonesty as perceived by these nursing students was caring, sharing, coping and control.

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Next Generation Education: Narratives for the 21st Century

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ABSTRACT

Students in today's classrooms have grown up using an array of technology tools and applications. For educators in the information age, technological literacy is critical. The potential of digital storytelling as an instructional tool for teachers and students has yet to be fully realized. Addressing both the cognitive and affective domains, digital stories are personal narratives supported by images, video, voiceover, soundtrack, and effects. This article explicates some of the pedagogical benefits of digital storytelling in the classroom. Additionally, the paper discusses how digital storytelling can be used to address areas of focus identified by two standards-setting agencies that influence educational policy.

Keywords: digital storytelling, technology, K-12 education, teachers, pre-service teachers

INTRODUCTION

Students in the digital age are accustomed to creating, consuming, and sharing information using a variety of technologies. From Web 2.0 to mobile devices, they embrace cutting edge technology and often mold applications to meet their own purposes. As one author noted, students today "don't think twice about generating original electronic content and sharing it online" [1]. Savvy teachers will find ways to pair students' inherent interest in social exchange with curriculum standards and performance indicators.

Stories fulfill many purposes. "The oral tradition of knowledge transfer and exchange has served as the basis for education since humans began teaching one another, and digital stories build on this model by incorporating rich, dynamic media" [1]. Digital storytelling is an effective instructional tool that utilizes a user-friendly technology that is both flexible and adaptable. Simply defined, digital stories are narratives, typically personal, that incorporate images, voiceovers, and soundtracks [2].

A "typical" digital storytelling project begins with a discussion of the elements of stories with a focus on point of view, the dramatic question, word economy, and rich language. The story writing session includes time for developing the story, giving and getting feedback, drafting a final version, scripting and storyboarding.

Students then record the voiceover, collect images, and select the soundtrack. A nuts and bolts session on the software gives students the technological information to create their own digital story. The culminating activity is the sharing of students' digital stories. Because students are writing and creating for an audience other than the teacher, the final product reflects more polished, intentional writing. Though this description of the digital storytelling process implies a linear progression, the process is actually recursive, with students returning to various steps as they refine and redefine their stories.

Teaching writing is not only an expectation of teachers, it is also a practice that is encouraged across the curriculum. Thus, digital storytelling is applicable across both levels of schooling and across content areas. The process and production of digital stories address many elements of student learning and can easily be adapted across subject matter. The purposes of digital stories include, but are not limited to, "instructional, persuasive, historical, or reflective" [1].

As is the case with many student assignments, the final product can vary tremendously. Numerous resources can

be incorporated into digital stories and students are limited only by their imaginations and their willingness to experiment [1].

Clearly digital stories have many advantageous qualities for the classroom. They also have the added benefit of fulfilling standards identified by education-related institutions that influence policy: *The Partnership for 21st Century Skills (P21)* and the *National Council for the Accreditation of Teachers (NCATE).*

THE PARTNERSHIP FOR 21ST CENTURY SKILLS

The Partnership for 21st Century Skills (P12) is an advocacy group that champions 21st century readiness so that students will be prepared to compete in the global economy. The stated purpose of P12 is to "help the U.S. education system keep up by fusing the three Rs (reading, writing, and arithmetic) and four Cs" [3]. The four Cs refer specifically to **critical thinking** and problem solving, **communication**, **collaboration**, and **creativity** and innovation.

The expectation is that students will gain a deep understanding of high level content and its interconnectedness with 21st century themes (i.e., global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; and health literacy). In addition to thinking skills, and a deep understanding of a subject, there are also several essential life and career skills that will be needed by students. These include flexibility and adaptability, initiative and self- direction, social and cross-cultural skills, productivity and accountability, and leadership and responsibility [3].

The Partnership has also identified support systems that must be in place to ensure that students master 21st century skills. This support system includes 21st century:

1. Standards,
2. Assessments ,
3. Curriculum and Instruction,
4. Professional Development, and
5. Learning Environments.

All of these support systems have direct implications for digital storytelling in the classroom.

1. Digital storytelling engages students with authentic data and tools to solve meaningful problems. As a result, students develop deep, rather than surface, understandings within a discipline. (Standards)

2. Digital stories can serve as a multi-dimensional assessment tool as they provide teachers with a method for evaluating content mastery; learning and innovation skills (e.g., critical thinking, problem solving); information, media, and technology skills (e.g., information literacy); and life and career skills (e.g., flexibility, initiative, responsibility) simultaneously. (Assessments)

3. Digital stories support innovative teaching and learning methods that integrate technology, problem-based learning, and higher order thinking skills. Digital storytelling also encourages the integration of community resources and extends learning beyond the classroom into the community. (Curriculum and Instruction)

4. To prepare 21st century learners, teachers will have to carefully evaluate the impact of their teaching methods in the classroom and determine which learning environments best promote 21st century skills. As a result of this analysis, it is likely that certain practices may be replaced or de-emphasized in order to achieve a better balance between direct teaching approaches and project-oriented methods. The incorporation of digital storytelling into the classroom can help achieve this balance and can also better address the needs of diverse learners by providing them with alternate forums to demonstrate progress. (Professional Development)

5. Through digital storytelling, students learn in relevant, real world, 21st century contexts that afford them the opportunity to engage in both individual and group-based projects. (Learning Environment)

NATIONAL COUNCIL FOR ACCREDITATION OF TEACHER EDUCATION

The National Council for Accreditation of Teacher Education (NCATE), the accrediting agency for teacher preparation programs in the United States, has also articulated the importance of ensuring that future educators are proficient in meeting the needs of 21st century learners. The NCATE mission statement asserts, "Today's society needs a workforce that can apply knowledge, reason analytically, and solve problems. At the same time, American society is becoming more diverse, with students in classrooms drawn from many cultures and ethnic groups. Preparing teachers to teach all students to meet society's demands for high

performance has created a new agenda for educators and policymakers" [4].

Of particular importance is NCATE Standard 4, which states, "The unit designs, implements, and evaluates curriculum and provides experiences for candidates to acquire and demonstrate the knowledge, skills, and professional dispositions necessary to help all students learn. Assessments indicate that candidates can demonstrate and apply proficiencies related to diversity. Experiences provided for candidates include working with diverse populations, including higher education and P–12 school faculty, candidates, and students in P–12 schools" [4].

NCATE Standard 4 encompasses the design, implementation, and evaluation of curriculum. In many regards, this standard is the heart of 21st century teaching. Specifically the standard mandates proficiencies related to student diversity:

1. Candidates understand diversity, including English Language Learners (ELL) and students with learning exceptionalities.
2. Candidates develop and teach lessons that incorporate diversity.
3. Candidates demonstrate sensitivity to cultural and gender differences.
4. Candidates incorporate multiple perspectives in their instruction.
5. Candidates develop classroom school climates that value diversity.
6. Candidates understand teaching and learning styles and can adapt instruction.
7. Candidates demonstrate dispositions valuing fairness and learning by all.

Similar to the support systems articulated by The Partnership for 21st Century Skills, these proficiencies have connections to digital storytelling.

1. Every student has a story to tell. When students speak and write from their own experience, student voice is encouraged. Positive identities are fostered when students' experiences are honored. (ELLS and Exceptional Learners).

2. As students share their stories, diversity is incorporated into the lesson in an authentic and genuine way. Responsive teachers capitalize on the cultural and linguistic strengths students bring to the classroom. The Center for Digital Storytelling, a pioneer in the digital storytelling genre, notes that "sharing and bearing witness to stories can lead to learning, action, and positive change" [2]. (Lessons with Diversity).

3. A critical component of digital storytelling is the story circle where participants share their initial ideas for a story with their fellow students. The teacher establishes the norms for participation in the story circle. These norms include making nonjudgmental comments and suggestions. Students are encouraged to develop skills in group dynamics and become astute in considering the perspectives of others. (Sensitivity to Culture and Gender Differences)

4. By its very nature digital storytelling incorporates perspectives that are relevant to students' lives and backgrounds. Teachers demonstrate respect by validating the experiences that students share in their stories. Students also learn new ways to hone their expressive skills and develop their fluency. (Multiple Perspectives)

5. Digital stories build classroom community through the collaborative nature of the process. Additionally, students learn new information about their fellow classmates, which may lead to increased regard, sensitivity, and respect. (Classroom Climate).

6. The act of creating a digital story allows students to convey their stories both within and outside of their preferred learning style. Kinesthetic, auditory, and visual senses are utilized throughout the process. Different intelligence preferences may also be employed, allowing students to work in their favored mode of intelligence. Many students have strengths that are often overlooked in traditional classrooms. As Robert Sternberg explains, "By becoming aware of those strengths and incorporating them into instruction, educators can boost student achievement" [5]. (Learning Styles)

7. When students engage in the process of digital storytelling, they are able to explore the thoughts and ideas about which they are most passionate. Frequently teachers are unable to incorporate students' interests because of the constraints imposed by curriculum pacing guides. Students also have a degree of choice and autonomy, and teachers can encourage curiosity, enthusiasm, and inquiry in the classroom. Under these

conditions, learning is much more likely to occur. (Fairness and Learning by All)

OTHER BENEFITS

The potential benefits of digital storytelling on student learning are numerous. Several key areas of student growth and development can be addressed through the implementation of digital storytelling in the classroom.

High Level Thinking

Paper-pencil tasks are frequently used to assess students' *knowledge* and *comprehension* of the content, which are low level thought processes. Digital storytelling can deepen and extend student understanding in a content area by requiring engagement at higher cognitive levels. In addition, the relevancy of subject matter is enhanced, inter- and intra-disciplinary connections forged, and essential concepts of a discipline more readily retained when students engage in digital storytelling.

Process Skills

A multitude of process skills are also developed during the development of digital stories. These include, but are not limited to, skills in oral and written communication; creativity; critical thinking; and research. The organizational skills of planning, record keeping, and time management are also enhanced through the creation of digital stories. Also, when working with others, those aspects of group dynamics such as teamwork, decision making, communication, and consensus building can be further developed.

Continuous Learning

Even after a digital story has been created, a grade assigned, and a new topic introduced, students can continue to reflect and act on the ideas generated from the digital storytelling process. Teachers should encourage students to continue to explore alternatives and refine their solutions, as this is the essence of inquiry [6].

Metacognitive Skills

Perhaps one of the most beneficial aspects of digital storytelling is the mental processes that are developed while students are engaged in the activity of production. Through each stage of the process students are planning, reflecting, and monitoring their progress toward established goals. Students need to be encouraged to think about the mental processes they are using as they work through the steps of a problem and how these steps and their sequence might be altered to improve performance.

Thinking Interdependently

Interaction with others can greatly enhance a learning experience. Whether a student is working independently or in a group, the activity of bouncing ideas off others can help refine and shape one's thoughts. Though digital stories are personal narratives, they should also be a social event in the classroom. Even if students are each working on their own projects, teachers still can encourage students to elicit suggested strategies and feedback from their peers along the way.

CONCLUSION

One of the biggest constraints on many teachers' willingness to employ digital storytelling in the classroom is time. In an era of high-stakes testing and accountability, many teachers feel pressure to "cover" as much content as possible in order to prepare students for standardized tests. This concern is a valid one. Digital storytelling can be time intensive, and many teachers are uncertain about how to effectively incorporate such experiences for students into the existing school schedule. The challenge is to demonstrate how digital stories are an essential part of the curriculum rather than a superfluous one. One way to convince stakeholders of the efficacy of digital storytelling is demonstrating how this instructional methodology meets a variety of standards.

It has been asserted that there are connections between digital storytelling and the support systems that need to be in place according to The Partnership for 21st century Skills These support systems are essential for students who will compete in a global economy. Technological literacy has already become an expectation.

Digital stories can also be a critical component of the professional and pedagogical foundation necessary for prospective teachers who must use and manage appropriate technological tools and processes. Teacher preparation programs that train pre-service educators to provide engaging lessons that result in measurable student learning should realize that digital storytelling addresses key NCATE standards. Having prospective teachers complete their own digital story and then plan and deliver a unit using this instructional methodology will demonstrate their proficiency in NCATE Standard 4. More importantly these novice teachers will be able to transfer this skill when they have their own classrooms. It is also important to note that the knowledge and skills cultivated through the creation of a digital story align with many other state and national competency goals across disciplines.

The development of a digital story requires learners to engage with content and concepts at a higher level through analysis, synthesis, and evaluation. Digital stories are a 21st century assignment and should be utilized to prepare future-ready students and teachers.

[1] **7 Things You Should Know about Digital Storytelling.** EDUCAUSE Learning Initiative at www.educause.edu/eli.

[2] **The Center for Digital Storytelling** at http://www.storycenter.org/index1.html

[3] **The Partnership for 21st Century Schools** (P21) at http://www.21stcenturyskills.org/.

[4] **National Council for the Accreditation of Teacher Education** (NCATE) at http://www.ncate.org/.

[5] R. Sternberg, "Recognizing Neglected Strengths," **Educational Leadership**, Vol. 64, No. 1, 2006, pp. 30-35.

[6] K.R. Stephens & F.A. Karnes, "Product Development for Gifted Students" in F. A. Karnes & S. M. Bean (Eds.), **Methods and Materials for Teaching the Gifted** (pp. 157–186). Waco, TX: Prufrock Press, 2009.

Some Recognition on "Interdisciplinarity"

—One of the Basic Strategies for Research Universities

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Abstract:

Based on the knowledge about the origin and development of "discipline", in this paper we put forward the concept of "interdisciplinarity". Going further, the interdisciplinarity coming from the world's diversity and complexity are pointed out and described. And the multiple meanings of interdisciplinarity, interdisciplinarity of the activities to know and to discover the world and creating and changing the world are discussed. Then the relativity of "discipline", absoluteness of interdisciplinarity and the difficulties to conduct research with interdisciplinary are discussed.

For universities, especially research universities, which are the main body of institutions to carry out multidisciplinary comprehensive education and research, the interdisciplinarity has become a sign and index of their research capability; Interdisciplinarity construction is an overall and strategic construction to establish future disciplines in universities.

Introduction

When people evaluate a modern university, the first thing they will check is the number of disciplines that the university has and their research capability. Every year, we inspect the development of every discipline. Meanwhile, we also have to organize the application for new master or doctor programs. This has become a focus of competition of all universities. Naturally, the so-called inter-disciplinary also begins to attract people's attention and become a much talked-about topic. Many monographs (5 - 24), including doctor theses and master theses (25 – 27), have made systematic expatiation of this problem. Meanwhile, there are some other papers doing reflection on inter-disciplinary, or making some practical activities, or giving some relevant suggestions and countermeasures about it.

This paper puts forward the concept of **interdisciplinarity**, and it will discuss the various recognition problems related to the **interdisciplinarity.** Fundamentally speaking, the **interdisciplinarity** should be a foundation on which research universities should be based in the new century.

1. A brief introduction of the concept of "discipline" and its origin

According to the encyclopedia, a discipline is a system of basic scientific knowledge which is organized in accordance with a certain teaching theory. Thus comes out the discipline that matches the corresponding science. By disciplinary teaching, we can impart students the established scientific concepts, basic theories and fundamental facts, and a discipline can also reflect the latest research outcome of the corresponding science. Disciplines are relatively independent knowledge systems. Disciplinary system should not only reflect the system of science but also should be in accordance with teaching requirements.

In a word, "discipline" is an approach or method that the human beings take to get to know the world. It's also a sign indicating the human beings' understanding level of the world. In the age of such saints and geniuses as Confucius, Laotze, Aristotle and Da.Vinci, there was nothing like "discipline" and neither were there anything like system of science or disciplinary system. With the passing of time, however, we had to disintegrate and dissect this world to get to know about it. After hundreds of years' development, since academy and institutions of high education helped "discipline" develop from only a few categories in the beginning to hundreds of different disciplines now. The development history of high education was accompanied by the continually extending, adding, deepening and subdividing of the disciplines in the institutions of high education. At the very beginning, there were a few subjects, such as mathematics, physics, chemistry, etc. With the time going on, there came along some new disciplines like biology, medical science and so on. And each discipline further branched out many new disciplines. To this day,

discipline has almost become something that covers and contains everything.

However, if we take a look across the continual establishment of new disciplines, we will find that almost all of the new disciplines are a result of "crossing" out the original discipline, and the development of new growing points of disciplines is also a result of crossing of the new disciplines in different levels.

2. Interdisciplinarity—Diversity and Complexity of the Nature of the World

The so-called "Interdisciplinarity" (¨Inter-disciplinary, Cross-subject, Cross-disciplines) in the encyclopedia, gives explanation of marginal (frontier) discipline and inter-discipline. They are general terms for the new disciplines which arise from the crossing-over and penetration of the original basic disciplines. Here, we superficially regard interdisciplinarity as a definition in broad sense. It contains the concept of inter-discipline, and it also contains the concept of synthesis and integration of disciplines and the concept that the original discipline swells too much that its content is subdivided into many new disciplines. With entering of other disciplines, the discipline will develop further, we can also say that the "crossing" trend of the discipline brings us some new ideas, new methods, new contents, and they probably will become growing points and forerunners of the new disciplines;

Also in its very nature, the world has the nature of the interdisciplinary, the diversity and complexity of the world determine the interdisciplinarity of the world.

3. To understand the "interdisciplinarity" of the world

In essence, the nature is diverse and complex, and interdisciplinarity is one of its essential characteristics. Whether for the small objects such as insects, trees and human beings or for the very large objects such as the earth and celestial bodies, complexity is one of their characteristics, and further they are all essentially interdisciplinary. So, when we are trying to understand the world from the point views of discipline, the world always exhibit its interdisciplinarity. Here we take anthropology as an example. Today, the disciplines that anthropology involves can be roughly divided into social sciences and physical sciences which can be further subdivided into linguistics, physiology, psychology, genetics, biomaterials, biochemistry, bio-structural mechanics, bio-solid mechanics, bio-fluid dynamics. It has covered almost all disciplines. Generally speaking, such divisionally exploratory research is interdisciplinary in its very nature. And if these disciplines mentioned above confine them to their own fields, they won't be able to go deeper. Because it involves many disciplines and the permeation and merge of disciplines, namely human beings' emotion, psychology and sense cannot be separated from the organs, organs' operation, the cells' metabolism and interactions, that even to this day there are still many mysteries and puzzling phenomena and natural laws to be explained, and there are still many interdisciplinary fields to be explored.

Nobel Prize is a widely-acknowledged science and technology award of the highest level which has made great contribution to the development of the society and Science & Technology [7 - 8]. Looking back on the 100 years' history of Nobel Prize, we can see the percentage of the interdisciplinary achievements goes up year on year, from 36.23% up to 47.37%. By the last 25 years of the 20th century, inter-disciplinary achievements that have been awarded the prize had almost reached 50%.

4. Interdisciplinarity of world creation

During the time when people invent stoneware and learnt to bear wood to get fire, there were nothing like disciplines, with time coming along to today, the 21st century, human beings' activities of world creation have began to bear more and more interdisciplinarity. Whether for the small articles like digital cameras, home appliances and electronic microscopes or for such large articles like automobiles, planes and spacecrafts, every high-tech invention ,every product, every experiment and every space mission, the creation activities' becoming more and more complex is almost a necessary result of crossing, penetration and cooperation of different disciplines. It's the true interdisciplinarity that provides the foundation to break down industry barriers and to carry out cross-industry cooperation.

5. Relativity of discipline and absoluteness of interdisciplinarity

"Discipline" is only a kind of classification method for a certain period of time to facilitate teaching, it obviously should be relative. And with the advancement of human beings' knowledge, a certain "disciplines" will experience the process of coming into being, development and dying out. Just as the development history of physics, the extension also reflects the relativity of the discipline and the absoluteness of the interdisciplinarity.

If we say that the trend of further subdivision continued in the 21th century, we mainly base this argument on the prerequisite that the life and energy of a person are limited. Then, we ought to think about this, the world is changing, and the knowledge which was originally very abstruse seems to have become common sense now, and the two kinds of the knowledge which were considered very unique and quite different can be possibly elucidated in a few words now, we may question the necessity of the existence of two different disciplines. On the other hand, we may raise the question whether the students of today still need to learn this branch of knowledge just as their precedents did and don't have extra energy to dip at other branches of knowledge? This not only marks the development level of science and human beings' knowledge, but also is requirement and necessary pathway to get to know the nature. We have experienced the cycle of going from whole to disintegration, analysis, simplification, and return back to the integrated whole.

There are crossing possibilities of the disciplinary of different categories and at different levels, every possibility can lead to a breakthrough in understanding this complicated world. There are many successful examples, here just list a few: CFD in Princeton university in 1970s, and MEMS in 1980s in University of California, and the molecular biology in California Institute of Technology and Harvard University, and the bookless library in University of Michigan in 1990s, obviously, these examples also reflect the absoluteness and actuality of the interdisciplinarity.

6. Difficulty of discipline-crossing

Although, development of science and discipline provides many possibilities and opportunities of discipline-crossing, it's still not easy to really realize the crossing.

First of all, we have to deal with the obstacle, "inertia or complacency of a discipline", such a situation exists in many disciplines in which those preeminent people who have made some achievement in their disciplines often tend to have such inertia, on the one hand, they feel that they have drained up their energy and dare not enter into new fields, even they are not happy with others' exploration of such fields. For this reason, for a very long period of time, the popular are saying that "different disciplines are separated as by mountains".

Secondly, if a person's research in his discipline (by narrow sense) hasn't reached certain level, you will not know which discipline to cross over, and on which points to converge and integrate, namely you will be unable to cross. Therefore, only those scholars (including students) who are willing to climb, and have reached or almost reached the summit of research can have a good view of the mountains behind mountains.

Undoubtedly, these interdisciplinary examples mentioned above are just the result of these well known universities' having or creating conditions and prerequisites, such opportunities also include many accidental factors, an academic exchange or a social gathering all may result "crossing". These opportunities will still slip away from your hands.

Additionally without the spirit of bravely facing failures and censure, it will be very difficult to adhere to working in such pioneering, exploration and innovation fields. Possibly, for some reasons, other people achieve the outcome before you do and you lose the opportunity to become world first.

Further on, without a free and easy educational environment how can the students acquire fundamental knowledge of different disciplines? How can they get familiar with the frontier problems of different fields and further explore these new growth points of "crossing"? Therefore, to aim at establishing a research university of high standard without a clear understanding of its difficulty and practical measures to improve academic and educational environment, such an ambition will finally fall to a laughable slogan.

7. Actual urgency of discipline-crossing

On the other hand, we have to notice the fact that the pace of "interdisciplinary" practice is becoming faster and faster with the advent of the networkization of information and the globalization of economy.

As is well known, presently, a graduate student can conveniently use such internet tools as Google to look up information of his interest, and he/she can also find information through internet about relevant professors and laboratory of any university, and he can further request for relevant research literature and materials or ask questions or discuss with them; With no doubt, this opens a convenient door for "discipline-crossing". That is to say, some things which have to be done for many years and in person, now can be realized very easily with the help of network. In addition, information and network technology themselves also contain intension of crossing and penetration of different disciplines, which provide some more practical condition for the realization of discipline-crossing itself.

Undoubtedly, economic globalization is also one of the "prime driving forces" of discipline-crossing. Economic globalization can't be separated from the interdisciplinarity, either. The spirit of globalization is to optimize the whole economic structure makes the most possible profit at all field. What kind of talents does economic globalization need and rely on? Economic globalization will certainly aggravate the urgency of cognition and cultivation talents of the interdisciplinarity

8. "Interdisciplinarity" of research-oriented high education

Experience tells us that most original papers with regarding modern teaching theory [7] [1-14], patents and inventions come from the research work of the postgraduates, and even though Nobel Prize winners and professors are not postgraduates when they receive the award. For these reasons, the world well known universities all attached great importance to the role of the postgraduates. Those world well-known universities like Harvard, CALTECH, MIT all carry out on-the-spot investigation of the teaching institution and environment of postgraduates. How to provide the postgraduates with an education system, academic environment and condition which are conducive to creating knowledge, and especially conducive to crossing discipline has become a major project, a fundamental characteristic and sigh of the standard in well-known universities. The interdisciplinarity will become an important index in university evaluation.

9. "Interdisciplinarity"- one of the basic school-running strategies of the research university

As interdisciplinarity is of fundamentally strategic significance for the building of high level university, Interdisciplinarity is development point of advantaged disciplines, growth point of newly emerging disciplines, breakthrough point of major innovation and commanding point of talent education. Interdisciplinarity has become a consensus and distinctive character of current high level universities.

Those world high level universities like Harvard, Caltech, MIT all have good foundation and cultural tradition of interdisciplinarity, and they all attach great importance to the students' general education in humanity, art and social sciences, and lay stress on the students' analytical capability and rational judgment ability of matter to realize crossing and creation in relevant disciplines, and to create a good academic and educational environment which will be conducive to the realization of "discipline-crossing" as one example as CALTCH's motto. CAlTECH has been ranked first many times in university assessment of the USA, clearly incorporates interdisciplinarity into its school running principle.

In MIT, the number of interdisciplinary research center and laboratory has over passed 40; Stanford University is carrying out a "interdisciplinary biology" research program involving the following three major areas; Harvard University and University of Michigan set up an "interdisciplinary cooperation fund" and establish some interdisciplinary institutions. Tsukuba university of Japan is another example, there is nothing like discipline or department, instead, the courses are divided based on disciplinary group or disciplinary family, and the purpose of such an arrangement is to expand and realize interdisciplinary education system.

For universities of developing countries, "interdisciplinary" construction should be a long time strategic school-running objective and should be a systematic construction of the school's academic environment and atmosphere [15 - 24].

Conclusion

It is noted that from the point of view of cognition, based

on discussion on origination and development of "discipline", the paper describes and illustrates that "interdisciplinarity" originates from the diversity and complexity of the world; it also discusses the multiple meanings of the interdisciplinarity, the interdisciplinarity of understanding the world and the interdisciplinarity of world creation activities, and it also illustrates the relativity of the discipline and the absoluteness of "discipline-crossing", the difficulty of discipline crossing.

Also it is noted that facing the new century with the progressing and development of people's world understanding and creation activities, whether for a Nobel Prize winning project or a great space mission, "interdisciplinarity" has become a more and more prominent characteristic; the interdisciplinarity has become a evaluation index of universities, especially research universities which are the main body of multidisciplinary comprehensive education and research; Those world famous universities and academic institutions all consciously or unconsciously adopt "interdisciplinarity" as one of the basic school running strategy.

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Economics for Engineers or Engineering Economics?

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ABSTRACT

This paper summarizes the results of an educational innovation project which has been progressively implemented since 2002 in various engineering degrees at the University of Oviedo. It was based on the experience of a group of professors and lecturers whose professional profile covers both economic and engineering fields. The final aim of the project was to increase the interest of the students in this kind of courses by means of stimulating their curiosity and the perceived utility of the knowledge and skills acquired. This was achieved by the introduction of information technologies not only as e-learning tools but also as part of the learning competencies that all engineering graduates should have acquired during their studies.

The results of the project have been measured by both objective and subjective indicators: the numerical grades obtained by the students in the courses and their personal evaluation of the contents, learning methods and skills achieved. As well as this, the time consumption of the different learning activities has been recorded for every student and the evolution of these records has been analyzed.

Keywords: engineering, economics, educational innovation, e-learning, time management.

1. INTRODUCTION

Courses on economics and business are always included as part of the program of studies in all engineering degrees. There is no discussion on this point, as all professionals agree on the importance of economic feasibility in any engineering discipline. Despite this, the educational experience shows that engineering students are sometimes reluctant to study this kind of courses, not so closely related to technical disciplines. This perception of irrelevance seems to be more intense in first year's students and it is softened as they advance in their studies.

This problem has been observed in different engineering disciplines, such as Mining, Chemical, Electrical, Mechanical, Civil and Environmental Engineering, as well as in various levels of study (not only undergraduate, but also postgraduate students). Anyway, this problem is not restricted to economic courses in engineering degrees, and lecturers frequently mention a more general problem of students specializing in one subject area being reluctant to study material in an area peripheral to their main interest: languages for engineers and science professionals in general [1], [2], mathematics and physics [3] or law [4] for health professionals, etc. In these cases, all authors agree on the need to consider the subject-specific needs of specialists in a given field.

2. AIM OF THE PROJECT

This paper summarizes the results of an educational innovation project which has been progressively implemented since 2002 in various engineering degrees at the University of Oviedo. It was based on the experience of a group of professors and lecturers whose professional profile covers both economic and engineering fields and who are responsible for diverse courses on economics and business. The target courses were integrated in Mining (1st and 4th year), Process (5th year), Bioprocess (5th year) and Environmental (5th year) Engineering studies. The average number of students ranges from 40 to 60 approximately. All the courses carry a value of 6 or 7.5 ECTS credits (1 ECTS credit is equal to roughly 25 – 30 hours of student work including 10 hours of work in the classroom).

The final aim of the project was to increase the engagement of students in this kind of courses by means of stimulating their curiosity and the perceived utility of the knowledge and skills acquired. This should lead to an improvement in the students' performance in the courses [5], [6].

3. METHODS

Screening and monitoring

The first step of the project was to determine the extent of the problem. Diverse screening methods were used for this purpose.

Time management report: Personal time management plays a key role in the educational process. Different habits influence the time consumption of different activities and therefore are important determinant of time management success in learning [7].

During the whole semester in which the courses were undertaken, students were asked to keep a record of the time devoted to the course. This time was classified in the following activities: attendance to lectures, personal study, problem and exercise solving (individual), problem and exercise solving (group) and project development (group). The records of every student were called "Time management report" and were collected and analyzed at the end of the semester.

Final personal report: Self-report measures have been used by many researchers to assess the behavioral, cognitive, and affective aspects of student engagement [8]. Students are asked to report on factors such as their attention versus distraction during class and the mental effort they expend on these tasks. Affective engagement questions typically ask students to rate their interest in and emotional reactions to learning tasks on indices such as choice of activities, the desire to know more about particular topics, and feelings of stimulation or excitement in beginning new projects.

After the semester final grades were known, students were asked to write a "Final personal report" analyzing their performance and results in the course, what they had expected and actually found, which activities and contents they found more/less interesting or challenging, what they missed, their suggestions, etc. They were also asked to compare this with other courses undertaken in the same semester.

Final grades: The above-mentioned monitoring tools, together with the evaluation of the students' performance (measured by the numerical grades obtained) have been used along the eight years of implementation of this project. The information obtained in the fist year was used to make a diagnosis of the situation by describing in detail the starting point. Since then, it has been used as a result monitoring system for feedback.

The diagnosis

According to the information obtained in the first year, the initial situation was very similar in all the target courses and can be described as follows:

- The average time spent by students in the different activities was distributed as shown in Fig. 1. The most time demanding activity was personal study, closely followed by lecture attendance. Problem and exercise solving (both individually and in a group) plus project development scarcely added up to 16% of the whole time devoted to the course.
- In their final personal reports, students stated that the contents of the courses and even the textbooks were excessively theoretical. They were interested in a more practical approach, with more problem solving sessions and more examples from industry.
- The perceived utility of the courses was quite low. The students found low apparent connection to real life in the materials studied. Specifically, they could not imagine any practical implementation in their future careers.
- Paradoxically, despite this lack of interest the students' performance was not worse than in other more technical courses, especially in the upper levels. Students who were close to finishing their degrees seemed to have developed a kind of "mechanical study discipline" that allowed them to assimilate any material avoiding any personal criteria.

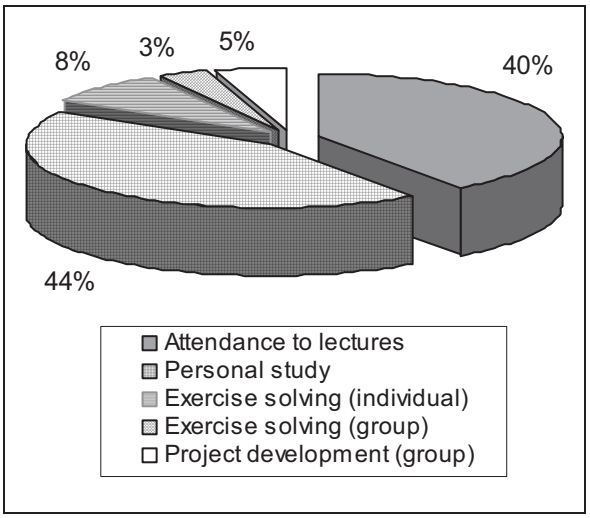

Fig. 1 Time management report results (DIAGNOSIS)

The treatment

Once the problem was diagnosed, a treatment could be planned to solve it gradually. The courses needed a deep change in approach and methods. We needed to persuade students that a subject they saw as irrelevant could be

very important in their career. As well as this, we knew that the courses should be more practically oriented than those similar ones included in social science degrees.

Economics and business are part of everyday life and the sources of information are countless. It was a matter of demonstrating to the students how these subjects influence personal and professional life. It was not difficult to find real examples, specific to the area of specialization, where the lack of economic feasibility had spoiled a technically feasible project. This was a really good point to start with.

It was even possible to find former students working in fields directly related to the subject who could give a talk at an appropriate moment in the semester. We found engineering colleagues working in production forecasting, planning and control, investment valuation, project finance, occupational health and safety, environmental and quality management, accounting and even marketing.

The e-learning platform: As textbooks had demonstrated to be rather unexciting, most of them have been replaced by other information sources, such as press, radio and television. Electronic communication media are specially interesting. Recent news can illustrate most of the contents of the courses with real life examples.

Different works suggest that an integrated virtual learning environment could engender a move to more autonomous learning by students [9]. Another interesting advantage of this kind of systems is that they ca be used by higher education institutions to increase the availability of lectures to off-campus students [10].

A web platform was developed and implemented to grant the access of students to all the learning materials. Lecturers can upload new contents in real time. The platform includes a forum for the discussion of cases, news and articles. As well as this students can upload and share their own documents and materials. By means of this platform, any example found by any member can be shared with all the learning community and later discussed in lecture sessions. Most of the problems proposed along the semester are based on these examples.

One of the most interesting aspects of this innovation is the opportunity to comment and discuss on economic news. With this activity, students discover the most important information sources, become familiar with the specific vocabulary of the subject and learn to understand and analyze economic information critically. Students demonstrate a special interest and satisfaction with this kind of activity and discover the connection of the course to real life.

The lectures: Instructors agree that there is a strong correlation between student participation and performance [11], so we decided to change the structure of the lectures to adopt a more participative model.

With the help of the e-learning platform, the development of the lectures has evolved significantly. Most of them cannot be called lectures any more but seminars. Students participate more actively and their contributions are richer. The number of strictly theoretical explanations has been reduced and they have been replaced by more practical activities, such as case studies and discussions. Since the implementation of the platform the lecturer is no longer the only one teaching in and outside the classroom. Cooperative learning is encouraged.

Computer room sessions: There is a wide variety of software applications for almost any business process. Thus, why should students be content with using just a pen and paper to solve problems and exercises? The computer room offers a good opportunity for students to be trained in the use of different software packages.

Because of this, many theoretical lectures in the classroom have gradually moved to the computer room. Part of the interest of these sessions is in the fact that students can learn to use popular software suites to quickly solve problems already solved in the classroom. For example, a very interesting and simple exercise is the simulation of a mortgage loan using the actual terms offered by a bank (this information can be obtained from its web page), a spreadsheet and the financial functions. Another popular application of the spreadsheets is the simulation of a market using the demand and offer curves and varying the parameters on which they depend (an interactive approach to a very theoretical postulate).

The other point of interest in these sessions is that students can become familiar with very specific software designed for particular business processes, such as forecasting, production planning, Material Requirements Planning (MRP), Enterprise Resource Planning (ERP), decision making, accounting, business simulation, etc. Skills in the use of this kind of software applications are increasingly appreciated by companies

Teamwork projects: There is no doubt on the advantages offered by considering a teamwork-based methodology with university students [12]. On the one hand, it enables students to experiment and acquire the skills that they will need in their future jobs [13], such as interpersonal communication, teamwork, group problem-solving, leadership, negotiation and time management. Project based learning has been established in the field of engineering as a significant experience, promoting cognitive activities and long-life learning [14], [15].

Taking this into account, every semester a teamwork project is proposed to students. They are organized in small teams (4 to 7 members) and each team is given a topic to work on. The topics differ from one course to another. In some cases they have to work on the characteristics of the different types of societies and their suitability for a specific business. In other cases, each team is asked to valuate a specific company in their area of interest, or to develop a whole business plan for a new company.

The results of their work are presented in a lecture in which the lecturers are the students. Every semester the final exam includes one or more questions on the contents of these lectures.

This activity is not compulsory, but students are given an incentive to take part in it by taking into account their contributions for the final grade.

The electronic whiteboard: The most recent step has taken place this year, with the implementation of the electronic whiteboard. Recent works have been published on the advantages of using automated capture and access systems to capture the materials presented in lectures [16].

This year for the first time we are collecting all the information generated during the lectures and the participative class sessions and we upload the documents in the learning platform for later review by students. It is too early to judge for the moment, but we expect good results from this new procedure, especially for students who do not attend lessons regularly [17].

Contents of the courses: The important changes in the courses have been done in the teaching and learning methodology and materials. The contents learned have not changed essentially. It is the approach that has changed.

Evaluation system: There have been no important changes in the evaluation system, apart from the fact that the contributions of students to the teamwork projects proposed are taken into account for the final grades. The main component of the final grade is the final exam grade. The final exam is a written exam that includes everything that has been studied in the course and covers both theoretical and practical contents, with applied questions, problems and exercises. This type of exam has not substantially changed since 2002.

4. RESULTS

The monitoring system described above was used to evaluate the results of the project.

Results from the time management reports

The average time spent by students in the different activities is currently distributed as shown in Fig. 2. The distribution has progressively evolved from the one depicted in Fig. 1 to the present one. The differences are very significant.

First of all, we should say that the average time (in absolute terms) devoted to the courses by the students has increased slightly. A new activity has been introduced, which takes 18% of the time consumption: computer room sessions. This activity has directly reduced the time devoted to lecture attendance and both together sum up to 37% of the time of the student, representing the classroom work. The time distribution between the six types of activities is much more balanced than in 2002. Personal study only consumes 14% of the time, whereas problem and exercise solving (both individually and in a group) has risen to 35% of the time. This latter activity, in conjunction with project development, sum up to 30% of time. It means that students spend almost a third of their time devoted to the course working in teams.

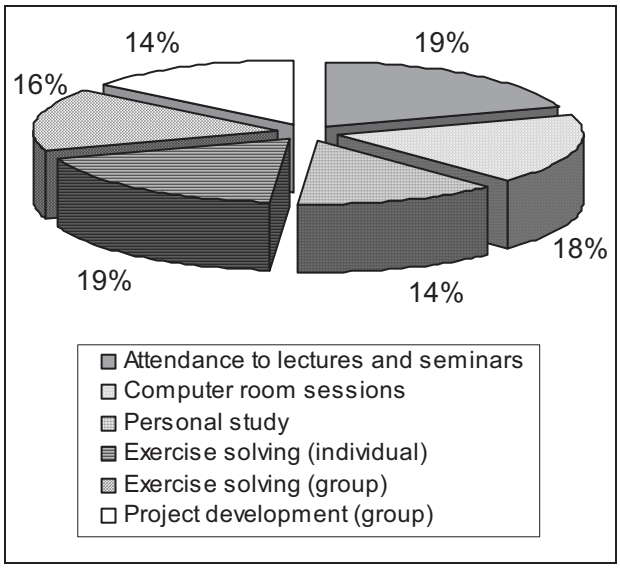

Fig. 2 Time management report results (CURRENT SITUATION)

Results from the final personal reports

The final reports collected along the last seven years show an interesting evolution in the perception of the course by students. They have shown a progressive involvement in the courses, with increasing enthusiasm and interest. They have also offered interesting suggestions on how to improve the different activities, some of which have already been implemented with good results.

Table 1 presents some interesting extracts from the final personal reports of the students collected along these years.

About the lectures: "I think that the participatory nature of the classes has been very important to dispel any doubts that might arise and for people see the course as something enjoyable…" "I think my performance was not bad, but I must say that I've devoted quite a lot of work to the course because I was encouraged by the way classes are developed…" "Giving students the opportunity to solve exercises and problems on the blackboard is a good choice since the lecturer sees where the difficulties are and also implies that students solve the exercises at home…" "Solving many exercises allowed us to understand much easier the theory…"
About the computer room sessions: "The class in the computer room to handle the spreadsheet in terms of financial mathematics has helped me to extrapolate (small scale) the usefulness of economic concepts and their importance in any business…" "I consider the computer classes particularly helpful, because we learned to use interesting programs…"
About the teamwork projects: "The lectures used to share information about our projects were a good idea, because on one side it took us a bit away from the routine of a regular lectures, and moreover it enabled us to learn some things by ourselves. In short, it seemed a good alternative to the traditional explanation of the issues…"
About the course: "At first, it seemed to me very inappropriate to take a course in economics in an engineering degree. Now I think it was very interesting, because I've realized that what we've learned helps us to understand many things of everyday life, like any advertisement of mortgage loans (interest, APR), accounting things (like a letter from the bank) or how the economy of our country works and how companies operate and are regulated…" "I believe that the knowledge gained in this course can be quite useful not only for my academic training but for everyday life (understanding the economic news, requesting a mortgage...). I hope to extend these basic skills in the future because I think they have huge practical application…" "I liked this course more than others and so I spent much more time studying it…" (Erasmus Student from Germany)

Table 1 Some extracts from the students' final personal reports (2003 - 2009). Translated from Spanish.

From the final personal reports we can conclude that the innovations in the courses have worked quite well to achieve the aims proposed for the project. The students' attitudes towards the course have changed significantly. From a subject perceived as peripheral which was considered in many cases as a waste of time, economics and business have turned to be a challenging subject that seems to be useful both for personal and professional life.

Results from the final grades

Fig. 3 presents the evolution of the average numerical grades (from 0 to 4) obtained by the students in the target courses since 2002 (the project started in 2002/2003 academic year). We have depicted separately the grades of regularly attending students and non-regularly attending students (absent), as the differences are meaningful. It is important to state that the type of exam has not varied significantly, so the evolution in the records cannot be explained by changes in the evaluation system.

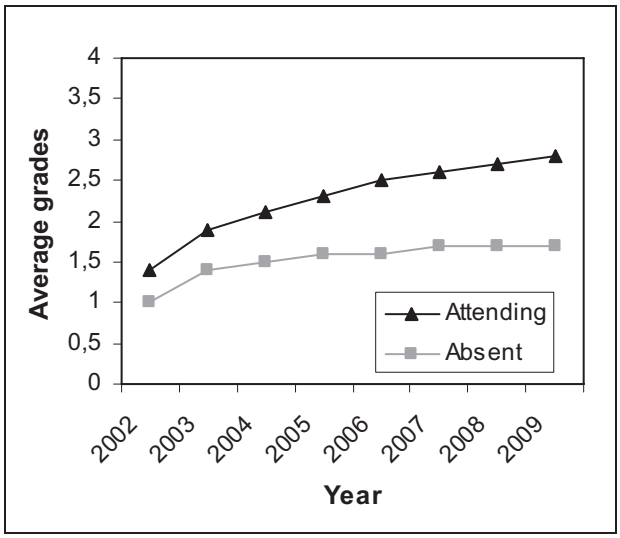

Fig. 3 Evolution of students' average grades in the courses. Regularly attending students (Attending) and non-regularly attending students (Absent)

Considered as an objective measure of students' performance, numerical final grades have increased significantly for both types of students. The most important increase was registered in 2003, the first year of implementation of the project when the most relevant changes took place. The rise in grades has been more intense in the case of regularly attending students (the positive correlation between attendance and performance has already been stated in different works [11]). This is consistent, considering that most of the changes have been done in the class sessions. Despite this, the innovations have also helped students who do not attend lessons regularly. This is probably an effect of the implementation of the e-learning platform, which explains as well why the increase in their grades after the first year has been much softer. The results of the present academic year have not yet been recorded, but we expect better results from non-regularly attending students due to the introduction of the electronic whiteboard.

The average final numerical grades of the students in the target courses are at the moment much higher than the ones obtained in the rest of the semester courses.

5. CONCLUSIONS

The main conclusions of the present experience can be summarized as follows:

- The use of e-learning technologies and information technologies can be a good system to link the contents of a course to real life.
- The introduction of specific examples from the area of specialization of the students contributes to this perception of utility.
- The discovery of this connection by students increases their engagement and interest in the subject.
- There seems to be a positive correlation between students' engagement, dedication and performance in a course, according to the results measured in terms of final numerical grades.
- The average grades in the target courses are significantly higher than in the rest of the semester's courses. Are we consuming too much of our students' time in our courses?

6. FURTHER WORK

The effects of the implementation of the electronic whiteboard have not yet been measured, but they are expected to be positive, especially for non-regularly attending students.

A deeper analysis should be carried out to determine the correlation between the time devoted to each learning activity and the student's performance.

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Teaching Interdisciplinary Topics by Transforming a Technical Oriented Course into Problem Based Learning

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ABSTRACT

Graduates of the degree programs of Computer Science and Business Informatics are expected to have deep knowledge in technical topics like Software Engineering, Computer Programming or Database Systems. Furthermore, capabilities in team work and understanding of business process management indicate additional assets for the graduates' working life.

At the University of Applied Sciences Technikum Wien, Problem Based Learning (PBL) is implemented in several courses. The new idea is to use PBL in the technical oriented courses "Database Design" and "Database Systems" with the purpose to teach interdisciplinary topics. Of course the technical topics are covered but additionally nontechnical topics like business process management are covered. The paper shows in detail the use of PBL in the course programs of Computer Science and Business Informatics. And it points out the main ideas behind the concept to illustrate which role PBL can play in the area of interdisciplinary teaching.

Keywords

Interdisciplinary Teaching, Problem Based Learning, PBL

INTRODUCTION

The University of Applied Sciences (UAS) Technikum Wien offers more than 25 different course programs. These programs chiefly focus on technical topics but strategically, all programs are used to covering economical and soft skills parts, too. The authors mainly teach in IT course programs like Computer Science and Business Informatics. During the last years different teaching methods have been tested, starting from ex-cathedra teaching, exercises, combination of non traditional methods up to Problem Based Learning (PBL). Problem Based Learning turned out to result in good learning outcomes mainly because students are forced to convert from passive information consumers to active team learners. So far, PBL experiences have been made solely in courses that deal with intermediate or advanced teaching contents. Core topics like software programming or database technologies are taught in more or less traditional ways. Based on very successful PBL experiences so far, the authors developed a new PBL concept for the courses "Database Design" and "Database Systems", two consecutive courses similar in two IT programs, Computer Science and Business Informatics. The assumption is, by a well designed problem definition students will not only learn the core technologies but they even gain additional knowledge about nontechnical issues.

Within two semesters students should develop a piece of software that implements a kind of simplified business software to support business processes. Features of the project are predefined and rely on a step by step basis on necessary database skills like storing or reading data, etc. Furthermore, students have to take care of business processes related to economical course contents. So PBL in database courses yields interdisciplinary learning including mandatory topics like software engineering, business process management, team work, etc.

PBL IN A NUTSHELL

From the students' point of view, Moust et al. describe PBL as a method consisting of seven steps (see Table 1) [2]. Teachers have to initially prepare the course. First of all, a problem must be defined. This problem should cover a realistic scenario (compare to [3]). If needed, teachers must explain the principles and the procedure of PBL. Only

when all involved persons (teachers and students) understand the process of learning, only when all know what they are expected to do the learning process itself can start.

Table 1: 7 steps for students in PBL [2]

Step	*Description*	*Coached?*
1	Clarify text and terms	Yes
2	Problem definition	Yes
3	Problem analyze	Yes
4	Structuring	Yes
5	Defining lack of knowledge	Yes
6	Research	Self studies
7	Presenting solutions, conclusion	Yes

Table 1 shows the steps to be followed. At the beginning, it is more or less a matter of clearing terms and looking for a structure for a possible problem solution. All steps except step number 6 are coached by teachers. The coaches follow the idea to bring students to a point where they can find a solution on their own. Step number 6 is the main part where students have to work in teams doing self organized research without any help by the teachers. Step 6 and 7 can be done iteratively, meaning that solutions of sub problems can be explained and even discussed with the coaches.

THE TRADITIONAL CONCEPT

Till last year, database skills in the course programs of Computer Science as well as in Business Informatics were taught in two courses, i.e. “Database Design” and “Database Systems”. These consecutive courses were located in the third and fourth semester of the curriculum.

The course cycle
Table 2 shows the traditional course design. More or less it consists of cycles where each round starts with a theoretical reading lesson by ex-cathedra teaching (T1). Here, learning content is presented to the students. At the end of each such lesson students get exercises that should be solved by the use of the presented contents. Students are forced to do the tasks individually (T2) and outside attendance time until the following lesson (T3). Afterwards the following reading lesson (T1) starts the next cycle.

Table 2: The traditional course cycle

Step	*Description*	*Who?*
T1	Reading lesson Ex-cathedra teaching Presentation of content Definition of exercises	Teacher
T2	Outside attendance Solving exercises	*Individual* student
T3	Practice session Presentation of exercises	Student Graded by teacher

Grading in the traditional concept
In principle, grades are calculated by passing two practically oriented tests. But there is one single criterion that must be fulfilled to get a positive mark: being prepared for more than 50 percent of all exercises in a semester. At the beginning of each practice session students have to state which tasks they have prepared and they are able to present a solution. They can earn credits for each announcement. Each single example is discussed based on a solution presented by a student. Teachers pick one of the students who told to be prepared for it. But if a student announces an example unjustified he or she loses all possible credits for the current lesson.

Course content
The course content of the traditional method is more or less limited to pure database issues. There are hardly any interdisciplinary topics but a relation to software engineering.

THE PBL CONCEPT

The new concept is based on the principles of PBL. Therefore, development of an online game in the area of business simulation is selected as the initial problem.

The initial problem
Students are urged to implement a kind of business simulation. In detail, it is a multiplayer online game. Players start the game owning a company, they can buy and sell land, they can build industries, they can buy and sell goods, they even can trade on a stock market etc. Several business processes are included in the game design.

Splitting into sub-problems The whole problem is split into sub-problems focusing on the actual teaching contents. This subdividing is preliminary prepared as part of the course design.

The course cycle
Table 3 gives the newly implemented cycle. The first cycle starts right after presenting the initial problem definition. Following the new concept (in regard to the sub-problems), the exercises are defined at the beginning of each cycle (N1). Students have to solve tasks without any presentation of content probably needed for finding a solution. They try to solve the exercises by research in teams and by self studies (N2). In upcoming coaching phase the solutions are discussed (N3). Each student team is supervised by a teacher who accompanies and guides the team for the whole semester. A following expert reading sums up these exercises on a theoretical basis (N4).

Table 3: The new course cycle

Step	*Description*	*Who?*
N1	Definition of exercises	Teacher
N2	Outside attendance	Student *team*

	Solving exercises	
N3	Practice session Coaching Discussion of exercises	Student, teacher Coached by teachers
N4	Reading lesson Expert reading	Teacher

The coaching

Due to the characteristics of the initial problem the teaching content is highly interdisciplinary. Without deep knowledge of business processes or economics for instance, it is impossible to implement the software following the predefined rules of the initial problem. Therefore, it is absolutely essential that coaches from different areas – not only from IT domain – support the lessons.

Grading in the PBL concept

Grading in the PBL must be divided into several grading methods for several courses. In the database course there are still two practical oriented tests. Now, the K.O. criterion of getting more than 50 percent of possible credits differs in the new concept. The work with student teams becomes closer in the PBL concept. Coaches get a continuous impression of teams as they now really see the progress of students.

Course content

The course content of the PBL method is enriched by the interdisciplinary topics, which means that linking-up with other courses outside the main IT focus plays an important role.

EVALUATION

As the newly developed course design currently takes place for the first time, so far a realistic evaluation of the method is not possible. Solely considering the database skills, evaluation can easily be done by comparing average student results as the two tests of the traditional concept and the PBL concept will be very similar.

Looking further apart of IT skills suitable evaluation methods are currently discussed.

EXPECTED ADVANTAGES

The main advantage of the new PBL concept is that the new method enables a more intensive work between students and teachers. During the coaching phases, teachers discuss problems and solutions in small groups. So, they can constantly monitor students' progress.

The interdisciplinary nature of the initial problem definition seems to yield to higher motivation. This is expected because of the first reactions of students who really appreciate the simulation game – they work hard on it.

From a broader spectrum not simply focused on the core IT technologies students can benefit as they easily learn to understand the coherence between different disciplines.

CONCLUSION

Formerly, the courses "Database Design" and "Database Systems" in the course programs of Computer Science and Business Informatics were taught following a traditional course concept. Traditional ex-cathedra readings were followed by exercises. Now a global concept using the PBL method including interdisciplinary contents apart of the IT focus is implemented. The main ideas behind the methodology switch force the students to think and work in an interdisciplinary way and hence it is a chance to decrease the difficultness of database systems by an increase of motivation of students.

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The Feedback Loop: Using Data for the Constant Improvement of Effectiveness and Academic Integrity

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ABSTRACT

The use of data serves to allow us to create a constantly improving learning environment for each of our students. Through constant communication with an independent data team faculty have access to data that helps guide improvement in student learning. Reviews of every program are done triennially and guided by metrics agreed upon by university committee. National assessments are used to measure the university against itself. Combining the art of teaching with the science of data analysis allows the university to achieve continuous improvement.

Keywords: Online Learning, Data Analysis, Assessment, Continued Improvement

Validation of learning at universities has been a challenge since the establishment of the University of Bologna, long considered the first university in the western world. Over time, a bureaucracy has grown around the teacher and the classroom that looks for objective validation of student learning. This business of assessment is intended to measure the "value added" by a specific educational experience.

Historically there has been friction between individual faculty and the university about how learning is measured. Answering the question "What is good teaching?" is as much art as it is science. A teacher who is considered "great" to a small number of brilliant students may be considered a failure to the rest of the class. Is that bad teaching? There may be a teacher who is extremely popular with the students, whose teaching is ineffective or is not even current with the subject matter. Is that good teaching?

Recently, there have been more attempts to validate entire programs and degrees at the university level. This has led to the use of standardized tests and learning measures that are independent of the faculty teaching experience. These assessment methods are often not popular, as faculty feel that they measure the wrong things and do not factor for varieties of pedagogy.

Faculty often resist the use of the resulting data in the classroom, seeing it as impersonal, intrusive and not representative of student learning. This resistance has stalled the integration of data into higher education planning and program review, and led to a negative perception of data as a tool for tracking consumer behavior, not student learning. The idea of student as consumer is, without a doubt, nothing short of an obscenity in the academy.

In recent years, added pressure has been put on colleges and universities to justify their high cost and constant raises in tuition. For this, and other reasons, accreditation standards and validation of student learning, have become more prominent and more

political in university administration. Colleges often see accreditation and data collection as something negative – something that is foisted on them from the outside and not part of their core functionality.

Data Team and Academy

There is a long-standing argument in the academy that quality can not be quantified -- that the measurement of learning effectiveness is not integral to the role of the university. We argue that data collection, validation and referencing should not be seen as an external mandate, but as a critical component at the heart of the academy. Attempts to restrict academic data from the public do not truly reflect the educational enterprise. Data should be available as a reference – a representation of student learning as well as faculty teaching.

Data and the Program Review Process

The American Public University System (APUS) is an online for-profit university with more than 60,000 students and 1300 faculty. We recognize that faculty involvement and voice are essential to a quality educational experience for our students. In other schools in the for-profit model, the curriculum is prepackaged and the faculty facilitates the delivery of course content to the students. In the APUS model, faculties have the ability to alter the curricular material to reflect their pedagogy, and have a strong voice in the selection of texts and related resources.

As a fully online institution, we have the ability to collect and review an extensive amount of student data, which we recognize as integral to the continuous improvement of a quality online program. Our challenge is to create a balance between the need for accountability in teaching and learning, and faculty comfort with data collection.

Our aim is to overcome this challenge, to harmonize the data requirements of the academic administration with the confidence of the faculty, and make them intrinsic to the needs of both groups. To do this, APUS has aligned data collection and analysis with the program review process, reviewing each program in a three-year cycle. We look at data -- including student evaluations of learning, graduation rates, grades, curriculum, and program enrollment -- to make sure we are keeping current with program objectives, core content and instructional resources, and to measure how well our students are learning.

WHAT DATA DO WE COLLECT?

We use several standard benchmarking instruments to measure teaching and learning at APUS, including:

- National Survey of Student Engagement (NSSE): Measures how engaged students feel about the value of their education.
- Community of Inquiry: Measures the of the dimensions of social presence and cognitive presence in the online classroom,
- ETS Major Field Test: Compares student achievement to national benchmarks to measure end

of program knowledge in major fields of study.

- Measure of Academic Proficiency and Progress: This measures how our graduating seniors compare nationally in areas such as quantitative reasoning and critical thinking skills.

Embedding Data in the DNA

To build a culture of assessment within the academy, we need to embrace data collection, review and reporting at the classroom level. At APUS, we have done this by embedding our data collection, review and reporting at into the core of our program review process.

Our data team is actively involved in the program review process, meeting with faculty, program directors and deans throughout the entire review process. We review grade distribution, NSSE scores, MAPP scores, MFT scores, COI scores, drop out and withdrawal rates, etc., and work with the academic community to understand how these figures represent teaching and learning at APUS.

By working with faculty, program directors and deans throughout the review process, we have the opportunity to integrate our data into the program review narrative. The result is a collaboratively produced fact book, with extensive data presentation and analysis of survey results. This process has fostered a partnership between our data team and faculty, program directors and deans. This partnership has allowed us to make improvement plans for faculty, to increase or decrease course requirements based on data and to see what programs and courses need to be restructured. This partnership has also shed a positive light on the collection, analysis and review of data in the APUS academic arena.

Continuous Improvement

In order to continuously improve student learning, we must combine the art of teaching with the science of data analysis, and embed data into the DNA of the academy. Once we do so, we will better see how effective the university system is, how we can help our students succeed and where we need make changes in our approaches to teaching and learning.

Effects of Written and Voice Asynchronous Feedbacks for assignments on Learning and Satisfaction in Face to Face Education

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ABSTRACT

One of the contributions of information and communication technologies for face to face education is to provide additional way of communication between teacher and students. Particularly, the Internet enables to do some activities out of class. Although this web supported activities has been widely used, it has raised further queries about how to make the best use of the Internet technically and pedagogically. Mostly, assignments and feedbacks are being exchanged on the Internet. The feedback which is one of the main parts of learning cycle is given in written format for both online or paper based assignments. Communication and data transfer speed make it easier to send voice feedback as a sound file or other methods. The aim of this study is to determine the effects of feedback formats (Written vs. Voice records) on student satisfaction in blended learning environment. In order to fulfill the aim, different feedback formats were provided to randomly assigned groups on for four weeks. Learning and satisfaction differences between groups were compared statistically. Results show that students have higher satisfactory level with voice feedback. Moreover preparation of voice feedback takes less time but requires more motivation and special environment.

Keywords: Voice Feedback, Student Satisfaction, Feedback in Blended Learning

1. INTRODUCTION

Feedback is the one of the main parts of learning cycle. It reinforces learning and provides opportunity to prevent any misconception. Teachers tend to provide feedback to student's all assignments. Assignment feedbacks are usually prepared in written format. In some cases, these written feedbacks are submitted to students by e-mail or Learning management systems.

Information and communication developments have provided technological platforms that enable flexible learning environments. Particularly, the Internet presents an additional way of transmitting assignments, feedbacks, announcement etc. The integration of these technological advancements such as the usage of web based activities along with in class education created a blended learning environment. The usage of high speed internet and editing tools makes it easier to create, modify and transmit the sound files. Feedbacks can be produced in voice format as mp3 file or podcast. However, there is not enough research that compares these formats in terms of supporting face to face classroom.

The goal of this study is to examine the effects of feedback format on student learning and satisfaction in blended learning environment. The problems that guided this research are: "Is there any difference between students who receive written feedback and voice feedback in terms of satisfaction?" and "Is there any difference between written feedback and voice feedback in terms preparation time?"

2. RELATED RESEARCHES

With the advent of technology and its usage in instructional technology, online learning environments become more popular. However they also emerges some problems like how virtual environment make feel higher presence feelings to the user. According to the study conducted Jelfs and Whitelock (2000), using audio feedback is an important point about computer users' feelings of presence [1].

Computer mediated communication formats were mostly compared in online and computer based instruction environment as well as voice and text formats. In online education, usage of live chat sessions and audio supported materials were examined. Usage of the combination of audio-text, text-audio-picture, and audio-picture alternatives were compared in both web-based and computer based environment. Lui et al. (2009) confirms that

course materials that use rich media like text- audio-video can promote higher user acceptance through stimulating a higher perceived usefulness and concentration [2].

Media types also were compared in business setting in computer mediated communication related studies. These studies stated selection of media types related to but not limited MRT and Social Influence Explanations because of that these theories can't explain some media selection for certain content and aim[3,4].

Voice mail was preferred for short, spontaneous, one-way drops of information, in contrast to the length and ambiguous communications. It means people chose e-mail for negotiations, ability to handle communication documentation and multiple addressability, and functionality. It documentation capabilities as well as the users role as message sender or recipient are important in business scale [5].

The Internet presents an additional way of transmitting assignments, feedbacks, announcement etc. Students either have a preference for online assignment submission and management or have no strong opinions. The main benefits for both students and Teacher are the saving in time and money and easiness of assignment management [6]. In terms of feedback usage, student also find online feedback very useful [7]. But students responded to feedback formats differently.

Keil and Johnson (2002) examined students' perceptions on online feedback for students exams. They stated that text feedback is more flexible because it enables random access to any point in feedback. Also it was mentioned that text feedback can easily be printed, shared. It also showed that students felt themselves more engaged and more cared by instructor with voice feedback. Audio or voices asynchronous feedback examined related to social presence theory [7]. Likely, it is stated that asynchronous audio feedback supply high student satisfaction and make students feel high involvement than text-base feedback [8]. On the other hand there is comparison study about the effectiveness of audio feedback in online settings [9]. It is stated that voice feedback may have potential usage in online environment but some difficulties should be overcome [9]. It also stated that students respond positively to audio feedback [10]. Common part of those and similar studies includes suggestion about making additional researches so that findings and statements can generalized about using audio feedback in learning environments.

Choosing a media to communicate are usually explained by Media Richness Theory (MRT) in literature [11,12]. According MRT, media can be classified based on the ability to carry nonverbal cues, provide rapid feedback, convey personality traits, and support the use of natural language. A primary goal of media richness theory is to determine which technologies best reduce uncertainty and equivocality [13]. MRT is used as conceptual framework of the study.

Although there are a few studies on voice and written feedback, they didn't focus on cost effectiveness of these two formats and student understanding. The goal of this study is to examine the effects of feedback format on student satisfaction in face to face environment.

3. METHOD

Basic randomized design comparing two treatments. Convenient sampling will be used. Students will be assigned two groups randomly. Independent variable is the feedback format (Written and Voice) for online assignment. Instructor writes down feedbacks to a new document or annotated on the assignment file as written format feedback. Voice feedbacks are recorded voice response of instructors to their students' assignments.

Participants

A total of 41 people, 27 male and 14 female, have participated in this study. They were between 18 and 24 years of age with a mean age of 20 and median of 20. All subjects were under graduate students enrolled in a "Graphics and Animation" course at Computer technology and programming department. The reason for choosing this course was that there were weekly assignments. The study was conducted at Erzincan University, Kemah Vocational School in 2009/2010 spring semester in Turkey. Participation to experiment was a requirement of the course. Satisfaction level from feedback was not counted in course grade.

Measure

Feedback satisfaction questionnaire were used to get data about experiment. Feedback satisfaction questionnaire was created in Turkish by considering media richness theory and general satisfaction [14] issues like usefulness, quality, and functions of feedback. This questionnaire includes 20 common likert items like "feedback was descriptive." and ''feedback was neutral". It also includes two open-ended question to get ideas of participants about application. Feedback satisfaction questionnaire administered after each feedbacks. On the other hand, in order to measure effectiveness of providing voice feedbacks in terms of preparing time, all feedback preparation time was kept by instructor.

Procedure

In this study, participants randomly assigned in to one of two treatment groups. Two groups were participated different classroom sessions carried out by same instructor. Instructor did same activities as much as possible. Only difference was that feedback to their assignments were given in different format between 2nd and5th weeks. Instructor sent student to prepare an assignment each week. All students were given same assignment. Totally four assignments were sent to students to conduct. Then they prepared and sent their assignments via e-mail. In order make fairly evaluation, uniform answer keys (trot) were prepared. Two of four assignment, first and third assignments, required text based answers while other two required graphical preparation. Assignments, formats and required skills are shown Table 1**.**

No	Type	Bloom Taxonomy Level
1	Text Based	Knowledge and Analysis
2	Graphic	Application
3	Text Base	Knowledge
4	Graphic	Application

Table 1: Assignment Number, Type, Level

In order to ensure consistency, assessment guideline was prepared for each assignment set. Feedback preparation process for each assessment includes following steps. Firstly one group selected randomly to start assessment. In order to measure provided feedback time, the time was kept track of. In the reviewing process for written feedback instructor took notes to send students. Then comments were written a separate document and sent as a text document. But for voice feedback group, instructor recorded verbal comment while reviewing the assignment using voice recorder. Then feedback files were sent to the students as an e-mail attachment. After two days from submitting feedbacks, students were asked to fill a questionnaire for each feedback. The questionnaire doesn't include personal information about students. However they were asked to specify nick name to use for all questionnaires conducted after each feedback provision.

4. RESULTS

Data were analyzed quantitatively and qualitatively. Repeated measure ANOVA tests were used to analyze the differences of satisfaction level between written and voice feedback groups and time spent for preparing feedback between written and voice feedback groups. On the other hand, content analysis was used for analyzing open-ended question. Independent variable is the feedback format (Written and Voice) for online assignment. Instructor wrote down feedbacks to a new document or annotated on the assignment file as written format feedback. Voice feedback was recorded verbal responses of teachers to their students' assignments.

The RM ANOVA applied to the satisfaction points revealed that the within group effect of assignment was non-significant ($p > .05$) in within group effects. However between group effect of written and voice feedback for all assignments resulted in a significant effect, $F(1,25) = 7.084$, $p < .001$, partial eta2 =.22. Satisfaction level from voice feedback (Mv=6.74) is higher than written feedback satisfaction level (Mw=6.74). Also interaction effect between feedback format and assignment was only approached significance (p=.064). Feedback satisfaction levels of students are shown in Figure 1 for each assignment.

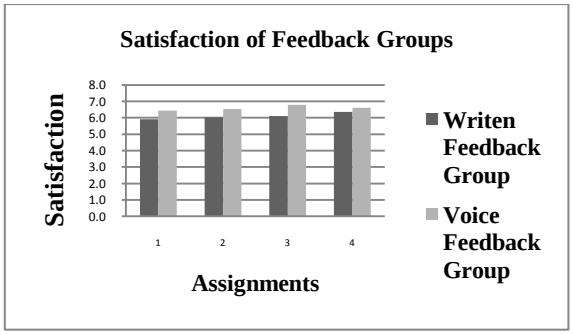

Figure 1: Written and Voice feedback satisfaction levels of students for each assignment.

While voice feedback group had higher satisfaction when considering all 4 assignments at once, differences aren't significant for second (p=.16) and fourth (p=.30) assignments. However, in assignment one and three, voice feedback satisfaction is significantly higher than written feedback (F (1)= 7.125, p=.012 and F (1)= 4.67, p=.04 respectively, Mv=6.43 and Mw=5.90 respectively). This may be because of required skills and types of assignment.

Results also showed that preparation times of written and voice feedback is significantly different, $F(1,147) = 69.86$, $p < .001$, partial $eta^2 = .32$. Conveying written feedback (M_w=186 seconds) took more time than preparing voice feedback (M_v=96 seconds). Mean feedback time for assignments are also different form each other, $F(3,147) = 359.1469$, $p < .001$, partial $eta^2 = .42$.

In terms of feedback quality, students who provided voice feedback stated that they were feeling as if the instructor tells something in classroom. They also feel themselves good and motivated since they thought that they are highly taken into account. Their opinion about format of feedback is also positive in general. However some of them suggested to instructor to provide more detailed feedback. On the other hand students who obtained written feedback generally stated that feedbacks make them to feel special. They also commend that it is good to take regular feedback.

However, specially for the comments about voice feedback obtained 3rd and 4th week are less enthusiastic than first and second week comments. This means that, students may getting used to get voice feedback and they might feel it is normal procedure. But quantitative results didn't support this finding.

Instructor (one of author) noted that voice recording requires more quite and suitable environment for voice feedback preparation. He also stated that high motivation is another requirement for preparation of voice feedback.

To sum up, in essence satisfaction level of students in voice feedback is higher than written feedback. It is also noted voice preparation requires more specifically place and/or time and motivation even though it takes less time to prepare.

5. CONCLUSION

It is aimed to examine the effects of feedback format on student satisfaction in blended learning environment in this study. The results related to students' satisfaction level show that students who take voice feedbacks were more pleasure in general. This can be explained by the familiarity and the nature of verbal communication. It means that the student who get voice feedback were able to get both verbal and auditory messages and take intonation, speech highlights and other auditory cues of instructors. On instructor side, giving voice feedback is more stressful and hard pressed and requires suitable environment. However, Instructors may prepare a written feedback in more flexible and independent from media.

The study showed that both feedback formats have some advantages for both student and instructor. It is recommended that to provide voice-feedback if teachers or instructors have appropriate time and tool to dedicate only for giving feedback. This is also certainly depends on teachers motivation because using voice feedback may make teachers more motivated in evaluation process.

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Developing an Innovative Online Teaching System

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ABSTRACT

This paper presents an in-house created software application that emulates and virtualizes computer networking laboratory hardware and proprietary equipment on PCs and servers. A user friendly remote laboratory manage system is developed using .NET technology. Through the presented lab management system, the students are able to conduct more than 200 lab assignments covering 10 courses from both lower level routing and switching classes to upper level network management and security classes that demand a large amount of physical equipment and a great number of student lab contact hours prior to the emulated lab. This emulation solution eliminates our dependencies on expensive proprietary networking equipment. It also reduces the burden of system administration. This remote lab has been used and tested in three networking courses. The feedbacks show that the lab delivers similar or better lab experiences for the DE students while the lab construction and maintenance cost is reduced to the minimum.

Keywords: Virtual Technology, Software Simulation, Networking, Information Assurance

1. BACKGROUND

1.1 Education Based on VT

Virtual Technology (VT)allows multiple operating systems running on the same platform as virtual machines. It has been widely adopted by the modern industry. High end servers and networking equipment are used to construct a consolidated system that improves manageability, enhances security, and greatly reduces cost.

The Information and Computer Technology (ICT) program of the East Carolina University has been pioneering in adopting VT for teaching computer networking, security, and system administration courses both in the undergraduate and postgraduate levels. During the past years, a state-of-the-art student remote computer lab was built on VT technology. Student can access to the lab 24/7 via the Internet. A tailored operating system image with software applications demanded by the student is automatically created during each lab use. One student reservation can have access to multiple operating systems through the use of VT-inside-of-VT technology. This feature is very important for computer networking and security major students who need a network of multiple operating systems to complete a lab assignment. The current remote-access computer lab can accommodate dozens of concurrent users.

The creation of our lab using blade servers, VCL (Virtual Computing Lab), VMware, and Virtual Box was well documented and published [1-5]. This paper will not significantly address the deployment of VT in education. Instead, it will focus on the development of a software application that employs VT and is tailored for a number of networking courses in the ICT program.

1.2 Emulating Proprietary Appliances

Most security, networking, and system administration courses highly rely on networking appliances for teaching the hands-on labs. Although the department has acquired IDS, firewalls, VPN appliances,

IPphones, routers, and switches from various vendors in the past, the preference has been shifted to Cisco products. It is because first, Cisco is the industry leader for manufacturing networking and security hardware and software. Second, the ICT program has six courses that are tied to two Cisco certification programs – CCNA (Cisco Certified Network Associate) and CCNP (Cisco Certified Network Professional). Third, East Carolina University is a regional Cisco Networking Academy that oversees 14 local academies and trains their IT instructors. Most of these local academies are colleges and high schools.

To maintain a Cisco networking lab can be a challenge considering the rapid advancement of networking technology that requires constant software updates and hardware upgrades. The stagnant budget further limits our capacity to keep the lab equipment to a state-of-the-art level.

Software simulation has been a successful means in teaching Cisco networking courses. Several simulators were tested by the ICT faculty including PacketTracer, LabSim, Boson, and Semsim. They are excellent substitutes of real Cisco equipment for teaching lower-level networking courses such as the two CCNA courses. However, the simulation software only builds a simplified abstract version of the operating system hosted by the appliances. It cannot be employed to teach higher level networking courses due to its limited functionalities.

VT makes emulation of Cisco appliances on PCs possible. The advantage of software emulation over simulation is that emulation allows the system memory to host the real and complete Cisco IOS (Internetwork Operating System) instead of trying to recreate a portion of it. It, therefore, provides the full functionalities of a real Cisco router, switch, VPN, and firewall. A small tool, named Dynamips [6], was identified for migrating Cisco IOS into computer memory. Once the IOS is loaded, the hosting computer is virtually transformed into a real Cisco appliance. VT further allows multiple instances of IOS's to be hosted within the same piece of physical memory. Along with the other operating systems, such as Linux and Windows hosted on the same physical memory through VMware or Virtualbox, a complex networking topology consisting of multiple hosts and networking devices can be emulated on one single PC. These operating systems communicate with each other through UDP/TCP ports on the hosting machine, emulating the physical Ethernet, token ring, and serial port connections.

Emulating proprietary Cisco appliances significantly reduced the cost and our dependency of real Cisco devices. The labs of our networking courses are taught by using the VT environment that is incorporated into our existing student remote-lab infrastructure where no physical Cisco equipment is required.

2. SOFTWARE DEVELOPMENT

2.1. Needs from Networking Courses

It is inconvenient to create a lab topology every time a lab is performed. The Dynamips software does not have a graphic interface and setting up the parameters for a specific lab can be confusing. Although some tools are developed to expedite the lab setup, none of them are designed for class teaching. Students still need to learn how to use these tools which are irrelevant to the contents of the actual labs.

To accommodate the lab needs of ten networking courses, the author developed a software application that is incorporated into a VCL image, named "ECU Cisco Lab". Students can access to this image through ECU VCL system as shown in Figure 1.

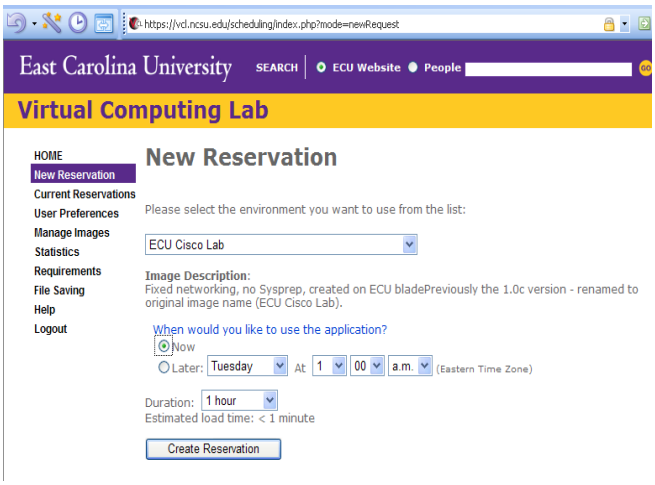

Figure 1. "ECU Cisco Lab" Image Reservation

The ECU VCL system can allow a maximum of 40 concurrent accesses to the ECU Cisco Lab image. That means 40 students can reserve the lab by clicking the "Now" button at the same time and have the lab ready within one minute. If all the resources are taken and no image can be accessed at the moment, a student can reserve the lab for a future time, which rarely happens. Each reservation can be made up to 6 hours which is sufficient for the students to complete a lab exercise.

When the reserved image becomes ready, student can connect to this virtual machine through Windows RDP (Remote Desktop) connection. The IP address, username, and password of this virtual machine is displayed on a webpage and also sent to the student through email.

The "ECU Cisco Lab" is a Windows 2003 operating system virtual machine with all the software applications installed for teaching the networking courses including the "Dr. Li's Networking Studio", which is the major component of the networking lab. It is programmed by the author in C# language using MS Visual Studio. It is copyrighted in 2009 by ECU.

2.2. Interface Design

The interface design was based on the concept of clarity and functionality. The graphics and buttons provide visual guidance that leads students directly to the lab exercises. The main window, shown in Figure 2, appears when the user clicks the "Dr.Li's Networking Studio" icon on the desktop.

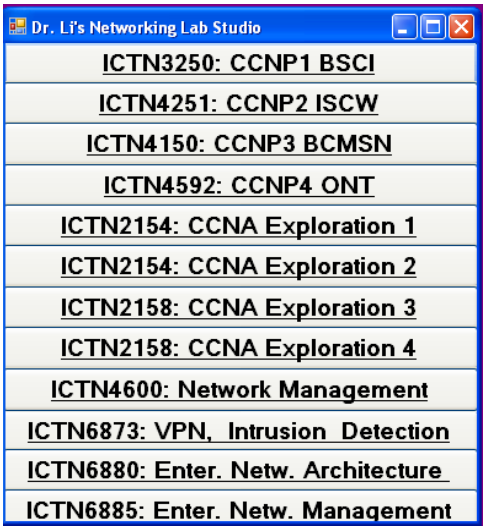

Figure 2. The Main Window for 10 courses

Figure 3. shows the sub-window of the network lab topology for ICTN4251 (Implement Secure Network), an upper-level network security class.

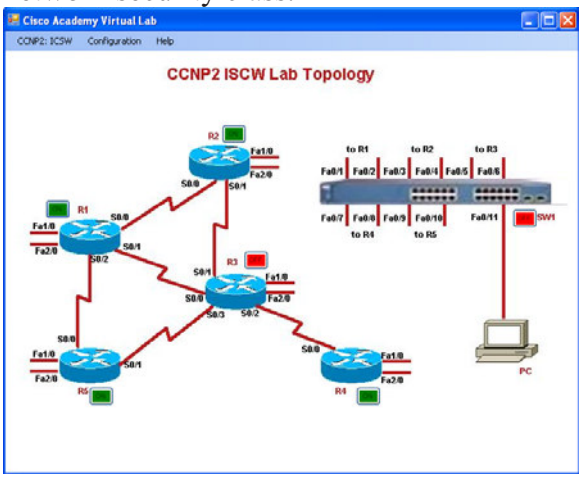

Figure 3. ICTN4251 Virtual Lab

7 lab devices are shown on this topology including 5 routers, 1 switch, and 1

PC. The 5 routers have full-mesh connection through serial cables. They all have two Ethernet ports connected to the switch. A PC is connected to the switch via Ethernet cable as well. There are different lab setups with various devices for each course. Most of them involve routers, switches, firewalls, and PCs. Only the lab topology of ICTN4251 is shown here due to page limit.

The user can power on each device by clicking on the on/off buttons on the diagram. The central switch and Router 2 are turned on in Figure 2. The PC or Servers can be turned on through VMware. They are Linux and Windows operating systems hosted by the VMware virtual machines and bridged into "Dr. Li's Networking Studio" to construct a complete networking system.

2.3. Operation

When a user clicks "configuration" button on the top menu, a dropdown list shows all the devices that can be configured through the system. For example, the user has options to configure Routers 1 to 5, a central switch, and a PC through the "configuration" menu in Figure 4. The configuration is preformed through reverse Telnet sessions to the hosting PC's loopback IP address. Unique TCP port number is assigned to each device to simulate console port connection.

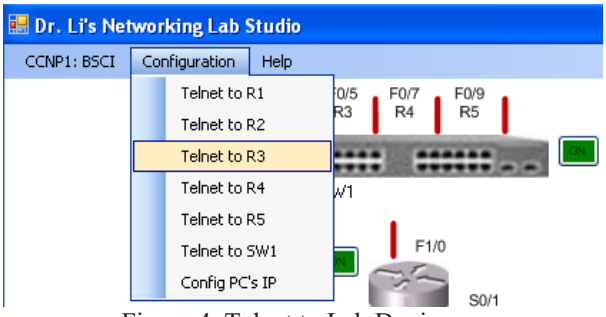

Figure 4. Telnet to Lab Devices

The configuration windows look identical to the configuration windows used for the real physical equipment. The configuration window the Central Switch is shown in Figure 5. The output shows Router 3 is connected on the Fast Ethernet port 0/3 of the switch. The switch has three user defined VLANs, named "ICETI10", "Conference", and "Presentation".

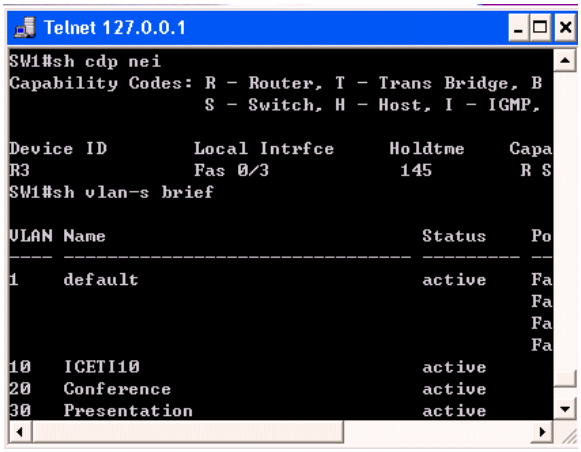

Figure 5. Device Configuration Windows

Students are usually required to open multiple configuration windows simultaneously to configure the virtual networking devices, PCs, and servers. Students may not notice any differences between configuring virtual networking devices and the physical devices because the interfaces and configuration processes are identical. The only differences are the improved performance, faster lab connection, and enhanced lab provisioning from using the virtual lab.

What is noteworthy is that all the presented devices are hosted virtually on one PC or a single server. No additional cost is needed if the "Cisco Network Lab" image is hosted on our existing VCL remote-lab infrastructure. The counterpart physical lab solution costs over $30,000 per pod.

2.4. Teaching Tools

As stated above, "Dr.Li's Network Studio" is closely tied to 10 networking courses. It not only provides the virtual lab equipment for the students to conduct lab exercises, but incorporates lab manuals and recorded videos of course lectures and lab

demonstration into the package. Therefore, it is a complete DE teaching environment with both class lectures and lab exercises.

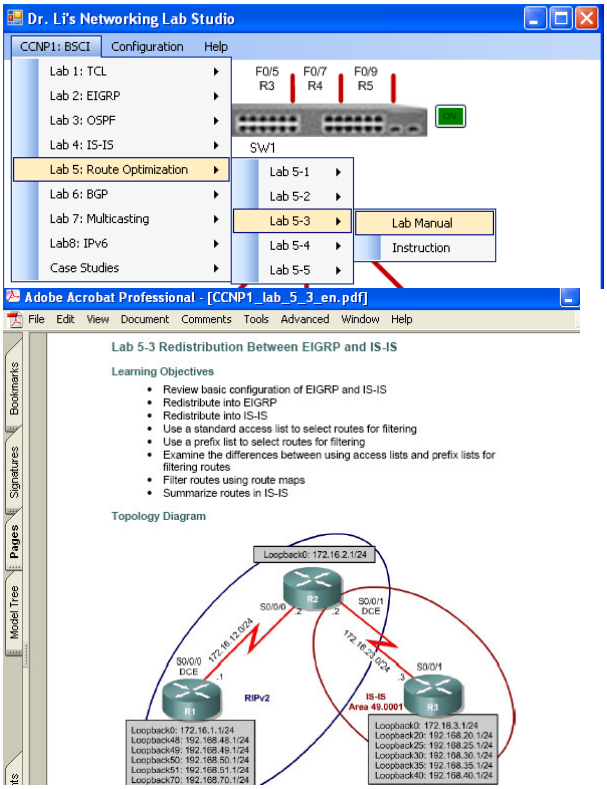

Figure 6. The PDF Version of the Lab Manual

A PDF version of the lab manual is accessed through the first dropdown list on the main menu as shown in Figure 6. There are more than 200 labs that can be performed by using the software package.

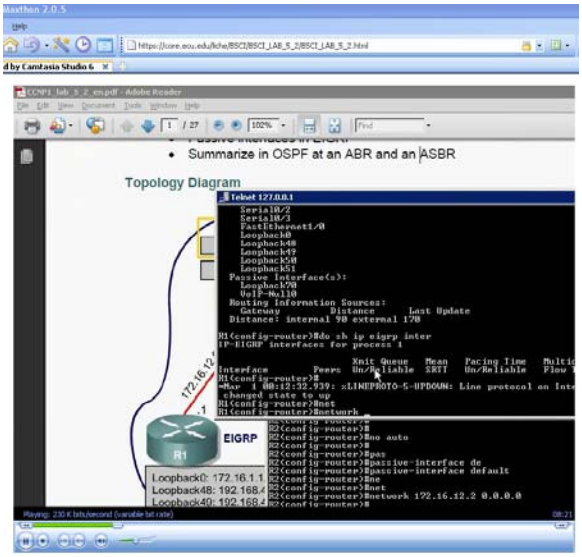

Figure 7. The Video Lecture and Lab Instruction

The instruction button links the students to a pre-recorded video of a lecture and lab demonstration for each individual lab exercise. The videos were recorded in Windows Mediaplayer format by using Camtasia. The average length of the video is one hour. The videos review the key concepts that are covered by each lab and provide a step-by-step guidance for the students to do the lab along with. The videos are hosted on a secure web server maintained by ECU IT services. Figure 7. shows that a web browser is opened when the "instruction" button is clicked. The video is displayed within the browser.

3. RESULTS AND CONCLUSIONS

3.1. Assessments

Students were surveyed to evaluate the virtual lab software in two upper-level undergraduate and one graduate networking courses. These students had used the physical labs for their prerequisite courses before they were enrolled into the advanced networking classes. The surveys were conducted at the end of the semester. 87% of the students prefer the virtual lab over the physical lab for improved availability and ease of usage. 93% of the students agree that the instructional videos and the "Dr. Li's Networking Studio" software are very helpful for them to understand the course material and complete the lab exercises.

The user overall satisfaction of the virtual lab solution is 90.3% versus 58.3% for the physical lab. The result is statistically significant ($p < 0.05$ level) to reject the null hypothesis, indicating differences of the two lab teaching approaches.

Peer reviews were performed by faculty, who are teaching networking courses, from the same department of the author and other institutions. The responses are overwhelmingly positive.

3.2. Comparison

When comparing the virtual learning environment created by this study with the traditional remote DE lab using physical equipment, the virtual lab is significantly superior in the following aspects.

Management and Maintenance. Once the image is created and deployed through a reservation system before the start of the semester, no more updates, cabling, and equipment maintenance is necessary.

Cost. The cost is reduced to the minimum considering no physical lab equipment is needed. The lab space and electricity usage are also reduced

Availability. 40 students can access to the lab simultaneously 24/7; while the physical lab only has two pods of equipment that allows a maximum of two students to use the lab at any given time.

Portability. The virtual solution makes the complete courses portable. Students are able to watch the lectures and conduct lab exercises anywhere there is an internet connection.

Synchronous teaching. The virtual lab allows instructors to login to the same virtual image a student is working on through VPN software such as RDP and VNC; so that instructors can monitor student activities and instruct the student to complete the lab. This synchronous approach has been used to evaluate student hands-on skills in real-time for two networking courses.

3.3. Conclusions

This study presents a software solution that emulates proprietary networking equipment, constructs a remotely accessible networking lab consisting of virtual security appliances, routing and switching devices, servers and PCs, teaches lectures and labs, and builds a both synchronous and asynchronous teaching environment. The presented software has been deployed through an existing online reservation system and used by 10 networking related courses. The student evaluation and peer review indicate significant performance improvement of the virtual lab over the physical lab.

The results from this study can be easily disseminated through Cisco Networking Academy program to thousands of networking programs nationwide.

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Language Learning Internet Website for Multilingual Communication

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ABSTRACT

In this article, we report a language learning tool for multilingual communication on the Web using a popular internet Website. The tool is promising for college students who want to improve their communication skills, especially their ability to use the English language. We think that the ability would be an important step towards multilingual communication.

Keywords: Multilingual Communication, Language learning, Web-based Learning, Language Chat and English Language

1. INTRODUCTION

In this article, we report a language exchange trial on the Internet then introduce a language learning tool for multilingual communication on the Web using a popular internet Website. The tool is promising for college students who want to improve their communication skills, especially their ability to use the English language. The language conversation trial is the first step towards our web-based language tool. Through the chat program, we try to get some variable finding in order to use for the language tool.

The study of multiple languages is an effective way to improve language skills. In fact, some organizations have been trying to use multiple languages for global communication among their members [1]. The members communicate in multiple languages with each other at the same time. The languages they speak are diverse and not specific to a particular language family. At present, nineteen languages are spoken in one such organization. The members have a positive opinion of learning multiple languages because they have become aware of the role languages play in world communication as well as of their own improved language skill.

For two years, we have been developing some e-learning materials to assist students who want to improve their English language skills. Particular attention is given to listening and speaking skills. English is a global language, and communication skills are indispensable when understanding each other in global communities. Generally, Japanese students lack sufficient skills for speaking and listening in English, particularly in comparison to their reading ability and grammatical knowledge. We attribute this lack of skill to inexperience.

As a remedy to insufficient language skills, we are developing a website for language learning that can be accessed through Youtube(http://www.youtube.com/). Lately, there exist many language learning sites on the Youtube. The site contains daily conversation exercises and useful expressions for many situations. In addition, we are incorporating popular culture information, such as historical places, local foods, and traditional activities. The site includes images and videos designed so that users can improve their language skills. The videos

include interviews with individuals speaking their native languages. Although only a few languages are currently available on the site, all of these videos were digitally recorded on Toyo University campus and real locations.

2. MULTILINGUAL CONVERSATION TRIAL

We are experimenting with a variety of communications activities involving students from Toyo University and native speakers of the various languages. Separate conversations are available to individuals who access the site. The YouTube segments feature Japanese students speaking with native speakers of other languages while using Skype or while having on-site conversations in their classroom. The objectives of the exercise are as follows:

- Incorporating the findings obtained through the conversation into the learning tool.
- Testing the students' improvement before and after using the learning tool.

In general, the participants are passionate in their efforts to communicate even though they lack the necessary vocabulary and capacity for expression. Each participant is questioned following their activities to determine their progress. The following guidelines are presented to the participants before the exercise:

(1) The native language should not be used.
(2) A single foreign language should be used for each conversation. In other words, they should not mix two languages during the same interaction. Instead, at least two foreign languages should be used over the same conversation.
(3) Individual participants may at times be corrected.

In the trial, there are about ten Japanese students and three international students. In advance, the students prepare some questions, but, during the conversation, they are free to talk about anything they choose. The participants are advised that they may ask and answer questions and introduce new content if they choose.

Especially, the English syllabus proposed in Malaysia [2] is referred as a good guideline to meet our needs. Themes and topics are listed in Table 1.

Table 1. Themes and Topics in the Malaysian Sylluabus

Themes	Content	Example
People	People and who they are	People in the family or village and what they do, Famous people
Environment	Development in one's community	Having modern facilities as opposed to crowding and noise and loss of trees and open ground
Social Issues		Using time wisely Choosing friends wisely
Health		Knowing oneself: one's behavior towards others, liking oneself
Science & technology	Plants	Keeping a garden Importance of jungles Descriptions of plants

The students choose one theme from Table 1, and prepare in advance, then are discussing with their foreign partners, at the moment, mainly in English. Besides those topics, they are introducing Japanese culture, society and their customs [3][4], for example, as for the culture, colorful porcelains, Kabuki, Manga, and so on. Figure 1 shows a picture of language exchange session with the students.

Figure 1. Language Chat by the Students

3. LANGUAGE LEARNING WEBSITE

The language site, which is updated daily, can be accessed on YouTube. At present, we have been preparing materials for the following languages:

- English
- Malaysian
- Mongolian
- French
- Chinese
- Korean
- Japanese

Native speakers have been asked to participate in short conversations about their countries and to speak naturally but at a slower speed than they would normally use. To evaluate this tool, we have been conducting some experiments with college students, as reported in the next chapter.

In this video material, Task-Based Language Teaching (TBLT) approach is considered for constructing the content. TBLT is a cutting edge teaching approach for second language learners [5][6]. TBLT is an approach which offers students material in order to achieve a goal or complete a task. Much like regular tasks that we perform everyday such as renting videos, booking a tennis court on the phone, taking part in conversations and discussions, TBLT seeks to develop students' inter-language through providing a task and then using language to solve it. Our video is created based on the content of [2], but is slightly devised and changed according to our demand.

Our website is preliminary one. Through this site, we expect many comments and feedbacks as well as critiques. In fact, there exists a lot of websites on language learning over the world lately. Based on the comments for our site, we are going to revise it, and we envisage developing an interactive learning website in the future such as local community site, in which learners communicate each other in target language and exchanging their culture and useful information. We claim that TBLT is a promising teaching approach in order to achieve our goal.

4. EDUCATIONAL FINDINGS

The findings from the experiment are valuable. In particular, we would like to claim that communicating in multiple languages could be more efficient than training in a single foreign target language. Our purposes, English is the target language, and our proposing method has been improving the students' English communication skill. Since the students participated in communication trial and used our leaning tool, the participants made measurable progress, and their attitudes toward the exercise were positive. Following the exercises, some of the participants initiated Internet contact with their language partners.

According to the Malaysian English Syllabus [2], there are three uses for practical English: interpersonal use, informational use, and aesthetic use. Our approach is thought to belong to interpersonal use, and especially to 'Take part in social interaction' as learning outcomes. The students are able to improve communication skills by participating in conversations and discussions in the language chat.

In the syllabus, it is said that reading, writing, listening, and speaking are complementary skills. Through our learning process, special attention is paid to respect on all the skills. After chatting, paper materials are given to the students for reviewing. The students are now using materials downloaded on the web [7][8].

5. CONCLUSIONS

In this article, we described a language learning site that we have implemented on the Internet and reported our findings from the initial exercises. It is our intention to expand the program and continue to report the progress of the students who participate. We intend to evaluate the results of our project thoroughly and develop a method for measuring the progress of the students using a test such as the TOEIC®.

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A Hybrid Model for Making Online Assignments Effective In a Traditional Classroom

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ABSTRACT

Today's college student has grown up in a world filled with technology and many current college students routinely utilize the latest and most up to date forms of technology. The result is an ever-changing way of communicating between faculty members and students. Many faculty members, however, are intimidated by the use of the terms "technology", "online" and "distance education." This often results in a communication gap between faculty and students where faculty members will "lose" students on the first day of class. Advantages of incorporating online tools into the course structure include freeing up additional class time, enhancing classroom discussions, and allowing students to remain current with information in their field. This hybrid instructional model focuses on the integration of technology tools as a supplement to traditional classroom teaching. This paper will describe how to effectively incorporate and implement technology using online course tools in a traditional classroom setting. Specific examples of online assignments, discussions, and assessments from an allied health education program and class will be discussed. Lessons learned and challenges confronted when adapting to the utilization of specific online course assignments and tools will be discussed.

KEYWORDS: Online assignments, technology, hybrid, online discussions, online assessments

1. INTRODUCTION

Using online learning and teaching methods has proven to be effective in decreasing the communication and technology gap between many faculty and students. Online learning has the ability to provide learners with more choices, greater flexibility, expanded resources, and increased opportunities, while offering faculty the opportunity to teach using alternate delivery and assessment methods [5]. Also, if structured appropriately, the incorporation of virtual learning environments can offer a rich collaborative, connected and flexible system that can be accessed regardless of where learners are at any time [6].

Throughout this paper, examples will be provided from specific health education courses that are offered in a traditional classroom setting in the Pre-Professional Allied Health Program at The University of Tampa.

2. EFFECTIVE ONLINE TOOLS

Online course tools require organization and a well thought process of implementation. Course tools should include specific and complete instructions in addition to accessibility to resources, grading rubrics and criteria, and any other information that would be provided for a traditional classroom assignment or assessment. The integration of online tools into a classroom-delivered course should be planned carefully and based on learner characteristics, course content, and the learning context of the course [8].

To effectively implement online tools into a traditional classroom, students must first agree that participation in online activities will result in learning. According to a study by Vonderwell and Zachariah, several factors that influence participation in online learning include technology and interface characteristics, content-area experience, student roles and tasks, and information overload [9].

It is important to introduce students to the delivery platform. A short tutorial and demonstration along with a handout of instructions for accessing and using the delivery platform is recommended during the first class meeting. Instructions should be specific, detailed, and repetitive to assist students, especially those who are first time users of the online system.

The following will discuss several different types of online tools and how to effectively incorporate them into a traditional face to face classroom course.

Online Assignments

Online assignments may be used in several different formats including submitting assignments as attachments,

submitting student journals, and using videos and internet sites to accommodate assignments and reflections. In a study on student perceptions of various e-learning components by Buzzetto-More, the most popular feature noted was the assignment section. Students strongly agreed that they enjoyed submitting assignments online, they prefer the online submission of assignments, and most of them responded that they liked the ability to check their assignment grades online [2].

Online assignments can also be utilized to further enhance critical reflection and self-reflection in student work. Due to the lack of space and time, the use of traditional classroom learning environments to structure and manage critical reflection has been criticized, [4]. Thus, conducting online reflective activities can provide space and tools to allow the development of both personal learning and professional issues in a class [6].

In the Pre-Professional Allied Health program at The University of Tampa, online assignments are utilized in several courses. The behavior change project was an assignment in a basic health science course. This particular course met once a week and the entire assignment was submitted online. Components of the assignment included a behavior change goal sheet, five journals entries, and a behavior change summary sheet. The behavior change summary was a self-reflection of the behavior change project that was completed during the course. Each time a student submitted a part of the project, the instructor provided feedback and a grade online. Since the course met only once a week, the online journal entries provided an opportunity for students to receive feedback from the instructor without waiting until the following week.

Website assignments were also included in several of the allied health courses. The website assignments required students to research a valid health related website and present a short summary to the class. The summary was also submitted online and posted to the course website to serve as a resource for their classmates. Using this format, technology was used in the classroom for the student presentation and as a supplement to the face to face interaction.

Online Discussions

One of the more popular communication methods for online interaction is "asynchronous" or "threaded" discussion [1]. Discussions and discussion groups provide a forum for students to discuss topics related to classroom content. Discussion groups allow students to interact with their classmates and faculty by active participation. The online asynchronous discussions offer several advantages over a traditional classroom discussion including, "increased time for students to research and reflect on ideas and physical anonymity that may decrease inhibitions and foster broad participation," [1]. In the article, "The Superiority of Online Discussion," it is stated that "online discussion groups offer a technologically-rich environment for developing virtual learning communities in which students can develop strong analytic and critical thinking skills based on inherent time, reflection, and distribution advantage," [1]. Additionally, a study by Dengler in 2008 supported past research which suggested that using online learning as a complement to the classroom can both increase opportunities for student participation and enhance participation of students who feel inhibited to participate in traditional classroom setting discussions [3].

Online discussions were used in the personal health course in the Pre-Professional Allied Health program. Many students are embarrassed to raise their hand or speak up during class when discussing topics including drug and alcohol use, sexuality, and other health issues. The online discussions proved to be a great tool for discussion. The instructor always started the discussion with a question. Each student in the class could read all the responses from other students. Each student was also required to post responses to the original question and to other student responses. Student responses could not be 'I agree' or 'I disagree'. Discussions were graded and instructions for the online discussion read: "Each unit will have one discussion question. To receive full credit you must be an active participant in the discussion. Postings limited to, "I agree" or "I disagree" will receive minimal credit. Make your answers thorough and understandable. This is an opportunity for you to share information, gain insight from others, and respond to opinions different from your own. Please keep postings relevant to the topic and appropriate for discussion." The instructor read all postings from students and commented as needed. The discussion was student centered but was often focused in the appropriate direction by the instructor if necessary. It is recommended the instructor monitor student participation and patterns of participation to assist in identifying student needs and problem areas [9].

Online Assessments

Assessments are often one of the most widely questioned online tools by faculty who have not previously used such tools. Many faculty are concerned about students taking quizzes and exams outside of the classroom and outside of their direct supervision. Online quizzes and exams taken outside of regularly scheduled class meetings can provide more in class time for hands-on activities. There are also measures that can be taken to decrease the chance that students may cheat on an exam.

Specific examples from a personal health course include utilizing the online system for quizzes and exams. Ten point quizzes were administered online for each chapter. The purpose of the quizzes was to encourage students to

read the chapters prior to coming to class discussions. The purpose of delivering the quizzes online was to allow more class time for discussion and eliminate the ten to fifteen minutes of class time needed to administer a face to face quiz. Due dates for quizzes were set prior to the class discussion date.

Online exams were also administered resulting in the the availability of two additional class periods that were previously taken for exam time. The exams had specific deadlines but were required to be completed outside of class. Students responded favorably to online assessments. They had flexibility in scheduling the time for taking the exams. They also appreciated the instant feedback of their results. Each student was also provided feedback on which questions were incorrect and what was the correct answer.

Many faculty are concerned about the possibility of cheating when assessments are taken online and outside of the classroom. Several measures were taken to reduce the possibility of cheating. Questions banks were used for each chapter. Exams were randomly generated from the question banks. Therefore, if two students were sitting side by side and taking the exam, the likelihood of having the same exam questions was extremely low. The quizzes and exams were also timed to prevent students from looking up information in their textbooks.

3. LESSONS LEARNED

Several lessons were learned when integrating online tools into a traditional classroom setting. First, it is imperative that the instructor or faculty member stay involved in the online course tools. Sending timely feedback to the student is important in the outcome of the learning experience and important in the student's attitude toward using online tools.

Secondly, support for students and faculty is essential. Students will require support from faculty for learning the online delivery system and faculty will require technological support from the instructional technology staff in using the system. This becomes extremely important when technical issues arise. If a troubleshooting system is in place to handle technical issues then time can be spent on the course content and not with frustration over the delivery platform and system.

Finally, instructors must listen to what students are saying about the experience. Course evaluations are a great starting place. Many students will also provide feedback during the course of the semester. Listening to what the students are saying and adapting the online course tools accordingly will provide a richer learning experience for the entire class.

4. CHALLENGES

Several challenges exist for blending online course tools with traditional classroom instruction. First, if the same online course tools are used from semester to semester, there should be a rotating review process of updating the content and resources. Secondly, the gap between traditional classroom pedagogy and instructional expertise in creating online course tools must be bridged [7]. If the faculty and students are not accustomed to working online, then a slight learning curve will have to take place to understand basic online language and resources. A tutorial or demonstration for both students and faculty members can be useful in overcoming this challenge.

Additionally, keeping instructional resources including websites, web links, online resources, and other information up to date with current and functional web addresses is critical.

5. CONCLUSIONS

Based on the information and examples provided,, it is clear that utilizing online course tools enhances the delivery of face to face courses in a traditional classroom setting. Online course tools can assist in bridging the communication gap between faculty and students. If online course tools are used, they must be organized and planned. A variety of online course tools exist including online assignments, online discussions, and online assessments. Many of these course tools can be used to free face to face class time for other activities and to further enrich the quality of the course. Incorporating online course tools in a traditional face to face classroom can be beneficial but the transition can be challenging.

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NtEd a new and free musical score editor for Linux

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ABSTRACT

NtEd[2] is a WYSIWYG musical score editor, which can support music teachers and music students to learn reading notes, to learn playing an instrument, and to compose music. Apart from all other WYSIWYG musical score editors it is cost free because it is licensed under GPL[1] and runs on Linux operating system, which is cost free, too. Thus, you can save money which is often a real obstacle for using such software in class rooms, because the usual WYSIWYG musical score editors are very expensive.

NtEd lets you insert notes to create a musical score, play the score, import MIDI files, and record the score from a MIDI keyboard attached to your sound adapter.

This article gives a short introduction into NtEd, explains the difficulties in writing such a software, and indicates how NtEd solves them.

Keywords: Musical Score Editor, WYSIWYG Editor, ALSA, Linux, Open Source

1. USING NtEd

You can get NtEd from [2] for free. You can get both, the ready packages and the C++ source. The main window [Fig. 1] lets you insert notes by means of the mouse or alternatively by PC keyboard. As you can see NtEd allows you also to place chord names and guitar chord diagrams. Furthermore, you can use drum notes. By means of the toolbox in the right bottom corner you can select the note length, the accidentals like sharp, flat, natural, double flat a.s.o., the articulations like staccato, tenuto, portato a.s.o., and the note style for drum notes.

By clicking pairs of notes you can connect them with a tie (legato). You can build chords and tuplets (2 - 13). You can place repeat signs and rests of different length.

NtEd places the material onto different systems and pages. The user can continuously change the size of the musical signs and he/she can choose the paper format.

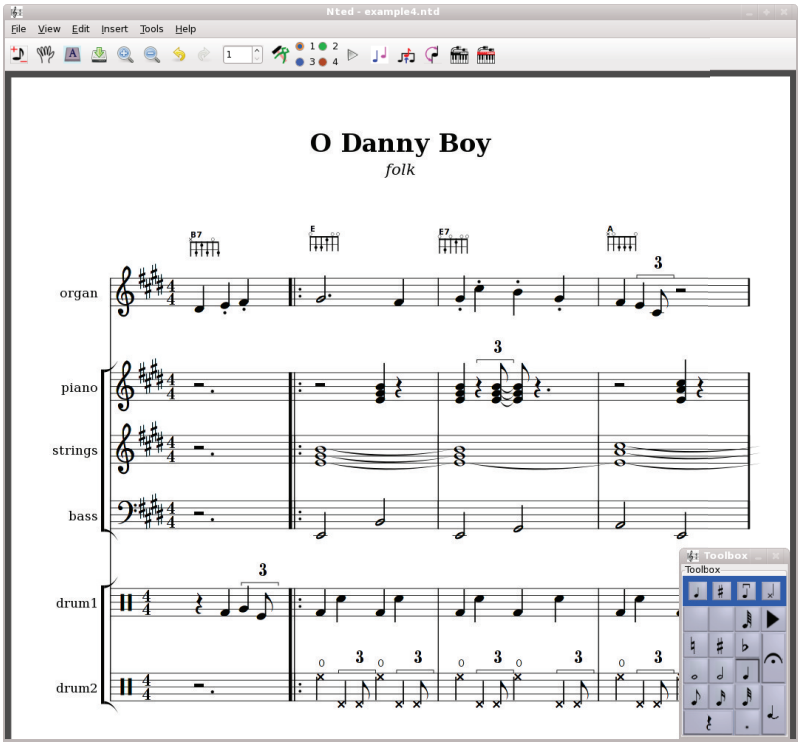

Fig 1: The NtEd main window

NtEd allows up to 4 voices per staff:
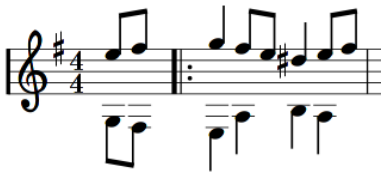
Fig 2: Two Voices in a staff

Furthermore, the user can attach an instrument to every staff. Thus, a whole orchestra is built. The play button starts replay via ALSA (Advanced Linux Sound Architecture)[3]. If some of the instruments are not in C tuning, NtEd allows you to add an offset to the pitch.

Other interesting features of NtEd are:

- **Transpose** You can transpose the score or parts of the score to a new key.
- **Mute** The teacher can mute some staves. This way the pupils can recognize how the single instruments contribute to the whole sound.
- **Copy/Paste** You can select groups of notes and copy them somewhere, also between different scores.
- **Extract staves** If the composition is ready it is necessary to create the notes for every single instrument[Fig. 3]

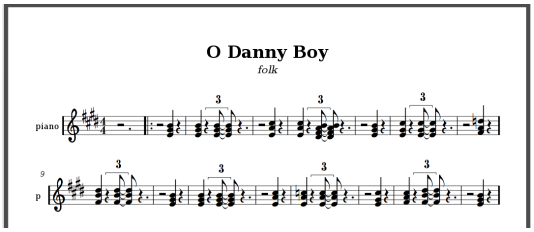

Fig 3: The Piano excerpt

To print the score there are 2 ways:

1. There is a *print* function on some menu which prints the score such that the printer output matches exactly what you see on display.
2. You can export the score to LilyPond[4]. LilyPond is a text based score editor, which is also cost-free (GPL). It creates the score from a text transcription of the music. For instance, the text:

```
\relative c' {\clef treble
\key a \major \time 2/4
 e'4  cis cis2 d4  b b2
 a4  b cis  d e  e e2
}
```

produces the following PDF output:
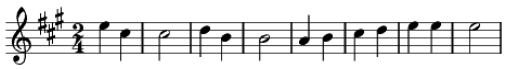
Fig 4: The LilyPond output

Thus, one can export the score to LilyPond, create the PDF by means of the LilyPond processor and then print the PDF. Why is it useful: The LilyPond output is better than the NtEd output, because LilyPond as an offline renderer takes as much time as needed to create the best results. So, you can regard LilyPond as a beautifier.

But there is a small drawback: Because LilyPond uses its own placing algorithms and its own music fonts the WYSIWYG principle is broken.

NtEd is able to create:

- PostScript
- PDF
- SVG
- PNG
- MIDI

It can import:

- MusicXML[6] *(with restrictions)*
- MIDI

Especially the latter is very helpful for pupils and music students. Most people who play an instrument are unable to play a piece of music without notes. They cannot hear what is played. But there are dozens of MIDI files in Internet. By reconstructing the musical score from these MIDI files, NtEd gives such musicians the possibility to play the music.

A further interesting feature is: Recording the music from MIDI keyboard. If a MIDI keyboard is attached to the sound adapter, the user can play on this keyboard and NtEd creates the appropriate notes. On one hand this eases the score creation. On the other hand a teacher can give his pupils an idea of how even live played music can be notated.

2. WHY IS IT SO DIFFICULT?

There are only a few WYSIWYG musical score editors. And the best ones are relatively expensive. One reason is: There are potentially only a few musicians which are willing to use a computer.

Another reason is: It is difficult. Sometimes more difficult than writing a text editor.

This chapter will give a brief overview of the main problems. Most of them come from timing restrictions. A WYSIWYG user expects a program reaction immediately after the mouse click. That is, you have at most 50 ms from mouse click till program reaction. All placing decisions have to take place during these 50 ms.

Vertical Alignment

In contrast to a text editor, the program must always keep a watch on the vertical alignment. In following example there are 2 tied quarter notes in first staff and one eighth in 2nd staff:
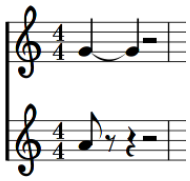
Fig 5: Before alignment

Now the user adds 4 32ths and a quarter into the 2nd staff:
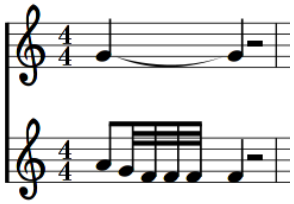
Fig 6: After alignment

The 2nd quarter in 1st staff must be replaced, because it sounds together with the quarter in 2nd staff. But even worse: The tie, a complicated filled Bezier curve pair, must be re-computed. And at end of line it can happen the line is too long and must be broken. This is still more complicated because you can move only whole measures, not parts of a measure. And think about the undo and redo functionality: All of this must be reversible, including the line break!

Horizontal Grouping

Horizontal grouping is almost unknown in text processors. Have a look at Fig 6: There are ties and beams which group notes together. Imagine the user moves up the 2nd note in 1st staff and inserts a 32th rest in 2nd staff:
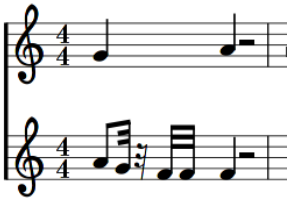
Fig 7: After modification

The tie must be broken because it can exist only between notes on the same line. But the beam must be broken, too. And bear in mind: All this must be reversible by undo button! This requires continuous recomputation of such groups.

3. NtEd SOLUTIONS

NtEd handles the vertical alignment by means of a complicated system of dynamically enlargeable arrays. If the user changes the score, all notes and rests are tagged with the time they should sound. This happens staff by staff. In a 2nd step all notes are placed into a position array, which can be regarded as a 2 dimensional grid. The example in Fig. 6 would result in:

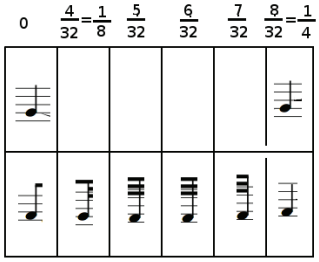

Fig 8: The position array

Elements which have the same time appear in the same column. Every symbol has its bounding box. The position algorithm computes the needed space for every column by determine the maximum bounding box width per column. From this information the position of each column is computed and the symbols in this column are tagged with this position.

This takes place every time the user modifies the score. The times are computed, the array is build, the positions are computed. And all this is fast enough to meet the 50 ms requirement. This holds even if the score is the first movement of Beethoven's 5th symphony with 12 staves and 500 measures! To save time NtEd tries to keep track of already positioned staves to avoid double positioning.

The handling of horizontal grouping is still more surprising: Before positioning there isn't any single information where to place beams. Because the beaming follows certain musical rules, the beams are computed after all elements are placed.

For ties the notes are internally connected by pointers. As you can imagine this is a source of many crashes especially because ties can be removed implicitly as shown in Fig. 7.

To draw the ties NtEd uses the Bezier curves offered by the Cairo library[5]. This is a very fantastic and very fast graphics library. It can draw lines, curves, paths, circles, and predefined fonts. And it can fill all these elements, independent of whether they are concave or convex. And it can antialias these elements. This is important, because it is impossible to give the signs a smooth appearance by using only black and white pixels. Intermediate colors must be computed as an enlargement shows:

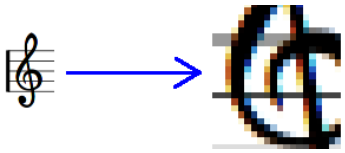

Fig 9: Antialias

Believe it or not: If the user moves upward a single note as happened with the tied quarter in Fig. 6 the positioning takes place, the whole page is cleared (filled with white color), and the score is redrawn with antialias. And all this is so fast, that the user has the impression to only move a single note upward. The only "trick" is the usage of a double buffer to avoid flickering.

Other Problems

There are of course much more problems. The beams and especially the beam slope must be computed. Regard Figure 10:
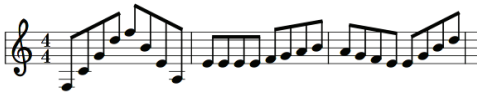
Fig 10: Different beams

As you can see the beam slope depends on the position of the beamed notes. NtEd offers 7 different slopes between -30° and 30°. Believe it or not: Although there are only 50 ms available, NtEd tests each of the 7 slopes and chooses that one, which causes the smallest change of the stem length compared with the un-beamed notes.

And there is another issue. The length of the beam groups depends on the time signature:
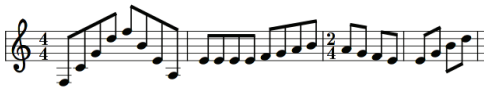
Fig 11: beam length

Here is nothing to compute! How many notes are beamed on which time signature is a result of a long history of note engraving. NtEd has an internal table which determines where to break a beam depending on the time signature.

Of course, the user can overwrite these rules in special cases. The same holds for the slope.

Some further problems are caused by polyphonic music. For certain instruments and choir music it is usual to place different voices on one staff. NtEd offers up to 4 voices per staff. Imagine the user places a first voice:
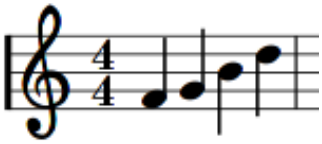
Fig 12: Single voice

Then he/she inserts some notes in the 2nd voice:
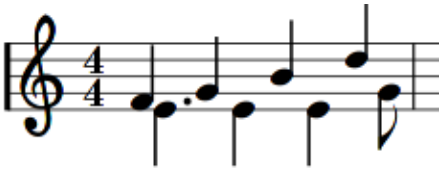
Fig 13: Polyphony

First of all a stem decision must be made. A musician expects the notes belonging to one voice to have the same stem direction. Note, the stem direction can change in next measure if the voices cross. Therefore, NtEd computes the stem direction on a measure-by-measure basis. To do this, it builds the average pitch and uses the stem up policy for the voice with higher average pitch.

If the voice count increases this problem becomes more and more difficult. In case of 4 voices it is often up to the user to overwrite the stem direction or to break some beams to avoid line crossing.

I regard it as impossible to solve all problems automatically. In general this is a task left to the user, even if a very professional *(and very expensive)* musical score editor is used.

Figure 13 discovers a further problem: Regard the first notes of every voice. They sound at the same time. But there is no place to put them at the same horizontal position. This is a known problem of music notation. So-called microshifts must be applied. To detect such conflicts and to compute the microshifts every column of every voice must be compared with the other voices. Thus, the computation complexity increases with the square of the number of voices. Bear in mind: All must be done during 50 ms! So, the limited computation time limits the number of voices.

4. MIDI IMPORT

As already stated, NtEd can import MIDI files. Users expect this feature as a matter of course. But reconstructing the score from MIDI file is a very difficult task. A MIDI file can be regarded as an endless paper with holes, like the paper roles used in mechanical pianos. Every line represents a pitch (D, G, and C in this case):

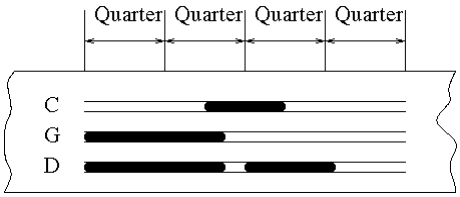

Fig 14: MIDI data

The horizontal direction represents the time. And the duration of a quarter note is know by a field in MIDI file header. The score looks like this:
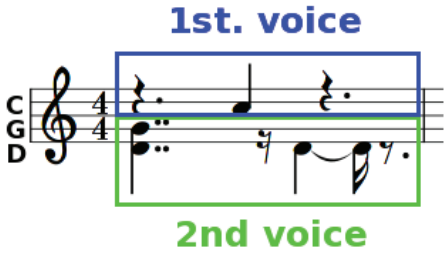
Fig 15: Score of MIDI data

As you can see, some very intelligent decisions must be made:

1. Because D and G end after C begins they belong to different voices.
2. There seems to be no conflict between the leading D and G and the 2nd G, i.e. they belong to the same voice.
3. There is a conflict between the leading D and G, but they start and stop at the same time, i.e. they build a chord.
4. The length of the chord is a quarter + an eighth + a 16th, which can be expressed by a double dotted quarter.
5. The length of the last D is a quarter + a 16th which can only be expressed by tieing 2 notes together.
6. The gaps on paper must be expressed by appropriate musical rest symbols.

As you can imagine it is not quite easy to perform the MIDI to score transformation. And Figure 14 shows a relatively simple example. The problem is still much more complicated if the MIDI file is produced by a musician playing a keyboard. Imagine the start of a C scale:
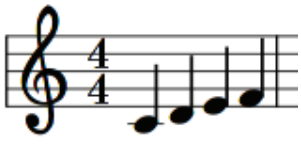
Fig 16: A C scale

The MIDI data should look like this:

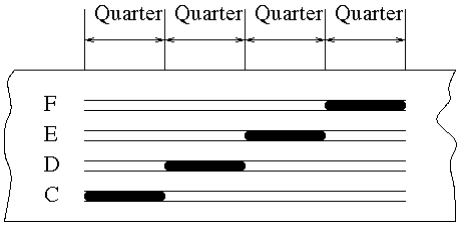

Fig 17: Ideal MIDI C scale

But no musician plays it this way. Most musicians release the keys a bit - say a 32th - too early *(the last 32th is filled by reverberation and sustain effects)*:

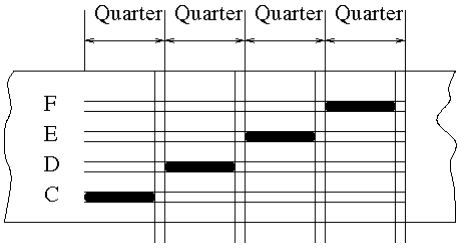

Fig 18: Bad MIDI C scale

An exact MIDI ⇒ score transformation would result in a system of double dotted eighths followed by a 32th rest:
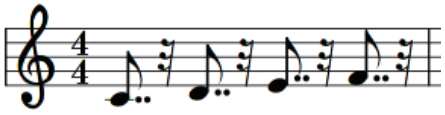
Fig 19: Bad MIDI C scale

Note, this is unplayable! NtEd has some heuristics which recognize the situation and reproduce the correct C scale as shown in Figure 16.

5. OUTLOOK

There are still some missing features. A lot of additional musical signs must be implemented. Fingering is important and surprisingly many users request special notation for lute or Gregorian notes.

But my dream is: OMR (Optical Music Recognition). It would help a lot if the user could scan a sheet of music and NtEd could read it. Many commercial musical score editors offer this feature, even though as very expensive additional module.

6. MOTIVATION

At last one may ask: Why does the author create such a program? Indeed, my field of activity is computer networks and distributed systems which has less to do with music.

I have to lead tutorials which require programming knowledge. In the recent times it became more and more difficult to be better than the students in writing programs. Therefore, some time ago decided to start to implement a sufficient complicated object oriented program. I decided for musical score editor because there exist only a few programs and especially on Linux there are only 2 WYSIWYG musical score editors, at all.

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http://www.gnu.org/licenses/gpl-2.0.html

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http://vsr.informatik.tu-chemnitz.de/staff/jan/nted/nted.xhtml

[3] ALSA: Avanced Linux Sound Architecture
http://www.alsa-project.org

[4] LilyPond:
http://www.lilypond.org

[5] The Cairo library:
http://cairographics.org

[6] MusicXML:
http://www.recordare.com

Bulgarian University Libraries as an E-Learning Support Center

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Key words: *education models; e-learning; digital libraries, digital library resources*

Abstract

Purpose:

The main topics, discussed within this paper are the new possibilities for successful integration of university libraries within the educational models for knowledge economy.

The evolution of functional library models is presented as an inevitable result of the transformations in the documental media area under the pressure of the world wide distribution of the contemporary technologies and globalization.

Design/methodology/approach:

Identification of the interaction areas between the library and the educational models is based on both the conceptual instruments of the General Applied System Theory, and the ideas of reengineering of the functional model of university libraries.

Originality/value:

The achieved results can be evaluated as an application of the theoretical basis of the General Applied System Theory. A convergence of the communication areas and the creation of prognostic model of the university library within the dynamical social changes and the reflection of the different educational models.

Practical implications:

Specification of the methods for integration of the university libraries within the unified European Educational Environment are presented with applied models in the Bulgarian university libraries

Paper type:

Academic Research Paper

1 Introduction

The contemporarily condition of one of the most stable institutions in the history of human civilization development, institutions that represent of preservation and dissemination of the knowledge – the library and the education – can be described / defined with a few words only – constant changing, current transformation.

In contemporary conditions of frequent introduction of new, innovative educational and learning models, identifying of the factors, defining the trends of development of the functional models of university libraries in Bulgaria is closely connected to both communication infrastructure modernization and society's dynamically flowing processes.

2 Characteristics of the system environment for joint transformations of the library and educational models

Formulating of basic communication channels for information flow conducting, traditionally formed in university libraries, requires the definition of basic areas of interaction between educational models and library models reviewing the dynamic of changes in the concrete / specific working conditions.

Respective the functions of the university library and this way they secure dynamically training content, which is o the changing requirement and satisfy a new criteria.

Relevantly the functions of the University library are considered to be in the so called condition of "dynamical balance". Thus they can provide dynamical educational content, adaptive enough, able to meet the changing requirements and corresponding to the new criteria.

The problem for identifying the conditions defining the perspective and the sustainable models for dynamical interaction between library and educational models has also a significant meaning in defining long term strategy concepts and providing / finding appropriate condition for strategic plans implementation.

Integration of the educational and training content (programs and plans) in e intelligent platforms, based on mobile communications, is a precondition for engaging the library as a basic communication access centre to knowledge saving [1].

The changing conditions in the field of higher education in Europe refer to Bulgaria as well. The problems concerning the quality of education are considered as a consequence of several factors: the rapid transition from specialized higher education to mass higher education; financial restrictions in the field of university education and the increasing autonomy of the higher educational institutions.

This is the natural base for useful participation of Bulgaria in the Bologna process. The educational system is gradually reforming. An open educational system is created. A system combining independence from the state regulation, transparency and recognition, a system which can guarantee an open access to concrete information, clearly formulated educational and training results and competences [2].

When obtaining knowledge, shifting the accent of the educational process from fundamental to specialized problematic areas / fields of study, especially considering the high technologies, requires restructuring and resetting (harmonizing) of the entire educational cycle – in both quantity and quality aspects.

The transition from static to dynamic educational model (lifelong learning) is reflecting (projecting) over the conception of "social education". Bulgaria must proceed to undertaking of certain measurements in order to overcome the underdevelopment of the higher education system at first place, and to renovate its educational strategies in order to increase the quality and the value of the higher education at second place.

3 Libraries interactions in transformation process from information access to knowledge access

Different measurements have been taken during the last 10 years. Most of them are coordinated at a higher state

level. Ratification of strategies for reform and modernization in the entire educational sphere has been implemented [3].

The basic goals of Bologna process can be summarized in the following directions:

1. To perceive compatible and comparable higher education system, supported by introduction of the two basic cycles of education (1st - Bachelor's Degree and 2nd Master's Degree) and to promote European Credit Transfer and Accumulation System as a tool for free, unimpeded and unlimited realization of students mobility.

2. To promote and endorse European dimensions in the field of higher education especially in the development of curriculum, inter-institutional collaboration, Mobility plans and schedules, integrated educational programs and trainings for students, academic and non-academic stuff, teaching stuff (lecturers) and administrative personal.

3. Enlargement and development of collaboration in evaluation of training and teaching processes quality throughout elaborating comparable criteria and methodologies.

Specification of these strategies within the contemporary Bulgarian reality submits a number of difficult questions. The answers to those questions, the solution of those problems can be found in application of good practices, established in the leading countries worldwide, as well as with keeping in step with the high criteria for education quality.

The following three basic trends in the development of educational and library technologies have been defined as dominating:

- Forming and development of a library consortia of the leading Bulgarian academic libraries;
- Bulgarian University Libraries integration in the framework of the leading European and International Libraries Associations and Networks (LIBER, EBLIDA, OCLC);
- Immediate introduction of digital technologies, supporting new educational models (e-Learning, mobile learning, distance learning).

The topic concerning digital technologies application in the educational system has two basic aspects:

- Modification of traditional teaching tools and methods in a new digital form
- Changing of educational paradigm.

The educational process is based on communication, corresponding to the level of development of technologies at the different stages of society's progress.

Basic characteristics of the contemporary social development are the computer-based communication technologies. They are used to integrate the computer as a final telecommunication devise in the heterogenic information-communication global network – the Internet.

"Open education" tend to be the new educational paradigm. Open education provides unlimited access to both: knowledge for everyone, regardless the time and the place and lifelong learning [4].

The new opportunities to implement a dynamic interactive synchronized educational process are features of the flexible open training.

The basic features of the rest of the forms of instruction reflect the way, volume and content, place and time of implementing the educational process. Respectively, the additional opportunities for the whole educational process management are in the system tools. Discussions over the differences between distance learning, computer based learning and e-learning have been on the presentation of the learning content and the ways of its implementation. Some e-learning theoreticians place the curricula presentation through the web-tools medium, others emphasise the communicative essence of the web-net, and yet others stress on the information resources and their function in the web-environment.

Integration the curricula into an intelligent platform based on mobile communications creates the new educational model m-learning. In developing such an educational technology for university students in Bulgaria, an entirely new type of information system has been planned, one that would be able:

- To provide web-based access, searching, knowledge extracting by using c personalized multilingual / bilingual user interface;
- To gather, systematize, classify, objectify, organize information recourses at different levels;
- To organize heterogeneous allocated information recourses (collections and fractals) in knowledge data bases;
- To provide information and data protection and security as well as to generate statistic data and to organize it within user and administrative data bases.

4 Digital conversion of library information resources and integration in the contemporary educational models

When specifying the technology for digital resources integration within the intelligent educational platform for students enrolled in Bachelor's and Master's Programmes at the State University of Library Studies and Information Technologies, a thought should be spared for the information resources features connected to the primary source and the kind of established communication resulting in access to them.

Information resources heterogeneity could be expressed in either type of data (text, graphics, metadata and hypothetical data) or in their presentation environment, structuring and access to them.

These characteristics can be summarized at the following directions:

1. Thematic direction / Subject oriented trends of the education – universal or concrete (libraries, archives, museums, printing / press communications, information technologies, information brokering, information security).

2. Information recourses - form, content, format, and introduction (paper documents, microfilms, tapes / bands, CD, DVD, audio or video tapes, etc.).

3. User Interface – language, search options and preferences, access to information, information use, knowledge data base for users.

4. Data support, security and protection of the information resources and knowledge data bases during their entire life cycle;

5 Conclusion

Above all, the adopted strategy of providing Lifelong Learning Process for each and every European citizen is a matter of financial support. In all respects, providing financial resources is only possible within the establishment of competitive economy, based on innovations in every sphere of development. In that way each citizen of United Europe will be stimulated to maintain, broaden and renovate its knowledge and skills. Thus, as a final result society's position on education will be fundamentally changed / changed radically.

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An Exploratory Study: The effectiveness of a Learning Management System (LMS) in the delivery of a face-to-face programming course

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ABSTRACT

In an effort to meet the challenges of teaching programming, learning management systems are used to facilitate teaching and enhance learning. In this study we determined students' perceptions, expectations and effectiveness of the LMS as used in a campus-based programming course and gained insight into the undergraduate student population. A survey was administered after they had completed the course. The instrument explored the perceptions and effectiveness of the various features of the LMS in relation to programming. In addition interviews were conducted. Findings showed that the respondents rated the communication and discussion among the highest and guidance to solving problems among the lowest. We comment on the efficiency of the LMS and how far it goes to support students in problem solving.

Keywords: Learning management systems, learning programming, guidance to solving problems

1. INTRODUCTION

With increasing demands to offer quality programming courses to meet the needs of the problem solving undergraduate student population, we conducted quantitative and qualitative research to explore the effectiveness of the use of an in-house learning management system(LMS). A learning management system is a software application used to plan, implement and assess a specific learning process. Typically a learning management system provides an instructor with a way to create and deliver content, monitor student participation and assess student performance. The results would inform the teaching practices as well as provide information on ways to improve the quality of the course and the LMS experience for future students of programming ([3]; [7]). Another impetus for the study was the faculty's desire to expand its current use of LMS as well as revise existing courses that make use of a LMS to improve their overall quality and student satisfaction with the LMS learning experience. We considered observations, interviews and survey questions as the most practical approach to efficiently gather data from the students who had completed the introductory programming module and who are currently enrolled for the next module in the course.

The purpose of this exploratory case study was to gather information on students' perceptions of the effectiveness of the existing LMS used in face-to-face classrooms, and gain useful information about the student population enrolled in the course. As is characteristic of any case study, the researcher is called upon to work with the situation that presents itself in the specific case. The observations and interviews were designed to address the following research questions:

- How effective was the use of LMS in learning programming?

- What were the students' perceived needs of the LMS?
- What were the characteristics of the students enrolled in this programming course?

2. LITERATURE SURVEY

While there is a variety of digital resources and Information and Communication Technology (ICT) tools to assist learning and teaching, technology is being used for little more than acting as subject matter storehouse or for managerial and clerical functions ([6]). Many lecturers -- and, in some cases, the entire university -- are moving towards the use of wide-ranging learning management systems (LMSs), such as Blackboard ([2]) and Moodle[10], for facilitating courses and boosting student learning. Although LMSs are deemed beneficial, they fall short in some aspects specific to computer science education, in particular programming. A learning management system (LMS) lends itself to web-based learning environments by enabling the management of courses, delivery of content and lectures, assessment and tracking of student engagement with the course. LMS are often considered as being the basis of any web-based learning course.

In recent years the development of LMSs has led to an increasing interest in web-based education. The in-house LMS (Open Learning System -- OLS) enables the students to follow the course notes on the web, to carry out quizzes and surveys, and to provide communication outside the classroom by means of chat facilities and discussion forums. LMS supports collaboration based-learning activity amongst students. There are a number of advantages to giving students assignments that they can work on collaboratively. The advantages of collaborative programming have been recognized and employed in commerce and engineering for some time ([13]). According to [12] and [5] students are able to take on more complex problems and gain a better understanding of the subject matter when the work is done collaboratively. Although in general the advantages of collaborative work have been recognized there are still some uncertainties about it. Some of these are, is it better to pair a novice with an expert or pair two novices, or perhaps pair two experts? Are individuals better at learning a programming language than pairs?

The driving force for adopting the technology of a LMS is often linked with benefits derived from using a LMS associated with large classes, which is often related to improved communication between lecturers and students ([8]; [9]). Another benefit is improved access to course content, which can encourage consolidation of what has been learned in lectures ([9]).
For example, [9], reports on the use of a learning management system, which suggests that there is some evidence that students who used the LMS more frequently did better. In another study of a physics foundation course (class size of 242), it was also determined that those who performed well (66% and more) used the LMS almost twice as much as others.

In order to improve and derive quality learning using a learning management system, it is necessary first to understand the students' engagement with such a system. According to [1], it is suggested that understanding students' engagement of Learning management systems (as used in online courses) would help to improve campus-based (which we generally refer to as face-to-face lectures) education. Learning management systems (LMS) such as Blackboard and WebCT ([2]) incorporate an array of online tools, such as discussion boards, announcements, email, assessment quizzes, group facilities, learning content and linked references.

In a separate study, Coates, James and Baldwin (as cited in [1]) observed that the prompt implementation of these LMSs was based on six compelling factors, namely:

1. a means of increasing the efficiency of teaching
2. the promise of enriched student learning
3. new student expectations for advanced technologies
4. competitive pressures between institutions
5. a key means of responding to massive and increasing demands for greater access to higher education
6. part of an important culture shift taking place in teaching and learning in higher education (p. 23-5).

Much has been written about the benefits of LMSs since its widespread adoption by many universities ([11]). An instructor may require an easy way of communication and an easy way to post documents, receive assignments and carry out a traditional threaded discussion will tend to show great satisfaction. On the other hand, those instructors who are experienced with Web 2.0 applications may want to present learning experiences based on audio, visual or mixed media formats, find these systems not so useful. Hence, faculty and to some extent students' satisfaction rates may be deceptive. In this study, it was necessary to examine the students who were learning programming using the in-house LMS and determine its effectiveness.

3. METHOD

Course design

The traditional, face-to-face course is typical of most medium-sized lecture courses with one lecturer teaching the students. Weekly lectures take place and the instructor supplements the lectures with online materials such as PowerPoint slides and multiple-choice quizzes and linked references. While most course discussions occur in class, online supplements are utilized in the face-to-face course and there are asynchronous discussions online. The instructor provides examples relating to the concepts taught and then asks students to solve similar problems. While some students prefer the face to face interaction between instructor and student, others find it intimidating.

The face-to-face class is supported by the (OLS) learning management system and use the OLS asynchronously. The courses are scheduled to be online during a specific time; within each module, students are required to participate in an asynchronous threaded discussion, complete written assignments and solve a programming problem.

Participants

Students who were enrolled in two modules (n=20 and n=16) using LMS within a traditional, face-to-face course of an introductory level programming course participated in the study. All students from each course were included in the study. Although students selected the course themselves at this institution; students who take programming courses are similar in age (between19-20), and previous experience. No distinction was made between male and female students in this study.

Data collection

In order to examine the effectiveness of the LMS and students' perceptions of LMS we asked students about the system's benefits and features, using questionnaires and interviews. For most part the data was drawn from the open-ended question to comment on what they liked and disliked about the OLS.

A questionnaire with regard to the undergraduate students' experience with the LMS in the university was administered. We supplemented quantitative data with interviews of 20 students. We realize that although few students can give expert opinions on instructional methods or LMSs, these opinions and perceptions do contribute to overall meaning.

Data Analysis

Initial themes were found through a combination of manually reading through the responses and using a software program, *NVivo*[1].

4. RESULTS

The findings discussed here focussed on students' experiences and expectations of using the OLS. Themes obtained from the initial analysis of student likes and dislikes around the LMS itself and the ways it was used are summarized in table 1.

Table 1: Responses from students on the use of the LMS

Themes	Details
Module organization and preparation	- Course information gave students guidance - Helped students to "plan ahead and prepare" - Provided more clarity about requirements for assignments and tests and course outcomes - Students could check class marks and tests online.
Better learning through	- Availability of PP slides used in lectures allowed students

[1] Nvivo is a qualitative data analysis (QDA) software package produced by QSR International

information availability	to listen more attentively in lectures and concentrate on understanding the work - Useful resources and links for assignments (reduced anxiety) - Hints and feedback "increased my motivation to learn" - Links to other sites increased relevance, understanding, interest and broadened my knowledge.
Improved learning through many to many communication	- A conducive *environment in which to ask questions:* - *Increased speed of feedback*: Good way of sharing ideas and solving problems quickly; getting quick responses to questions before tests or while working on assignments - *Peer tutoring*: "Interesting to see what other students think"; "I feel a sense of not being alone in the difficult aspects of programming"; - *Self assessment*: "forum made it possible to assess my progress in comparison to other students"
Wider use required	Many students proposed that the LMS should be more widely used at the university.
Flexibility in learning	Students were glad to have the flexibility of catching up with learning material/lectures they may have missed. Information could be accessed from "anywhere", which saved time
Lack of consistency across courses	While, this study dealt with the programming course in question, students' responses to some aspects were related to other courses. They made mention that the manner in which the system was used across courses were inconsistent. They asked for a dependable high standard of use.
Guidance to problem solving	A predominant message was that students felt that the OLS was not sufficiently helpful to them to solve programming problems.

The results will be presented in relation to the research questions and discussion will follow.

Effectiveness of LMS used in face-to-face lectures in a programming course

Participants rated each of the features of the LMS in response to "How effective and valuable were these features in facilitating your learning of programming?" Point values for the responses were assigned as follows: very valuable (4), valuable (3), not sure (2) not valuable (1). Means and standard deviations were calculated for each feature.

The overall high ratings of some of the features of the LMS such as communication and discussion forum speak to the importance of communication and collaboration that students require. The use of the feature rated as most effective were those related to some form of interaction between students and tutor. When given the opportunity on the questionnaire to provide comments about the communication, one participant said:

> The students communicate at a different level on the OLS as compared to in the classroom. Some students are shy- in this way they can express their views and in the process learn. I use the communication on the OLS to learn from other learners from evaluating and figuring out where they went wrong.

Even though the communication and discussion feature was rated among the highest, some participants reported dissatisfaction with the unavailability of other students and tutors at the time when they needed timely response. The students and tutor may not be online at the same time to answer questions and queries. Others indicated that detailed explanation of problems or diagrams cannot be given using the communication feature of the LMS. One participant said:

> It is just preferable to learn face-to-face, but for the tasks and announcements it's fine.

Since it is generally agreed that the Net Generation students are considered interactive and "internet savvy" ([4]), online discussion boards should provide great potential to engage students in the subject matter. In this study, however, although the online discussion was rated high, student interviews revealed that online discussions were perceived as "busy work" and sometimes done to accumulate marks for engaging in the course, but appropriate and useful discussions about the method of solving

problems did not take place. It was determined that a well-administered and synchronized online discussion could be very useful.

Access to course materials, syllabus and sample quizzes were the next highly rated features. This suggests a strong dependence on the lecturer and the notion that one can be absent from lectures and still be up to date with the lectures and learning. The open-ended questions yielded responses that indicated the convenience of having access to course materials without having to be at lectures. This is indicated in the following quotation:

> Notes are put up so learners would not have to keep asking for notes.

The least rated feature was "guidance in solving a problem". Participants were not satisfied with the level of guidance obtained in solving programming problems using the discussion forum. They preferred face-to-face lectures in these instances.

> Detailed explanation of problems (diagrams) cannot be given over communication

Perceived needs of and expectations of the LMS

In addition to the qualitative analysis of participant responses to open- ended questions asked in the questionnaire, response to the survey question "Please rate how well you think you will be able to use the LMS to learn and teach programming" was used to determine their perceptions of the LMS.

The majority of the students (86%) felt that it would be moderately difficult to difficult to learn problem solving and programming using the OLS. However, it was found that a fair number of participants felt that it would be moderately easy to easy to manage their studies in a more efficient way. Furthermore, it was determined that students' perceptions emerged into expectations of the LMS. Many students' comments were strongly related to their expectations around how the system should be used. While students embraced the LMS for its efficiency in accessing information and keeping on track with the module expectations, it was not effective to learn the particular skills required of programming.

The following quotes from participants' responses to open-ended questions indicate some of their expectations:

> The more courses that use OLS, the more often, people will log on, so more frequent discussions will take place. Special discussion groups with experts from across UKZN taking turns to be 'live' on OLS to answer questions. Maybe online tutorial sessions may be helpful.

However, at the same time, students felt that more was required for programming questions and concerns as indicated in the quote below:

> However, it will be more interesting if the lecture can answer the OLS question in the class. I still require face-to-face help in solving programming problems.

Characteristics of undergraduate programming students

In order to gain an understanding of the students who participated we asked them to fill out a background questionnaire.

These undergraduate students were mostly young adults just out of high school, who for most part had no previous programming background. A clear majority of the students (58%) had either limited or no computer experience. Any computer skill or experience gained was at this university. In this survey 44% reported spending 3 to 5 hours per week on the LMS outside of formal lectures and 28% of the students reported that they spent more than 5 hours per week using the LMS, including the time spent for other courses. The low percentage of usage of the OLS may be attributed to the non-use by other courses as is supported in the quote above. Hence students do not often log in to OLS, which, would otherwise, foster and encourage more belligerent use of discussions and other features of the OLS. It is also possible that students who have less technological mastery would adversely affect their usage of the OLS.

Furthermore, it is quite likely that the strong reliance on lecturer support may be due to the immaturity of students in the use of technology in higher learning and chronological age. Using the OLS also creates a sense of learners taking responsibility for their learning, for which many of these students may not be ready. This conjecture requires further study.

5. CONCLUSION

This study proved to be informative in identifying those features of the LMS that the face-to-face students rated as most and least effective in learning programming. Those that were rated most effective, such as that of the communication and access to course materials were students who had a fairly good knowledge of programming.

While using an LMS to manage administrative and organizational matters and for making more course resources available is effective and useful in large classes, this case study found that the discussion forums brought the greatest satisfaction among students. The increased communication, via the forums, helped lecturers respond to problem areas quickly and to be more sensitive to student learning needs. However, it was noted and documented that while the use of OLS was innovative and increased student interest, it did not specifically meet the requirement of the course, which is learning to solve computer programming problems.

The participants perceive the use of OLS to have great potential, and their expectations are that more courses should use the OLS so that students login more often and make use of the potential features of the LMS. Students obviously appreciated the guidance communicated via the LMS, as well as the greater clarity about course outcomes and assessment methods. The improved lecturer-to-student communication also enhanced learning through the timely provision of additional resources. This communication provided many benefits including a non-intimidating environment in which to ask questions and improved speed of feedback

However, the findings suggest that the use of LMS in face-to-face learning does not inherently improve students' problem solving skill in programming. Rather the LMS is simply a means by which instructors can use to involve students and purposefully promote students' increased engagement with course material and discussion. Hence in this study, the LMS is seen as complementary rather than as a substitute for face-to-face lectures.

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The Daemon as Educator: Ubiquitous Access to A Personal Mentor

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ABSTRACT

In Socratic philosophy, human beings had access to an inner voice that could be counted on to provide guidance and assistance when needed. This inner voice or daemon was always available and had access to realms of knowledge that mortal consciousness did not have. We propose that the field of Machine Learning has reached the level of maturity where the construction of a personal daemon is now feasible. The ubiquity of broadband access to the internet can guarantee that this personal daemon is always available. Such a construct can greatly increase the efficacy and availability of education for all citizens.

Keywords: Cloud Computing, Machine Learning, User Modeling, Personalized Mentor, Educational Adjunct

1. INTRODUCTION

Classical Greek philosophers developed the idea of daemons (δαημονεν), divine entities that attach to individual human beings, with the purpose of guiding them to grow and mature into their fundamental nature and character. Towards the end of the Republic [1], we read "All the souls had now chosen their lives, and they went in the order of their choices to Lachesis, who sent with them the *genius* whom they had severally chosen, to be the *guardian of their lives and the fulfiller of the choice:.."* (Italics ours). Each daemon accompanies its charge throughout their entire life and constantly directs its charge to fulfill their potential. The concept of the daemon as one's personal companion and guide found its greatest expression in the life of Socrates, who credited his daemon as the source of his wisdom and courage in the face of death.

Suspend disbelief for a moment as we recast this wonderful idea in the contemporary idiom. The phrase "choice of life" we can understand as the genetic and social matrix of an individual. But what can we understand by the idea of the daemon? Implicit in the idea are the following key constructs.

1. The daemon possesses a deep understanding of the human to which it is attached
2. The daemon has access to a realm of knowledge no individual human being could attain.
3. The daemon is an advocate for its charge, i.e, it can only act in ways that positively affect the development of its charge
4. The daemon is always available

We propose that a confluence of developments has now made it possible to create an entity that embodies all these constructs and to enlist that entity in the service of humanity compatible with the vision of those ancient Greeks philosophers. The developments we refer to are respectively, the introduction of cloud computing, high bandwidth access to the Internet from mobile devices and significant developments in the field of machine learning. Specifically, we propose the development of a software agent running on a virtual machine implemented in the Internet (clouds) that has access to all the data on the Internet and access to the most sophisticated machine learning tools. This process will attach to individual human beings, learn all about them and then guide them in developing their full potential. In this paper, we focus our attention on the ramification of this idea to education. In the following sections, we argue that such a program is indeed feasible and that the time is ripe to implement it.

All 4 elements listed above are essential, though from our perspective items 1 and 3 are the most controversial and require some justification. Most significant is the claim that an artificial entity, i.e., a computer process, can come to know and understand a human being and then significantly impact their lives in a positive manner. The lynchpin of the whole argument is the idea that a computer program can come to "know" a human being in the sense that we would say person A "knows" person B very well.

Consider the now quite common scenario of logging into an on-line bookseller or on-demand movie site and being presented with a list of recommendations. Chances are good that a reasonable number of the presented recommendations were for the most part interesting to you and were titles that you either

had already bought or would consider purchasing. After taxing yourself deciding whether to go ahead and purchase any of these recommendations, perhaps you turn on Pandora to relax to some of your favorite music. On the surface, these applications really seem to have learned something meaningful about you and to be able to use that knowledge in a way that improves your life. Recent advances in Recommender Systems [14] rely on sophisticated algorithms that analyze the similarities between previously selected items. It is essential to note that to be effective the algorithm would have had to have previous interactions with you. As with all inductive algorithms, the more interactions the more likely the algorithm is to provide a valid recommendation. To determine the set of musical selections most likely to please you, Pandora analyzes the musical structure of the songs you like and then selects those songs with similar structure. The reference information is contained in the Music Genome, created by a set of musicologists and containing more that 10,000 pieces of music codified with respect to hundreds of musical attributes such as harmony, rhythm, tonality, range, etc. [12, 20]. The key item here is that the algorithm has access to a rich set of reference data.

When we say that a software process is an agent we require that it can learn and that it acts to achieve some goal. The Automated Travel Assistant [18] provides an excellent example of an application that can learn an individual's travel preference, search airline timetables and provide a set of tailored recommendations. Indeed, the study of intelligent agents has brought forth a myriad of applications that support or automate human functions. Neural networks were used to craft a personal news service based on an explicitly learned user model [8]. We argue that it is now feasible to extend this approach to create an intelligent advocate that will monitor and support the educational development of its charges. This Educational Daemon will take advantage of all the breakthroughs in machine learning, user modeling and developmental psychology to provide a supportive guide that is always accessible, easy to interact with, and tailored to each individual student. It is personal in the sense that it will actively learn the students it supports.

Second generation "intelligent agents" are very sophisticated machines. Due to advances in computer hardware, distributed processing and machine learning the computational power of these agents is significantly expanded. These machines can automate human tasks, and they can interact with people in human-like ways that include natural language and the ability to participate in a conversation or dialog [9, 5].

Building such a personal entity, **Y**our **E**ducational **D**aemon (YED) is clearly an ambitious project, one that will require the collaboration of experts on multiple fields. Clearly, a key competence of this agent would be the ability to understand or model the student it will serve. The following description from the mission statement of the Journal of User Modeling aptly summarizes the areas of research and development that will be required to bring this idea to reality

"……conceptual models, mental models; levels of user expertise; intelligent information retrieval; adaptive hypertext and hypermedia; adaptation to the handicapped and elderly; user stereotypes; formal representation of user and student models; applications in office machines and consumer electronics; and privacy and security of information for personalization.

User Modeling and User-Adapted Interaction is ideal for researchers, students and industrial practitioners in artificial intelligence, human-computer interaction, linguistics, and the instructional sciences"

2. DEFINING THE DAEMON

In the introduction we mentioned 4 key characteristics required of our daemon: (1) developing a deep understanding, i.e., learning about the student that it will serve; (2) determining the target environment in which the student will operate viia access to reference data; (3) delivering a set of training /learning regimens tailored to the individual student and to the target environment and (4) being always available. It should be noted that theses characteristics are not unrelated. Actions such as playing a game with a child can serve a tutoring function as well as provide an assessment of the child's specific cognitive and social skills. Such activities provide the daemon with useful information in addition to increasing the child's self confidence [29, 30].

In essence, YED is a learning advocate for the child it serves. Furthermore, this advocacy will evolve over time as the child moves though the education system. For the present we arbitrarily limit our focus to grades K – 12. This is clearly a formidable task but a feasible one as we hope to demonstrate.

It is essential that YED is always available to the student. For our purposes we consider the daemon as a background process running on a virtual machine. A new instance of this process is forked (created) when a new user (prospective student) subscribes to this service (attempts to communicate with their daemon) for the first time[1]. Since the daemon is always available and does not halt when the student detaches or closes their channel, it must preserve state information. In other words, the next time the student connects to it, the ED will start from where it last left off and incorporate all the learning from the last encounter.

We explore each of theses factors in more detail below.

2.1 Learning the Student

In the rich literature on machine learning [11], the breadth of concepts and/or skills that a machine can quantitatively be shown to learn run the gamut from abstract concepts such as Boolean expressions to playing games such as chess to driving a car. Here the target the YED must learn is the student: their strengths, weaknesses, preferences and interests. Initially the YED views the student as a tabula rasa and the information it obtains would be from the parent or teacher. As soon as the

[1] Processes can become daemons by forking a child process and then having their parent process immediately exit, thus causing init to adopt the child processes. The resulting process is not attached to a specific TTY (user) or Socket (interface) and does not die when the specific TTY or Socket session terminates.

student is capable of accessing their daemon, the YED will learn from these interactions. These interactions would take the form of:

1. Playing games with the student
2. Administering tests
3. Asking and answering questions

With each interaction the daemon builds a richer internal model of the student. In conjunction with externally provided data such as results of classroom administered tests, the internal model converges with increasing interactions to an accurate model of the student.

Of course we must be able to validate that the daemon can actually learn the child to which it is attached. While a child's educational profile is not as well defined as a class of Boolean expressions (e.g. k-term CNF formulas), the framework of the Probably Approximately Correct (PAC) learning model [17] provides a reasonable way to think about the problem.

We first assume that to learn a child in the context we are interested in is equivalent to learning the answers to a potentially large but finite set (bounded in advance) of specific questions about the specific child. For example, the questions "In what quartile will student *s* score on the mathematics section of the TerraNova test" and "Given a list of 10 words students in the same grade as *s* should know, how many will *s* be able to spell correctly?" are reasonably precise statements that could be empirically validated. As discussed above, these sets are dynamic and vary over time. Let's denote this set C_t, where t is a pre-specified time index.. Furthermore, let D_S be an arbitrary distribution over all students and let $D_{C,t}$ be an arbitrary distribution over C_t and let L_t be a list of questions drawn at random from C_t according to $D_{C,t}$. Then, given pre-specified parameters δ and ε ($0 < \delta < 1$) and ($0 < \varepsilon < 1$), we can reasonably say that an algorithm *A* can "learn a student" if

$$\forall \text{ t in the Index set}$$

$$\text{EQ (1)} \qquad P_{D_S}(A \text{ answers} > 100*(1-\varepsilon)\% \text{ of } L_t \text{ correctly}) > 1-\delta$$

In essence, for a student selected a random we can expect with probability at least 1- ε that our daemon will be able to answer at least 100 * (1- ε) % of the questions correctly. Since we are dealing with children and not abstract entities it might be advisable to add another constraint of the form:

$$\forall \text{ t in the Index set } \& \forall \text{ s in S}$$

$$\text{EQ (2)} \qquad P_{C_t}(A \text{ answers a question in } L_t \text{ correctly}) > 1-\beta$$

This constraint guarantees that for every child at every time period the algorithm must have a minimum level of competence.In the above expression the probability is computed over distribution D_S. Note that we are only addressing feasibility here and not performance. The issue of efficient learning is critical but outside the scope of this paper.

While there are no empirical results on complex agents of the type we are discussing, there have been significant results on the use of machine learning algorithms to implements many of the functions YED would require. Three areas stand out:

1. Test construction and analysis
2. Playing games
3. Concept learning

2.1.1 Test construction: A valuable test will allow the examiner to accurately categorize the ability of the examinee based on the overall performance of each item in the test. This is crucial in accurately determining what remedial steps are required and which enhancements could be offered. The same toolset will allow the daemon to assess the level of progress after a specific course of action has been completed. In addition, an effective test will help the student clearly see their strengths and areas for improvement [31].

The theory of test construction is concerned with determining the optimal type and number of items, (tasks or questions) will simultaneously maximizing the accuracy of the test Stated this way, the problem becomes an optimization problem and hence a candidate for mathematical based methods [7, 10, 2, 18] and machine learning methods [15, 6]. Adaptive techniques enable the creation of dynamic assessments in which the question generation function selects subsequent questions based on the difficulty of the previous questions and the performance of the student on those questions [27]. This approach can increase the efficiency of the testing process as well as provide the student with a quick self assessment. Once YED has selected the appropriate test(s) for a given set of developmental targets and evaluated the results, the internal times series model represent the student is updated to reflect the new information.

2.1.2 Playing Games: There is a rich body of research in machine learning on the ability of algorithms to learn to play games and to learn from games [19, 24, 25, 30]. Our interest is in this modality is twofold: first to evaluate the student within the developmental life-cycle and second, to use games as a tool to develop perceptual skills, motor skills and cooperative behavior. We can imagine the daemon playing a game of 20 questions or GHOST with the student and using the interaction to evaluate the student's ability for logical thinking and vocabulary aptitude.

Videogames are a particularly fruitful tool to engage children (and adults for that matter).There already exist game development methodologies that allow the results of the game to be made available to a Learning Management System (LMS) Specific targets can be encoded in the game and then made available in assessment logs or reports to the LMS [25], or in our case, to the daemon.

2.1.3 Concept Learning: There is a robust body of theoretical research in the field of machine learning on concept learning [3, 4, 13] A large variety of concepts such as regular sets, decision lists and many classes of Boolean expressions have been shown to be efficiently learnable if the learning algorithm is able to query an oracle (teacher). The query can be either a proposed hypothesis or an example. In the first case the teacher responds in the affirmative or provides a counterexample. In the second, the oracle responds yes if the concept would hold true for the example, and no otherwise.

In some sense, of course, this is how children learn concepts as well. An algorithm would be able to judge a student's grasp of a specific concept by means of similar interactions, i.e., asking

the students for examples and counterexamples or by providing them to the student and asking if they are valid.

A key heuristic in concept learning is to reduce complex concepts into simpler components, learn the simpler components, and then aggregate these back into the initial complex concept. [27]. YED would use a similar approach. A student interacting with YED would be presented examples that implicitly build a "concept hierarchy" or inheritance structure to represent the complex concept.

The key idea here is that we can exploit the growing knowledge of how machines can efficiently learn concepts to building machines that can efficiently evaluate whether a human understands the same concepts. As with user modeling and intelligent agents in general, an inter-disciplinary approach is needed to define the optimal set of human-daemon interactions.

We would be remiss if we did not mention that machines can learn to recognize emotional constructs and states as well [28]. This ability will be a core competence of the daemon in its interactions with its charge.

2.2 Access to Reference Data

Analogous to the Socratic deamon, YED is able to access information extending beyond the individual it serves. In order to effectively develop an effective training plan, the daemon must be able to relate the student's capabilities to the appropriate development target. This target is a function of the student's chronological age and developmental profile. The curriculum requirements are a key source for this information. Since these requirements are specific to geography, and highly dynamic, they would be best accessed from the appropriate repository. As new games or tests became available, the daemon would incorporate them into its interactions with the student.

In addition, the daemon would have access to a wide variety of online training packages. To list a few we have:

- Leap Frog Enterprise for early development
- Hooked on Phoenics for reading and spelling
- Houghton Mifflin Learning Technology for math

Assuming suitable business arrangements are negotiated, YED would be able to dynamically draw upon them as cloud functions in its interactions with the child.

Both parent and teachers would ideally provide the daemon with additional information about the child such as relevant medical information; teaching plans for the upcoming semester course grades, etc. Finally, note that external data could also come from other devices that the student interacts with. The use of robotic toys to engage children with autism has been shown to provide valuable information and to positively impact social and psychological development [30]. Such information would be extremely valuable to the daemon and given the increasing availability of high bandwidth access to the home and classroom, these robots could be considered extensions of the daemon.

2.3 Mentoring the Student

Once YED has adequately modeled a student, it can begin to execute its primary goal, i.e., develop the student's capabilities and enrich the student's life. In those areas where the student is not performing at the level of their potential, YED will determine the optimal training program. For example, if YED learns that the student has a problem with memorization, there are multiple games the daemon can play with the student that develop this skill implicitly.

In those areas where a child has a clear aptitude, the goal is to provide the child with opportunities to broaden and develop this talent. For example, if a child shows an interest in art, the daemon could arrange a virtual museum tour, all the while taking note of those artists that speak to this individual. If a child draws a picture while on-line, the daemon can compare it existing artworks and display like compositions.

The ability of a machine to learn concepts allows it to teach the concepts as well by inverting the steps. For each concept to be taught, an algorithm would generate an effective set of definitions, similar hypotheses with counterexamples and positive examples. In a variation of the game of "20 questions", the algorithm would interact with the student by providing successive instances from this concept set and allowing the child to converge on the underlying concept. The daemon would be able to verify that the child has indeed learned the concept using the same game.

In addition to helping the daemon learn about a student, games can be a powerful modality for teaching by bypassing the traditional one-way direction of the teacher student relation and facilitating implicit learning.

Chess, for example, has been shown to develop logical thinking, personal responsibility, and risk analysis. Furthermore, studies have shown that students who learn and play chess do better across the board. To illustrate the time series behavior of the YED note the following sequence used by the chess coach[2] in a Waterbury CT grade school chess club.

1. At age 6 the YED would introduce the child to the Fritz & Chester program. To test the child's level of proficiency, YED would periodically initiate a game with a standard chess playing algorithm and gauge the level of play.
2. At the appropriate time, say around age 10, YED would introduce the student to Chess Master periodically checking on the student's progress.
3. When the student reached the necessary level of maturity, he/she would be introduced to RYBKA or Fritz.

The use of games as mentoring tools extends to the social and emotional domains as well as the cognitive domain. Games can be used to develop: role playing and competition [24], focus [30] and collaboration [25]. Specific attention has been given to games that can improve the social and emotional development of children with autism. [21. 23, 28, 30] One of the goals of

[2] We are indebted to Dave DaAngelis for many fruitful conversations on teaching Chess.

these games is to help autistic children learn to recognize emotional states in their interactions with other human beings [23, 28].

Just as we require assurance that our daemon is capable of learning how the student thinks and functions, we must be confident that the daemon is actually accomplishing its goal of teaching the student to learn what he/she did not know beforehand or to perform better at a specific task. Although methods exist for assessing the impact and effectiveness of new technology with respect to remediation [22], additional tools will be required to vet the scope of this proposal.

2.4 Ubiquitous Access

As with the fictional daemons, YED would always be available when needed. Since the daemon preserves state information, it would have to live in the clouds, i.e., it would exist as a function that could be accessed over a broadband connection to a PC, Smart phone, Smart TV, etc. Furthermore, if given permission by the student, YED would be able to determine when the student came on-line and autonomously request a connection. The daemon might have discovered something of interest to its protégé and set a reminder to bring it to his/her attention.

2.5 Putting the Pieces Together

We have discussed the individual components of the proposed daemon. The task at hand is to assemble the cross disciplinary team to build the application. The application must present itself as a coherent entity to the students so that the students will believe that YED understands them within the context of their educational life. If done correctly, YED will have passed the famous Turing test [16]. In the appendix we present 2 high level use cases of YED interacting with a student that illustrate the integrated functioning of all the components we discussed above.

3. CONCERNS, EXTENSIONS, AND NEXT STEPS

Recognizing that the very high level outline we have presented above is already quite ambitious, it would be unfortunate if we did not at least mention potential issues, extensions and next steps.

3.1 Concerns

Because YED has access to and manipulates personal information about its students, there are clear security and privacy issues that must be addressed. The daemon must also be completely autonomous and not subject to the control of outside parties, no matter how noble their intentions.

We also do not view the YED as a substitute for the teacher student relation but as an adjunct. YED can provide both parents and teacher with status updates and logs of its interactions with the student. However, even here, great care has to be taken to protect the privacy of the student and the integrity of the relation between YED and the child.

For the daemon to be effective in learning about the students it serves there must be significant and continuous interactions between both parties. This is one of the reasons that it must be always available, accessible over a multitude of media pathways and easy and pleasant to interact with. This will require a significant investment on the part of the student.

3.2 Extensions

In this short paper we have focused almost exclusively on the purely educational role of the daemon in its interactions with the student to which it is attached. The daemon, however, can serve multiple purposes and offer a wide variety of support to humanity. Here are a few.

1. It can reduce the possibility of the student falling behind by proactive monitoring of the subject's proficiency relative to the standard curriculum.
2. Assume the daemons are able to communicate with each other and share information about their charges' preferences, strengths and talents. This would allow them to create group events. This would allow them to create social interactions between likeminded individuals by opening communication and sharing of work and ideas. Chat rooms and internet facilitated conference calls can be set up either dynamically or by reservation.
3. It can provide the student an "always available" friendly playmate, where play and studying are interwoven.
4. It can provide an objective third party view of the student's strengths and weaknesses to both teachers and parents.

The second and third capabilities would be especially useful for students that are remote from urban centers or with disabilities that do not allow them access to other students on a regular basis.

3.3 Next Steps

In this paper, we propose that it is now feasible to develop an intelligent agent capable of learning the cognitive sand emotional structures of a child and which can then use that information to facilitate the child educational and social development. To move from vision to reality we propose the next steps.

1. Assemble a team of educators, psychologists, computer scientists and data networking specialists to create the design specifications for the daemon.
2. Provide a proof of concept that an intelligent agent can learn the developmental level of a student and then provide the appropriate set of remedial exercises, games and training packages that address the individual's needs. To accomplish this in a timely fashion we would narrow the focus to grades 6-8.
3. Create the high level software design for the daemon paying special attention to ubiquitous access and the data network infrastructure that would be required.

4. USE CASES

NAME	1.0 Math Homework
REFERENCES	Harcourt Math Teacher Edition; Assessment Material
DESCRIPTION	This use case will identify grade level achievement, identify and correct pre-existing knowledge gap, and test corrective action
ACTORS	Student, YED
ASSUMPTIONS	Student in grade 6 Homework: Linear equation
PRE-CONDITIONS	1. Math Homework can be downloaded form schools website 2. Harcourt Math Teacher edition (or equivalent) is accessible to YED 3. Math assessment software is accessible to YED
BASIC COURSE	1. Student starts to work on homework assignment 2. Student connects to YED via home computer 3. Student logs into school/classroom site to download math homework 4. Student starts solving simple equations 5. YED monitors the process and identifies mistake in the final result due to recurring mistake in simplification process. 6. YED accesses the assessment software and identifies cause as issue with division process (prime divisors) 7. YED communicates to student that the results of the equations are not correct due to above issue 8. YED downloads interactive material to explain prime divisors and division process 9. YED offers examples and exercises for the student to work 10. Student works the exercises. 11. YED tests the application by suggesting news equation to be solved 12. Student solves them correctly 13. YED verifies that student has learned the concept by checking that exercises are solved h correctly 14. Session terminates
POST-CONDITIONS	State information is written to YED memory. User model is updated to show attainment of proficiency with prime divisors

NAME	2.0 YED as Companion
NOTES	This experience can be achieved on application of a Smartphone (mobile device) or desk top
DESCRIPTION	This use case will use multi disciplinary e-educational game to keep the student engaged and challenged
ACTORS	Student, YED
ASSUMPTIONS	1. Student in grade 7 2. YED has learned the following profile of the student a) Short attention span b) Competitive c) Successful "multitasker" d) Limited vocabulary for the grade
PRE-CONDITIONS	1. Adaptive e-educational games accessible to the YED 2. Assessment software is interconnected with e-game
BASIC COURSE	1. Student accesses YED for entertainment purposes 2. YED suggests an adventure based challenge game 3. YED uses a multi-disciplinary game including social studies, science, and math 4. Within each challenge, the YED includes neologisms, along with the definition 5. YED observes that the student excels in social studies and math and increases the difficulty level for those areas 6. YED observes that the science tasks are not accomplished properly, therefore it decomposes the macro science challenge into intermediate steps, 7. YED analyzes the results of the game, compares against assessment data to identify potential gaps 8. YED identifies remediation steps. 9. YED stores the final conclusions 10. Session terminates
POST-CONDITIONS	YED will use the stored data to propose new interactions with the student, updates student profile

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Design and Development of a Medical School Curriculum Management System

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ABSTRACT

The objective of this research is to design and develop an online curriculum management system for medical schools. This involves relational database design as well as user process flow design. These two design charts were developed with careful consideration of user requirements. The Entity Relationship Diagram included several related tables: Courses, Sessions, Instructors, Calendars, Events, Objectives, and Keywords. The process flow diagram included process flows for several users: Students, Faculty, Coordinators, and Administrators. The database-driven website model was used to develop the system using MS SQL for storing and querying data, ASP as the web programming language, JavaScript for calendar event movements graphically and data entry checking, and AJAX for seamless page refreshing. Several online forms and pages were developed to accommodate input and output processes. While information gathering and interaction with eventual users is vital to the accurate and appropriate design of the system, it is possible to develop an online curriculum management system for medical schools which satisfies the needs of curriculum management at the Faculty of Medicine and Health Sciences, UAEU and is earnestly used and accepted.

Keywords: Medical school, curriculum, design and development, online management system.

1. INTRODUCTION

Data management systems are valuable tools for better management of medical curricula [1]. CurrMIT is such a tool widely used in the United States of America and Canada [2]. It uses a relational database containing curriculum information and instruction details such as outcome objectives, resources, content, educational method, assessment methods, and educational sites. CurrMIT, however, is not available for medical schools outside the US and Canada. The University of New South Wales, Faculty of Medicine in Australia has also developed a unique curriculum management system called eMed. This system provides integrated tools for managing graduate outcomes, content, activities and evaluation of programs [3]. They justify developing their own system rather than using best-of-breed subsystems available in the market because of their need for full integration and customization. The Faculty of Medicine and Health Sciences (FMHS) at the United Arab Emirates University (UAEU) found itself in the exact same situation and opted to develop its own curriculum management system.

2. BACKGROUND

For several years now the UAEU has been using an eLearning platform (Blackboard) for delivering learning content to students. While Blackboard satisfies the content delivery end of an electronic curriculum and is well suited for university courses, FMHS has a need to manage the curriculum in a different way because its course structures are different from typical university courses.

Most university courses have one instructor exclusively in charge of several students. They meet several times a week at set times for the whole semester spanning around four months. This instructor is responsible for taking attendance, writing and conducting assessments, as well as all other matters pertaining to the course. For the most part, eLearning systems are designed based on this course model.

At FMHS, however, there is an inherently different course model because of the integrated nature of the curriculum in a medical school. Each course at FMHS has many instructors (around 10-20). One of them is the coordinator who takes care of preparing the course timetable, collecting exam questions from the instructors, among other course management duties. Each instructor is responsible for his own lectures in the course which range from only one lecture to around 20 lectures. FMHS also has three distinct types of teaching sessions: Lectures (where typical or didactic teaching is performed), Tutorials (where students discuss topic and teach each other under supervision), and Practicals (typically conducted in the labs). The total number of sessions in the program are around 3,500 sessions of various types.

The medical curriculum at FMHS is six years long with around five courses yearly, each lasting about two months. Unlike typical university courses where the student may take several courses at the same time, at FMHS medical students register for only one course which takes up all their time. At the end of each two year period the students take a comprehensive exam.

3. METHODS

For several months, data gathering and interviews with key personnel took place in order to understand the specific needs of users. A relational database system was designed using a suitable entity relationship diagram (ERD) and process flow diagram (PFD). The system was designed using ASP, JavaScript, AJAX, and MS SQL Server. ASP was used as the programming language that performs all the processing, JavaScript was used for graphical on screen calendar manipulation and data entry checking, AJAX was used to refresh information on parts of the webpage rather than refreshing the whole webpage, and MS SQL Server was the Relational Database Management System utilized to store all the data regarding the curriculum. Dynamic web pages for input and output were developed to be clear, consistent, and user-friendly. Finally, user control was taken into account giving each user access to allowed information and processes only. Information gathering, needs analysis, development of data entry tools,

actual (automated) data entry, system development, testing, and launching took only 8 months from start to finish. Only one developer, the author, worked on the design and development of this system for half of his time using the needs analysis results as a guide.

4. RESULTS

Needs analysis for the users of this system, who are administrators, medical educators, course coordinators, teaching faculty, and medical students, produced the following needs list:

1. All users need to:
   a. View the course's general information.
   b. View the detailed session information.
   c. View the course timetable.
   d. Identify instructor time conflicts in the timetable.
2. Students need to:
   a. View their attendance record.
   b. View their grades record.
   c. Evaluate courses and teachers.
3. Faculty need to:
   a. View session titles and summaries in which they teach.
   b. View their personalized teaching calendar.
   c. View a help file for the system.
   d. Modify their own session summaries and objectives.
4. Course Coordinators need to:
   a. Modify the course's general information, session summaries, and timetable.
   b. Modify the instructors of sessions.
   c. Easily identify sessions that are not timetabled.
   d. Modify the timetable in a user-friendly, graphical fashion.
5. Course Administrators need to:
   a. Have same access as course coordinators.
   b. Have the ability to print out the course's general information and timetable.
   c. Enter and modify student attendance.
6. Medical Educators and College Administrators need to:
   a. Have same access as course administrators.
   b. View statistics regarding the system's use.
   c. View statistics regarding faculty teaching load.
   d. View statistics regarding departmental teaching load.
   e. Have the ability to search the curriculum for keywords and locate the place and amount of teaching of specific subjects graphically.

A suitable ERD was developed using the results of the needs analysis and relational database theory (partially shown in Figure 1). A suitable PFD was also developed and is partially shown in Figure 2.

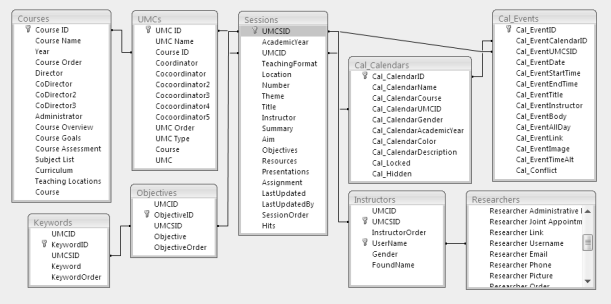

Figure 1. Partial Database Entity Relationship Diagram.

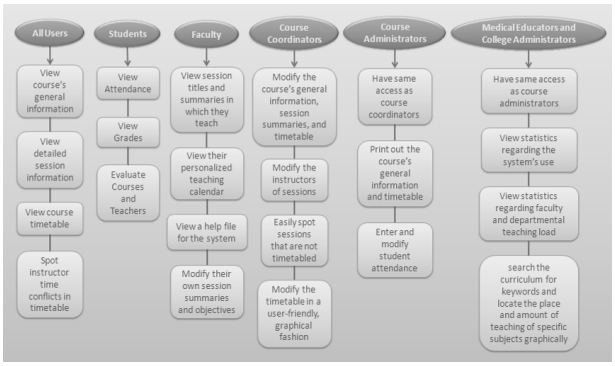

Figure 2. Partial User Process Flow Diagram.

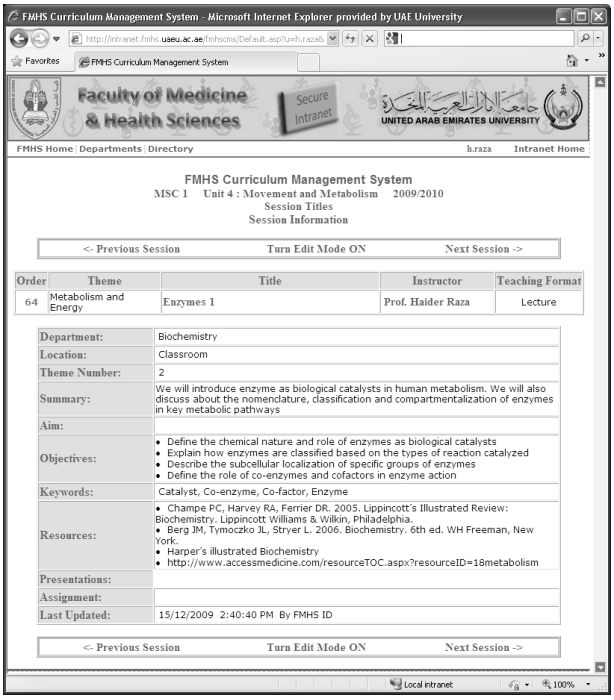

Figure 3. Snapshot of the editable session information page.

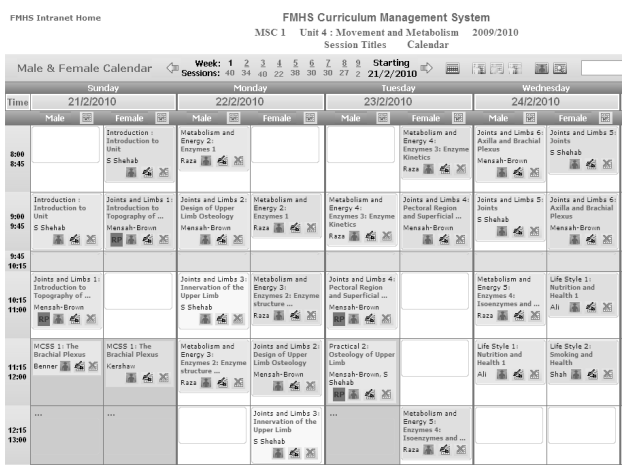

Figure 4. Snapshot of the graphically editable timetable.

5. DISCUSSION

Significant components of an electronic medical curriculum taken from the needs analysis of our medical college and a general idea of how other medical colleges operate could be as follows:

1. Overall course guidelines and objectives
2. Session information containing session title, instructor(s), teaching method, theme, summary, objectives, keywords, resources, assignments, and location.
3. Timetable of sessions
4. Personalized view of faculty teaching timetables
5. Attendance management
6. Student evaluation of course and instructors
7. Grade management
8. Map objectives at all levels with CanMeds objectives
9. Question banks and exam management
10. Logbook management (for clerkships)
11. Rotation management (for clerkships)

The first five items have been satisfied in our system. Previously developed evaluation and grades systems are fully integrated with our system. The last four items are currently being development.

Because of the key fact that in our medical curriculum many teachers teach in one course, both central and distributed management of the curriculum are important. In every part of the curriculum just mentioned there are components that need to be viewed and managed centrally by administrators and there are components that need to be viewed and managed by individual teachers, students, or staff.

Making available customized views for each user type is crucial to the success of the system in achieving its intended goals. These views must be made available with the correct level of information and the appropriate access rights depending on who the user is. For example, students and teachers should be able to view session summaries and course timetables. In addition, teachers should be able to modify session summaries for their own sessions only and view their personalized teaching timetable in all courses. The personalized teaching timetable is the most popular feature among faculty and is in itself an overwhelming reason to use the system. Significantly important features for course coordinators include the ability to graphically move sessions within timeslots, the ability to easily identify sessions which are not timetabled, and the ability to identify session with teacher conflicts.

The rapid development of this system using half of a man-power for 8 months is only possible due to high knowledge of and involvement in the curriculum, as the developer is also a user of the system as a teaching faculty member, course coordinator, and medical educator. In addition, past experience in developing such systems and keeping the design and tools used for development as simple as possible contributed significantly to the rapid development and deployment of this system.

On the other hand, the development of other curriculum management systems such as CurrMIT and eMed required at least a year of a handful of developers. Granted, these systems probably are more feature-rich than our system but our system is specifically designed to satisfy all the requirements found in the needs analysis and nothing else, and therefore it works well for us. In the future there may be a need to enhance the system with additional features which is easily possible due to the simplicity of the design and the availability of software developers using the tools used for development.

The next step is to allow for a period of use and then analyze the curricular data. There have been several such analyses on curricular data obtained from CurrMIT such as identifying what students are expected to learn, how they learn, and how they are assessed [4]. Another study showed that despite some difficulties, the resulting ease and accuracy of reports generation is extremely beneficial to course directors and curriculum oversight [5].

6. CONCLUSION

It is possible to design and develop an online curriculum management system for medical schools which satisfies the needs of curriculum management at the Faculty of Medicine and Health Sciences, United Arab Emirates University, Al-Ain, UAE. Information gathering and interaction with eventual users is vital to the accurate and correct design of the system. Applying the appropriate IT tool in the appropriate way is also critical to the success of the system. For example, using Javascript and AJAX, it was possible to develop a user-friendly calendar which allows for moving sessions within timeslots using drag and drop.

7. ACKNOWLEDGEMENT

I wish to thank the Faculty of Medicine and Health Sciences Medical Education Department for their input and support.

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Design and Development of a Generalized Clerkship Management System

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ABSTRACT

The objective of this research is to design and develop an online clerkship management system general enough to accommodate the needs of three groups of learners (medical clerks, interns, and residents). This involves relational database design as well as user process flow design. These two design charts were developed with careful consideration of user requirements from the three groups. The Entity Relationship Diagram included several related tables: Levels, programs, learners, administrators, learner absences, learner grades, and learner log entries. The process flow diagram included process flows for several users: applicants, learners (clerks, interns, or residents), faculty, program directors, and administrators. The database-driven website model was used to develop the system using MS SQL for storing and querying data, and ASP as the web programming language. Several online forms and pages were developed to accommodate input and output processes. While information gathering and interaction with eventual users is vital to the accurate and correct design of the system, it is possible to design and develop a generalized online clerkship management system which allows for the management of three different groups of medical learners.

Keywords: Clerkship, generalized, design and development, online management system.

1. INTRODUCTION

The automation of clerkship management processes by utilizing an electronic management system has introduced efficiencies into these programs. Online systems are even better because they allow for remote management of the program [1-5]. Some of these systems focused on learners documenting their experiences (electronic logbook) [4] while others on instruction and documenting learning objectives [2,5] and others focused on clerkship evaluation [3].

The purpose of this project is to design and develop a generalized online clerkship management system which allows for the management of three different groups of learners. These three groups are categorized by their academic level which are clerkships for fifth and sixth year medical learners, interns, and residents of the Faculty of Medicine and Health Sciences, United Arab Emirates University, Al-Ain, UAE.

2. METHODS

For several months, data gathering and interviews with key personnel took place in order to understand the specific needs of the users. A relational database system was designed using a suitable entity relationship diagram (ERD) and process flow diagram (PFD). An online system was developed using the ASP online development language. Dynamic web pages for input and output were developed to be clear, consistent, and user-friendly. Finally, user control was taken into account giving each user access to allowed information and processes only.

3. RESULTS

Needs analysis for the three groups produced the following needs list:

1. Applicants need to:
   a. Apply to the program.
   b. Upload their documents during the application process.
   c. Email updated documents after the application process.
2. Program Directors need to:
   a. Check the applications.
   b. Upload applicants' updated documents.
   c. Update the applicants' status and add comments.
   d. Approve applicants into specific programs.
   e. Add learners from scratch into specific programs.
   f. View and edit learner records.
   g. Manage rotations and assign learners to rotations.
   h. View logged activities by learners.
   i. Setup and manage multiple choice question exams.
   j. See results and statistics for these exams.
3. Faculty need to:
   a. View learner records assigned to their rotation.
   b. Evaluate learners assigned to their rotation.
4. Residents need to:
   a. View their learner record.
   b. Log activities during the rotation.
   c. Evaluate their faculty and their rotation.
   d. Approve their faculty's evaluation of them.
   e. Take multiple choice exams online.
   f. See their result for these exams.

A suitable ERD was developed using the results of the needs analysis and relational database theory (partially shown in Figure 1). A suitable PFD was also developed and is partially shown in Figure 2. Figures 3-5 show snapshots of the system.

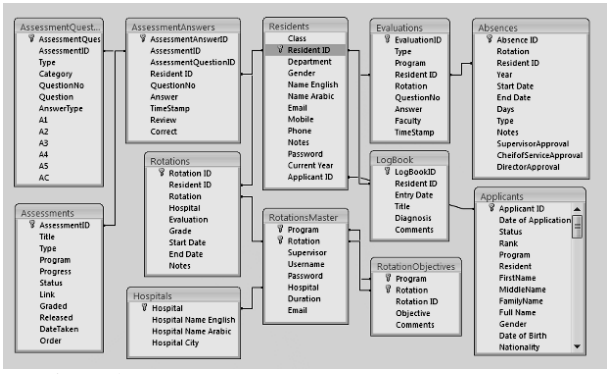


Figure 1. Partial Database Entity Relationship Diagram.

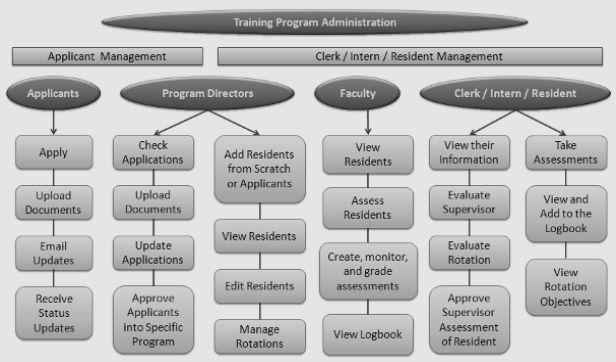


Figure 2. Partial User Process Flow Diagram.

Figure 3. Snapshot of the Resident Record Web Page.

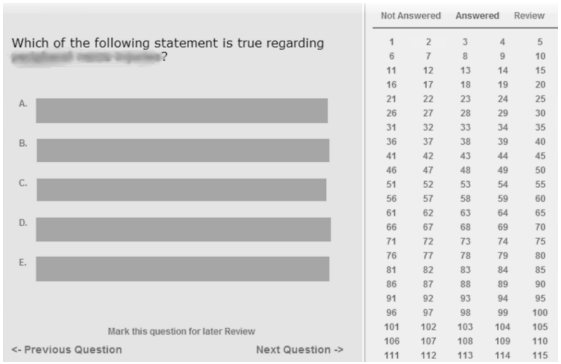
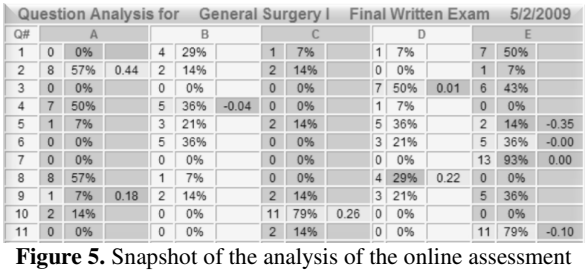


Figure 4. Snapshot of a question in the online assessment.



Q#	A			B			C			D			E		
1	0	0%		4	29%		1	7%		1	7%		7	50%	
2	8	57%	0.44	2	14%		2	14%		0	0%		1	7%	
3	0	0%		0	0%		0	0%		7	50%	0.01	6	43%	
4	7	50%		5	36%	-0.04	0	0%		1	7%		0	0%	
5	1	7%		3	21%		2	14%		5	36%		2	14%	-0.35
6	0	0%		5	36%		0	0%		3	21%		5	36%	-0.00
7	0	0%		0	0%		0	0%		0	0%		13	93%	0.00
8	8	57%		1	7%		0	0%		4	29%	0.22	0	0%	
9	1	7%	0.18	2	14%		2	14%		3	21%		5	36%	
10	2	14%		0	0%		11	79%	0.26	0	0%		0	0%	
11	0	0%		0	0%		2	14%		0	0%		11	79%	-0.10

Figure 5. Snapshot of the analysis of the online assessment showing percent correct and Point-biserial.

4. DISCUSSION

This project started as an online residency management system developmental project. It was interesting to later discover that clerkships and internships have very similar data and process management needs to residents. It was therefore possible to conduct a needs analysis for these two additional groups and add them to the system design with ease.

Although this is primarily a developmental project, it's worthy to note that the data gathering stage helped residency, clerkship and internship administrators better organize their programs. This is typical of systems design in that requirements analysis allows administrators to document as well as rethink many of their processes.

The system has been in use for over a year and feedback has been positive. Several suggestions have been implemented in the system to enhance its use. These include enhancing the way online exams are conducted and analyzed, as well as some user feedback issues when performing data entry.

The main obstacle faced was the lack of willingness of some users to use the system and perform simple data entry tasks. This is especially important in the case of program directors when entering rotation information since many of the system's processes depend on this information. More user training is needed to overcome this problem. Highlighting the advantages of such a system to the users will also help with overcoming this obstacle.

While there are some software packages that assist with the management of some aspects of this project, none satisfy all the needs identified during the requirements analysis phase. In addition, integrating several systems is difficult and customizing them to suit the user's needs is impossible without having the ability to modify these programs.

5. CONCLUSION

It is possible to design and develop a generalized online clerkship management system which allows for the management of three different groups of medical learners which are clerkships for fifth and sixth year medical learners, interns, and residents of the Faculty of Medicine and Health Sciences, United Arab Emirates University, Al-Ain, UAE. Information gathering and interaction with eventual users is vital to the accurate and correct design of the system. This step also allows program administrators to gain a deeper understanding of their programs.

6. ACKNOWLEDGEMENT

I wish to thank the Faculty of Medicine and Health Sciences Postgraduate Education Program for their input and support.

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Rotational Speed Control Based on Microcontrollers

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1. ABSTRACT

Currently, some kinds of control systems, although be simple, have much electronic components which are responsible for arithmetic and logical operations. These components set the microcontrollers, which are used for several control actions and their performance bases itself on processed signals for discrete systems or digitalized signals for continuous systems. In this work, are implemented the ON-OFF, P, PI, and PID controllers and their performance are evaluated at the rotational speed control of a mini wind turbine (cooler).

Keywords: Control Systems, Microcontrollers, PID Controllers, Rotational Speed and On-Off Controller.

2. INTRODUCTION

The classical or analogical control theory is relative to analysis techniques and design of systems which can be represented by continuous mathematical models in the time [1]. To compose an analogical control system, just analogical components as resistors, capacitors, operational amplifiers, etc., should be used. Besides, the components used as actuators should be also analogical as mechanical, pneumatical and electrical devices.

Currently, much of the control systems, although be simple, have their performance propitiated by a large quantity of electronic components, which set the circuits responsible for arithmetic operations as sum, subtraction, multiplication, division, derivation, integration, among others; and for logical operations like AND, OR, NAND, NOR, XOR, among others.

To make possible, logistically and commercially, the use of designed control systems, in the recent decades great efforts were undertaken in order to build structures to contain a great amount of circuits, with several functionalities in only one component. These structures are named microcontrollers.

The microcontrollers are used for a large variety of control actions and their performance bases itself on the premise in which the processed signals should be digital, if the system or process controlled is discrete; or digitalized signals if the system or process controlled is continuous [2]. Consequently, although for certain systems the analysis and design of the control base themselves on the analogical control theory, the control system is digitalized. The control system based on analogical control theory more largely used is the Proportional-Integral-Derivative action (PID), once its performance is considered satisfactory for most of systems and processes controlled.

In this work, is investigated the PID controller performance and its variations, P and PI, besides ON-OFF controller, for the speed control of a mini wind turbine (cooler). The controllers are implemented using microcontrollers, specifically the Mclab2 development platform.

3. CONTROL THEORY

A control system has the function of comparing the real value off the output plant to the reference input (set point), determining the deviation among them. With this deviation, the system produces a control signal to reduce to zero or a small value the deviation. In Figure 1 is shown a control system block diagram. The way which the controller produces the control signal is denominated control action [1].

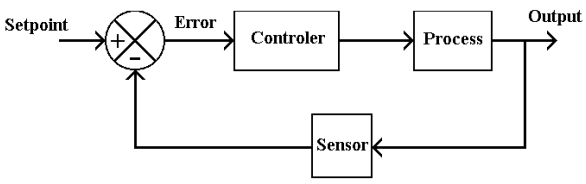


Figure 1. Block diagram of a control system.

The controllers can be classified in accordance to their control actions:

- *On-off* Controller;
- Proportional Controller;
- Proportional-Integral Controller;
- Proportional-Integral-Derivative Controller.

On-Off Controller

For systems of two positions, the active element has only two fixed positions, or simply on-off. This control type is relatively simple and cheap; hence it is often used for domestic and industrial control systems [3].

The output controller signal is *u(t)* and the active error signal is *e(t)*. In the control of two positions, the signal *u(t)* stays in a maximum value or in a minimum value, if the signal of active error is negative or positive.

Thus:

$u(t) = U_1$, for $e(t) > 0$ (1)

$u(t) = U_2$, for $e(t) < 0$ (2)

Where U_1 and U_2 are constants and the minimum value U_2 is usually zero or $-U_1$.

In Figure 2 are presented the block diagrams of two positions controller. The interval in which signal of active error should vary before the commutation is denominated differential interval. The differential interval, shown in Figure 2(b), allows the output *u(t)* of the controller maintaining its current value until the signal of active error has changed lightly besides the value zero.

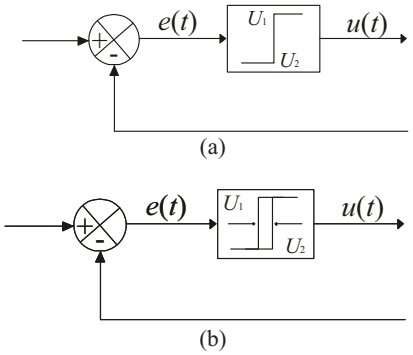


Figure 2. Block diagram of on-off controller (a); block diagram of on-off controller with differential interval (b).

The disadvantages of this controller are the oscillation of the output around the set point (control point) of the controller; hysteresis; not guaranteeing precision, but an approximation of the controlled variable.

Proportional Controller (P)

For a proportional controller the relationship between the controller output *u(t)* and the active error signal *e(t)* is:

$$u(t) = K_p e(t) \quad (3)$$

Using the Laplace Transform:

$$\frac{U(s)}{E(s)} = K_p \quad (4)$$

Where K_p is named proportional gain.

This controller is relatively simple and of low cost, however, in some cases, depending on the system to be controlled, it cannot reach the wanted stability, besides generating permanent oscillation, in according to the tuning of its gain. When the current value is equaled to the set point, this controller presents a steady-state error, with the tendency to stay a little below of the control point, harming the precision of this strategy.

Proportional-Integral Controller (PI)

This action is defined by:

$$u(t) = K_p e(t) + \frac{K_p}{T_i} \int_0^t e(t)dt \quad (5)$$

The controller transfer function is:

$$\frac{U(s)}{E(s)} = K_p \left(1 + \frac{1}{T_i s} \right) \quad (6)$$

Where T_i is named integrative time.

This control uses the combination of P and I controllers. The integrative part eliminates the steady-state error presented by the proportional part, however it presents long response times.

Proportional-Integral-Derivative Controller (PID)

The combination of the proportional, integral and derivative control actions sets these controllers, which are denominated proportional-integral-derivative. The controller equation is:

$$u(t) = K_p e(t) + \frac{K_p}{T_i} \int_0^t e(t)dt + K_p T_d \frac{de(t)}{dt} \quad (7)$$

And the transfer function is:

$$\frac{U(s)}{E(s)} = K_p \left(1 + \frac{1}{T_i s} + T_d \right) \quad (8)$$

Where T_d is the derivative time.

The block diagram of the PID controller is shown in Figure 3.

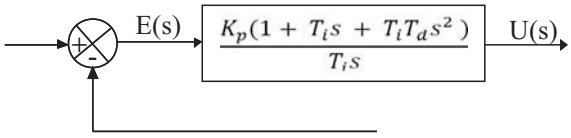


Figure 3. Block diagram of the proportional-integral-derivative controller.

Each one of the variables can be tuned independently in according to the characteristics of the system to be controlled. Therefore, the characteristics of the PID controller are:

• The proportional controller presents steady-state error;
• The integral controller has the effect of eliminating the steady-state error, but can make the transient period more long;
• The derivative controller has the effect of reducing the rise time, making the response time shorter.

4. EXPERIMENTAL PLATFORM

The application of the speed control was developed using the Mclab2 development board (Mosaic), shown in Figure 4. This arrangement allows the use of several functionalities of the PIC16F877A microcontroller of Microchip [4, 5].

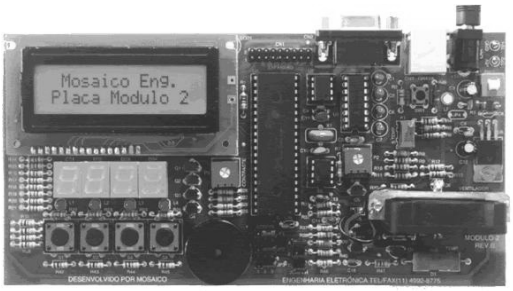
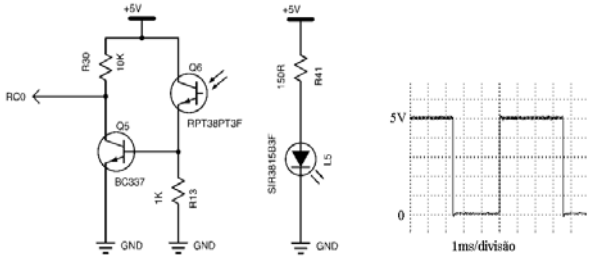


Figure 4. Photography of the Mclab2 development board.

In the development of this work were used the circuits of the tachometer and cooler driver. The tachometer consists of a sensor of barrier, set up using a LED infrared and a phototransistor. The sensor is responsible for monitoring the passage of each propeller blade.

The voltage signal generated by the tachometer, shown in the Figure 5, is inserted in the microcontroller using one of their digital inputs. Monitoring the time between the descent borders of this signal, the cooler rotational speed is calculated. The signal in high and low logical levels represents the presence and absence of blade front to the sensor, respectively.

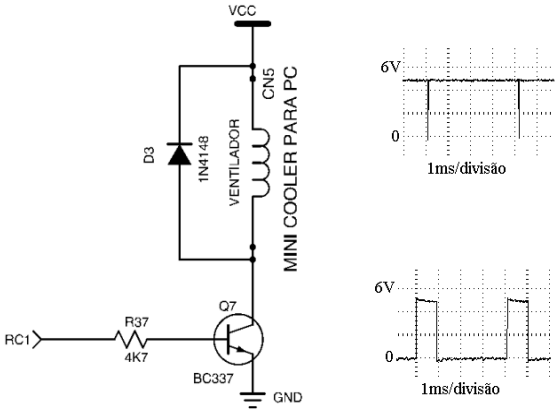


(a) (b)

Figure 5. Tachometer circuit (a) and output signal (b).

Set point is adjusted using a potentiometer which will apply a voltage signal to the analogical input of the microcontroller. The reference signal is adopted, for whole the experiment, as being 1400 rpm.

For driving of the cooler, is used a signal modulated by the pulse width (PWM – Pulse Width Modulation), result of the action of the circuit shown in the Figure 6. This signal is produced by the microcontroller and applied in the cooler. The signal produced by the microcontroller possesses levels of 5 V and it is amplified for 12 V, before being applied to the motor which drives the cooler.



(a) (b)

Figure 6. Cooler driving circuit (a) and PWM signals with 25% and 100% of duty cycle (b).

For P, PI and PID controllers are used duty cycle variable values between zero and 100%. For the ON-OFF controller the duty cycle used is zero or 100%.

The results presented in the graphs are acquired by the serial interface of the microcontroller. To each 38,4 ms are sent set point values and the measured speed to PC. With these data it is possible to evaluate the performance of the control along the time.

The firmware, programs that accompanies the microcontroller, was developed in C language [6, 7]. The used compiler was PCW Compiler (CCS - Custom Computer Service).

5. EXPERIMENTAL RESULTS

Controllers ON-OFF, P, PI and PID were implemented. The last three were syntonized using the Ziegler-Nichols first technique. In Table 1 are presented the values of d (dead time) and the time constant T, which are represented in Figure 7. Using these values is possible to obtain the parameters T_i, T_d e K_p, useful in the parametrization of respective controllers [8]. These values are presented in Table 2.

Table 1. Parameters by Ziegler-Nichols first technique

Parameter Z-N	Time (ms)
T	840.0
d	195.0

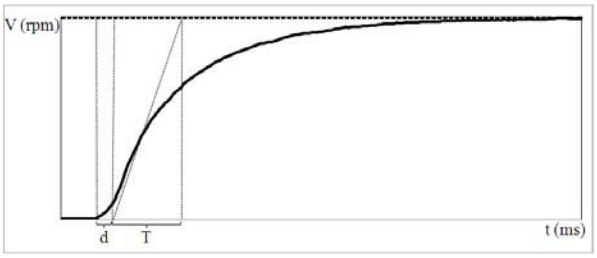


Figure 7. Response to step input.

Table 2. Parameters for the P, PI, PID controllers from Ziegler-Nichols

Controller	K_p	T_i	T_d
P	4.308	∞	0
PI	3.877	0.650	0
PID	5.169	0.390	0.098

For the analysis of results were acquired the speed values, for an input step, illustrated in Figure 8. To give support to the controllers analysis, the relevant variables were synthesized in Table 3.

The analyzed factors are: set point time, accommodation, overshoot and quadratic medium error. The first measures the time for the controller to reach the set point, the second represents the time for the control to stabilize the quadratic medium error, the third measures the difference between the set point and the maximum value reached by the controller and the fourth indicates the quadratic medium error observed after accommodation time.

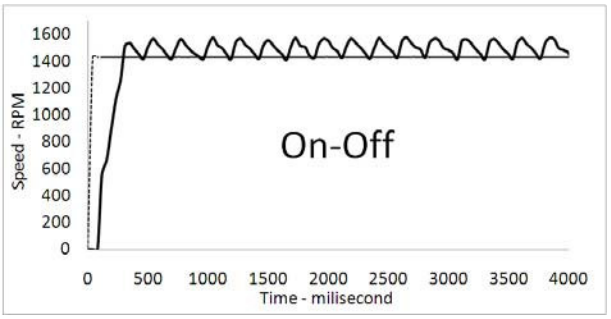
In according to qualitative analysis of the Table 3, the ON-OFF controller arrives the reference and it stabilizes more quickly than all the other controllers, however presents a quadratic medium error of 4.098%, the largest among the tested controllers.

The P controller possesses values of set point time and stabilization very close to the ON-OFF controller. The quadratic medium error in the steady-state is sensibly smaller. However there is occurrence of a larger overshoot when compared to the previous.

The PI controller, differently of the other controllers, needs a larger time to reach the reference and to stabilize. However it demonstrates no overshoot and a quadratic medium error smaller than ON-OFF and P controllers.

The PID controller, although presenting a considerable overshoot (20.50%), possesses the smaller quadratic medium error in stationary regime and it gets to arrive to the reference in an intermediate time between the extreme of the ON-OFF and of the PI controllers.

The system with the parameters presented in Table 2 was submitted to a braking of the cooler. The results are presented in Figure 9 and in Table 4.



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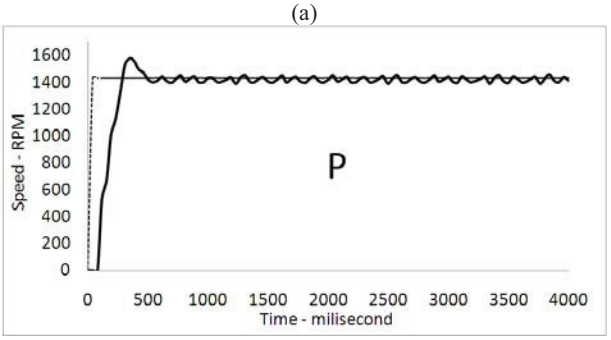

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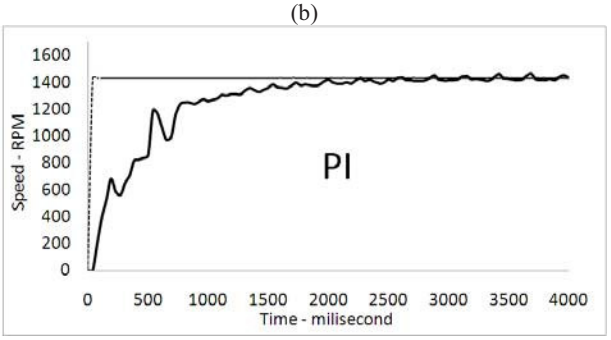

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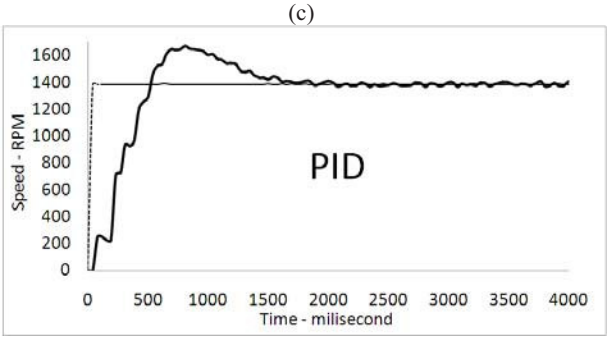

(d)

Figure 8. Response to step input with Set point in 1400 rpm for the ON-OFF (a), P (b), PI (c) and PID (d).

Table 3. Obtained results for step input

Controller	Set point time(s)	Accommo-dation time (s)	Over-shoot (%)	Quadratic medium error (%)
ON-OFF	0.307	0.346	6.93	4.098
P	0.307	0.384	10.02	1.334
PI	2.342	3.418	0.00	0.725
PID	0.768	1.920	20.50	0.716

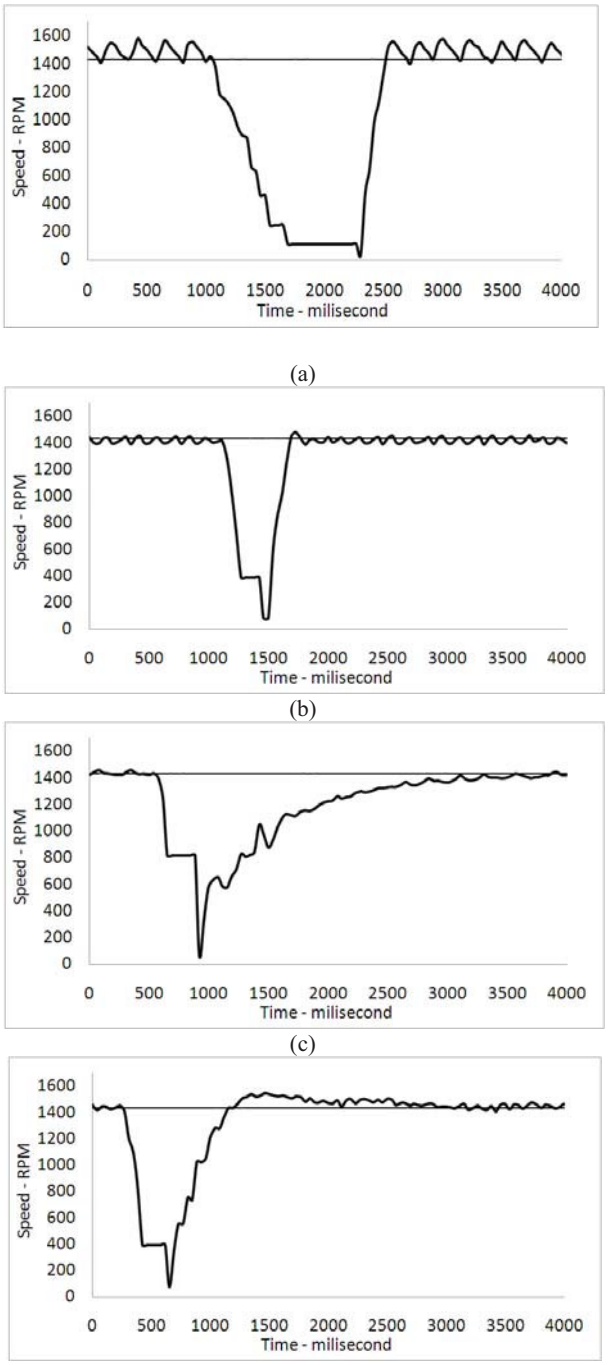

Figure 9. Braking response with Set point in 1400 rpm for the ON-OFF (a), P (b), PI (c) and PID (d) controllers, respectively.

It is verified, that the quadratic medium error stays approximately the same ones. The overshoot increases for the ON-OFF controller, while it presented decreasing for the others controllers. The accommodation decreases for the PI controller and increases for the others controllers. The set point time increases PI controller and decreases for the others controllers.

Table 4. Obtained results with disturbance with set point in 1400 rpm

Controller	Set point time (s)	Accommo-dation time (s)	Over-shoot (%)	Quadratic medium error (%)
ON-OFF	0.230	0.422	8.74	4.373
P	0.230	0.461	3.01	1.087
PI	2.957	3.072	0.00	0.956
PID	0.576	2.266	7.00	0.721

6. CONCLUSIONS

In this work, the results provided by classic controllers implementations were presented, in this case, ON-OFF, P, PI and PID, using a microcontroller to control the speed of a mini wind turbine (cooler). The monitored variable is the cooler speed, while the controlled parameter is the voltage applied in cooler.

It was verified that the smallest error in relation to the reference signal was obtained with PID controller, which is more robust than the others implemented controllers, but that presents the largest overshoot. For applications where the overshoot should be considered, PI controller can be used, since the time to reach the reference is not a crucial parameter for the design. For this last case, controller P would be the most suitable.

For future works, it intends to control the speed of the cooler in order to maintain constant the relationship between this speed and the wind speed, and thus to use the control techniques implemented in real wind turbines.

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Enhancing of security on critical accident locations using telematics support

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Abstract:
This article focuses on decreasing of transport accident frequency on critical accident locations. Main part of article describes risk assessment in case of road transport. The attention is paid on transport infrastructure, transport means as well as system, which is dedicated to road transport management.

Key words: security enhancing, critical accident locations, risk evaluation

1 Introduction

In central and eastern European countries is the highest ratio of people who tragically die or are injured compared to others EU countries. EU "White paper" defined task to decrease mortality in transport by 50% for these countries in period 2000 to 2010. This task involves all inhabitants. The process of enhancing security in transport is complex and includes complete transport system, which is – transport infrastructure, transport means, methods of transport traffic management, legal environment as well as inhabitant as traffic participant. According to results of analysis, most people die and are injured in road transport - therefore the content of the article will be oriented only on road transport. For successful fulfilment of mentioned tasks it is essential to apply certain measures in all mentioned areas. The article presents analysed tasks, which are based on analysis of state of transport infrastructure. Further presented tasks are based on analysis of transport means and methods of transport traffic management. The measures, which are inferred from state of legal environment and inhabitants' behaviour (who are traffic participants) are also very important.

2 Analysis of present security state on critical accident locations

In recent years authors and their workstations were cooperating on many projects, which were oriented on security issues. The issues we were working were on all levels, from global, regional as well as issues of local security – security of individual objects. This analytical activity was based on risk evaluation methodology – look at table n.1.

Table n. 1 Transport risks evaluation methodology

Risk evaluation	1. Circumstances – relation to environment	Investigate particular object in relation to surrounding environment- to look at transport system from different angles.
	2. Threat identification and defining of assets	To choose particular location in transport infrastructure- for instance tunnel, to identify all theoretically possible threats = p and to set values to all assets = d.
	3. Risk analysis	Create risk map – qualitative and quantitative methods. To decrease unacceptable risks. To eliminate risks, which remaining risk is unacceptable.
	4. Risk valuation	Measures aimed to active risk policy.
		Prevention, risk transfer, reserves creation.
		To choose and apply proper methods.

Mentioned methodology was applied on transport system. The article works out with first and second point of transport risks evaluation methodology. The analysis is using terms from theory of transport systems, and focuses primarily on these issues:

1. **transport infrastructure** – junctions, roads, routes,
2. **transport means** – driving, driven,
3. **traffic management systems** – operational – intelligent IS, telematics applications,
4. **legal frame** – international conventions, laws, regulations, directives and technical standards,
5. **people** – employees and other participant of transport traffic (passengers, bystanders, people living close to road, etc.)

2.1 Analysis of transport infrastructure security

Road transport infrastructure consists of highways, road, local roads, junctions, road bridges, road tunnels and crossings with other transport means (most often it is railway crossing).
First task is to describe relation of system to surrounding environment. Particular transport object, for instance railway crossing can be seen as individual system with defined structure and functions. Crossing itself is in relation to surrounding transport network viewed as limiting element. These limitations have technical character underpass height and width, as well as time character – they are related to transit of trains. Technical characteristics of crossing depend on road and railway classification. In our countries, it is forbidden to build crossing of highway and railway on the same level. The

same pattern is used also in case of 1st class roads and international corridors. On the other hand, in case of new high-speed railways all crossings are built as elevated crossings. Frequencies of using of railway as well as frequency of using of road are two most crucial features for defining technical equipment of crossing.

Figure n. 1 Vertical road sign on railway crossing
Source: www.ipravda.sk, 2.12.2009

In case of crossings with very low usage frequency, it is sufficient to use vertical road sings – see figure n. 1.
More frequently used crossings usually have warning lights signalisation. In certain specific cases, the security is enhanced by railway gates. In Slovak republic, there are 2200 crossings, where 20-30 people die every year. Other important factors, which can influence crossing security, are local natural and urban conditions. There are crossings, where the main factor for occurrence of extraordinary event is weather – fog, snowing, and heavy raining.
On the other hand, some of human impacts, like other constructions, vegetation, light conditions and so often lead to tragic accidents. Therefore in certain cases it is inevitable to rebuild such crossing into elevated crossing.
To analyse mentioned objects it is necessary to integrate them into suitable overview tables – look at table n.1. This process corresponds to point two in risk evaluation – we execute threat identification and thereafter we define possible impacts of extraordinary event.

Table n. 2– Probability of transport object threatening

Type of occurrence	Class	Frequency of occurrence in region	Time effect of threat
5 – Very high	A	Event appears very often (almost daily)	Continually
4 – High	B	Event appears occasionally (once in a month)	Often
3 – Medium	C	Event appears rarely(once in a year)	Rarely
2 - Low	D	Event appear abnormally (once in 20 years)	Abnormally
1 - Very low	E	Appearance of event is almost impossible (less than once in 100 years)	Almost impossible

Source: Balog et.al.

Table n. 3 – Impacts of extraordinary event in case of transport object

Type of impact	Category	Impact description
4 - Catastrophic	I	Great loses on lives and property, long-term shutdown of transport object, long-term and serious impact on surrounding environment.
3 – Critical	II	Certain loses on lives, serious injuries, great loses on property and damage on natural environment.
2 – Marginal	III	Injuries, low loses on property, partial damage on natural environment.
1 - Negligible	IV	Traffic limitation – traffic jams with no accidents or injuries.

Source: Balog et.al.

For risk calculation we have to define impact of extraordinary event - (crisis situation). Impact classification according to used methodology is shown in table n.2.
Application of previous characteristics on particular objects can be done in following way. As a model situation we choose road D3 in town Čadca. There is a segment, with length 2km, where are located different objects, which can fundamentally influence functioning of transport infrastructure. Figure n.2 shows particular road segment from air view.
First part of road segment, the road goes op on a slope, which had to be indurated, because of low soil stability. This part is followed by bridge and entrance to tunnel. After passing the tunnel we get to sharp left side curve, the road continues as scaffold bridge up to main crossroad in town Čadca.
After approximately 500 metres, there is railway crossing with warning lights signalisation. Due to the location and altitude of town Čadca, investigated road segment is influenced by freezing temperatures for approximately 100 days of a year. This fact in combination with fogs, heavy snowing or heavy raining defines this segment to be risky.

Figure n. 2 Air view on segment of model road D3
Source: www.mapy.sk 2.12.2009

2.2 Analysis of transport means security

Issues connected to transport means security is question of its technical security. Automobile producers and producers of other transport means pay lot at attention to technical security issues. People according to their financial situation prefer transport means, which offer higher security standards.

If we have a look on transport means as an individual subsystem, than it is possible to identify different factors from surrounding environment influencing such subsystem. It is primarily present state of transport infrastructure, weather, physical and psychical state of driver and crew, state of transported cargo and other factors. [3]

Due to defined methodology, second point is threat identification. If we want to investigate technical security it is necessary to have a look on internal and external factors. Internal factors are – state of major sets of transport mean – brakes, driving, motor, and body shell. While investigating external factors it is important to focus on state of infrastructure – its construction and operational features. If we find out, that, quality of road after winter is very bad, but number of transport means using that road is relatively low, than the probability of extraordinary event appearance is relatively low. If the road is in good conditions, but intensity of its usage is high, than the probability of extraordinary event occurrence is relatively lower. The worst variant is in case of road in bad technical conditions and high volume of transport – in such case the probability of extraordinary event occurrence grows rapidly.

Second point of mentioned methodology helps us to define possible consequences of extraordinary event. Transport mean is constructed and designed in order to minimize threats connected to transported persons and cargo. Special attention is paid in case of transports which include important people, dangerous and sensitive materials. Technical conditions of cargo – especially in case of dangerous materials can be crucial element threatening transport security as well as security of transport mean. In case of transport of explosive, highly flammable and radioactive materials it is necessary to provide perfect technical conditions of tankers as well as transport cases. We can say that transport of persons and transport of dangerous and sensitive products requires 100% technical conditions of transport means. In case of extraordinary event, these vehicles can be destroyed together with its surrounding. (In case of explosion of tanker, which transports gasoline, the fire and explosion can hit object up to the distance of 50 metres.

If we want to apply content of tables n.1 and n.2 to analyse risks of particular transport mean, we have to assess in detail all its sets as well as cargo state. For better imagination, we can assess cistern truck, which is transporting gasoline – look at figure n.3.

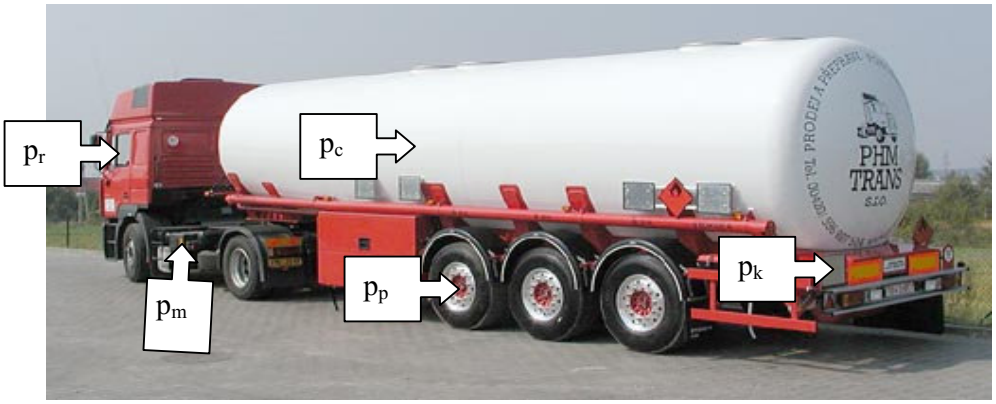

Figure n. 3 Cistern truck with identified threats, Source: Author's photo archive

Total probability of extraordinary event occurrence can be described as sum of probabilities, which can cause extraordinary event. Total calculated value is derived from relation:

$$P = p_m + p_p + p_r + p_k + p_c \quad [1]$$

where p_m is probability of motor failure
p_p is probability of wheel frame failure
p_r is probability of driving failure
p_k is probability of body shell elements failure
p_c is probability of cistern failure

As a possible impact, we can look at financial value of transported gasoline, which can be calculated as transported litres times 1 Euro. Further on, we have to add price of cistern truck and value of driver's life. Total estimated cost is 300 000 Euro.

2.3 Analysis of road traffic management systems

Development and production of road traffic management systems has rich history in central Europe. In past years there is rapid growth in application of technical facilities and technologies, which are known as intelligent transport systems. Basic tool for their application is KAREN methodology. Structure used in Europe is in figure n. 4.

National programme of support for intelligent transport system was signed in 2009 in Slovak republic. One of its parts is proposal to create national transport information system. Structure of proposed national transport information system is presented in figure n. 5.

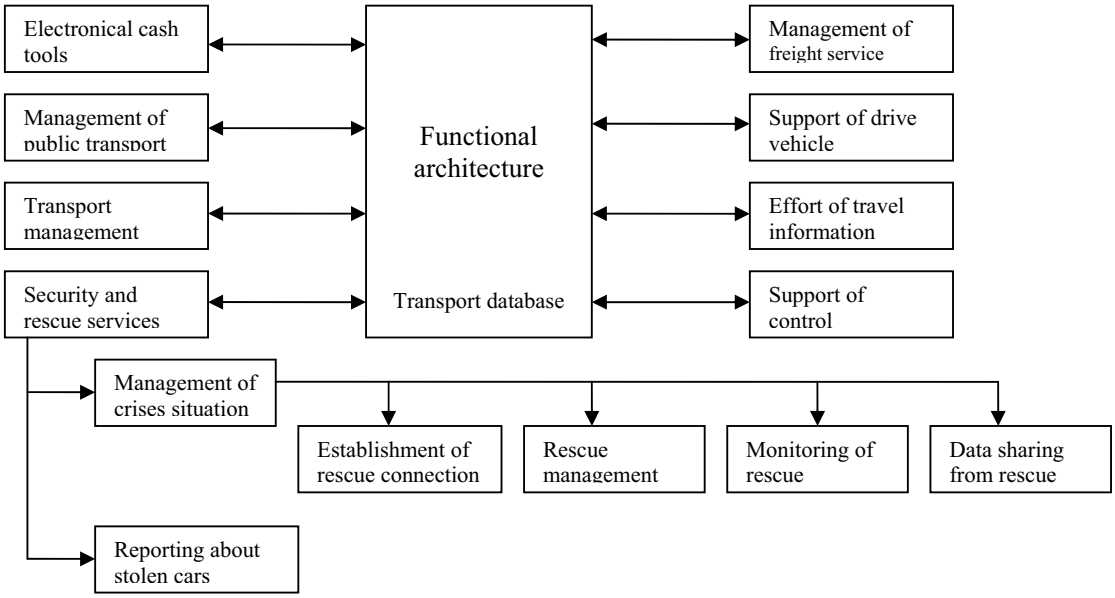

Figure n. 4 KAREN functional architecture Surcce: [2]

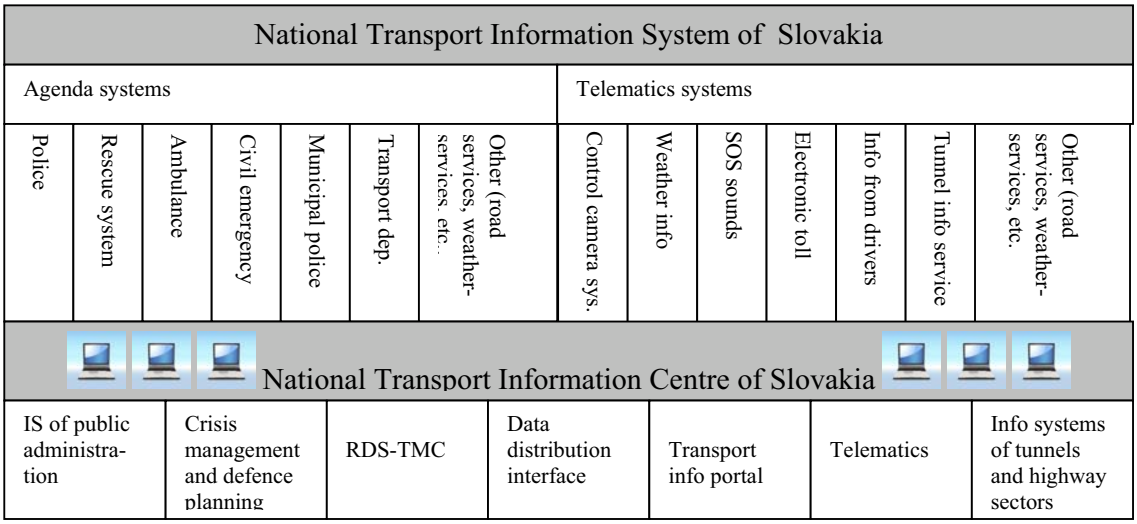

Figure n. 5 National transport information system in Slovakia, Source: [4]

If we want to assess level of road transport management, we should have a look on solutions, which are now used in Germany. In this country they use variable electronic road signs on highways and 1. class roads as a standard. In eastern European countries is building of such modern road signs is the task for next years.

3 Conclusions

In future we will present other project results – influence legal frame on road traffic security and influence of human behaviour. The research itself will be oriented on security enhancing on critical accident locations.

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Dangerous goods transport impact assessment to the environment

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Abstract

In this article there are presented new procedures and methods applied to calculation of environment exposure by dangerous substances outflows in road transport.

Key words

Ecological risks, dangerous substance, exposure, probit function, bandwidth

1 Introduction

Since 2008 there is solved the project BIOTRA in the Czech Republic, which is covered by National research program. The project is aimed for methodology creation of ecological risks evaluation associated with dangerous objects transport in special view of environment biotic elements. The result of the project BIOTRA it will be the decision making software tool for ecologically considerate transportation alternatives selection, which will allow also determine recommended routes for dangerous goods road transport.

2 Road transport risk assessment

Standard methodic of present and planned traffic way effect evaluation to the environment is oriented to exhalation, dustiness and noise assessment by common traffic. The part of road transportation risk analysis is also the possibility of a vehicle accident connected with dangerous substance outflow. The probability of a major accident is low but the consequences may be large. At present, there is no methodology, which may allow complex road transport risk assessment in light of dangerous substance potential outflow consequences for the environment.

The risk analysis represents complicated process even if the algorithms for exposure and population jeopardy modeling in consequence of fire, explosion or toxicity can be found in technical literature. The trait of such problem is individual and social risk assessment in potentially affected area. The risk is possible to quantify and for its acceptability decision making is this quantification even necessary. Quantitative assessment represents an exposure. It is a numeric value (e.g. estimated number of deaths caused by an event per year) or numeric function, which describes the relation between probability and consequences of existing hazard. The hazards may be machines, activities or technologies, but also different objects or processes which endanger humans or environment. Generally the risk is the product of dangerous event probability and its consequences.

3 Potential dangerous substance outflow

The significant danger for transport, human health and environment is the dangerous substance transport. By traffic accident there are some following characteristics:

- The substance quantity is limited by transport vessel capacity (road tank, tank car),
- the escape time is limited by the vessel discharge; it is assumed the worst case, which is the instantaneous outflow of whole tank volume to the environment,
- the outflow location is not known in advance, it may be situated wherever on the transport route.

Tab. 1: Total number of road accidents with dangerous substance participation

Road transportation		
Group	**Substance**	**Road accident total**
A	**Ammonia**	**285**
B	Coal - oil	3606
B	Coal -oil products + crude oil	362
B	Liquid hydrocarbons	14
B	Oil	0
B	**Oil products - total**	**3982**
C	**Gas**	**3646**
D	Hydrochloric acid + Hydrogen chloride	208
D	Phosphoric acid	15
D	Sulphuric acid	183
D	Nitric acid	66
D	Acid	13
D	**Acid - total**	**485**
E	Bottle gas	311
E	Butane	13
E	Butadiene	4
E	Propene, propylen	50
E	Propane	24
E	methane, natural gas	1105
E	**Gases**	**1507**
F	**Chlorine**	**67**

4 General procedure of calculation of dangerous goods road transport accident probability

Based on accident frequency data in defined period there is necessary to investigate the accident frequency level of vehicles which transport some dangerous substance. For the purpose in research it is necessary to have information about:

- accident source,
- accident rise time,
- accident reasons,
- accident participants.

Accident probability evaluation by dangerous goods transport has the following steps:

1. Getting statistic data about the number of accidents by dangerous goods transport in past period
2. Accident distribution according to accident source, time, reasons and participants.
3. Vehicle accidents probability calculation of the whole number of dangerous goods transport.
4. The distribution of gained probability values to the intervals.
5. Accident result transfer to the way network with transport frequency accepting.

The accident source is in our case single transport network stretch by every concrete transport line with relief morfology data, environment element identification, transport infrastructure characteristic and accident frequency evidence in given sector.

With this step there was primarily necessary to implement inventory of available information with their content relevancy test from traffic accidents evidence by defined requirements.

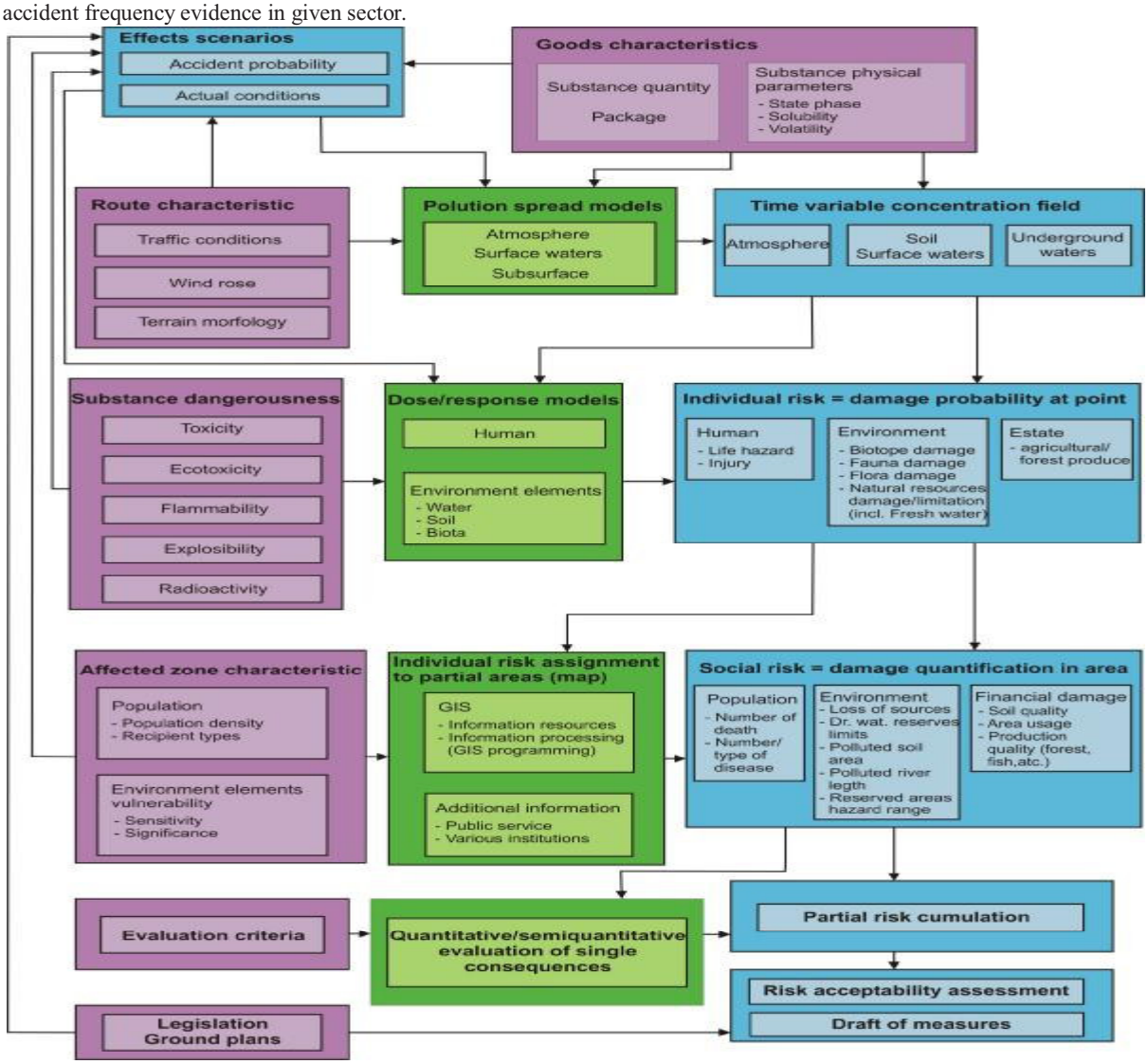

Figure 1: Human and environment risk assessment by dangerous substance transport diagramm

Input parameters have red color, models - green color and single evaluation steps - blue color. Basic input parameters are information about dangerous substance volume, chemical and physical parameters and substance dangerousness. The next input information are transport route characteristics, both in light of cant and directional rates, and in light of relief morfology and weather conditions in given area. Based of these data it will be realized a selection of possible effect scenarios and a choice of equivalent models of substance dispersion in the environment.

By modelling there is necessary to enter dispersion conditions. By reason that it is a potential accident, which can occur in different points of traffic route and in different seasons, there is necessary also to thing over different combinations of event place and time actual conditons. It is necessary to choose representative combinatios – often leading to major or respectivelly insignitificant consequences. To each chosen combination it is necessary to determine its occurrence probability, whereas the sum of these probabilities is equal to 1.

5 Outflow calculation and display from stationary sources

The dispersion models result (air-borne spread, fire, explosion, spilling) is time variable concentration field of escaped substance. Generally it is calculated several concentration fields for chosen conditions combinations. Concentration field and substance dangerousness parameters are inputs for respondent answer models to negative impact. Negative impact (toxicity, thermal radiation, shock wave, radioactive radiation) is necessary to quantify. It happens by the help of exposure dose calculation, which represent physical, chemical and biological effects depending on substance concentration and action time.

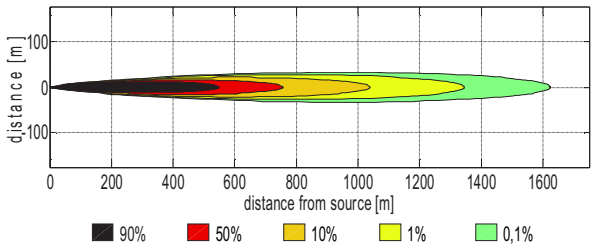

Figure 2: Example of human death probability by toxic exposure in dependence on source distance (instantaneous outflow 1000 kg NH3, atmosphere stability class E, wind speed 1,7 m/s)

6 Social risk

Social risk = Accident probability x consequences.

Consequence = exposed human death probability x The number of threatened people.

Unit individual risk = Individual risk for ever-present unprotected person by unit accident probability.

Unit social risk = Individual risk modified according to presence period, protection level and number of threatened people by unit accident probability.

Death probability is different for group of people according to their protection level (reduced individual risk according to cathgories).

Unit social risk

$$SR_j = \sum\left(IR_j \cdot \sum\left(H_i \cdot h_i\right)\right)$$

Where IR_j is unit individual risk in *j*-partial area,

H_i number of people *i*-cathegory in *j*-area,

h_i people protection level coefficient i-cathegory

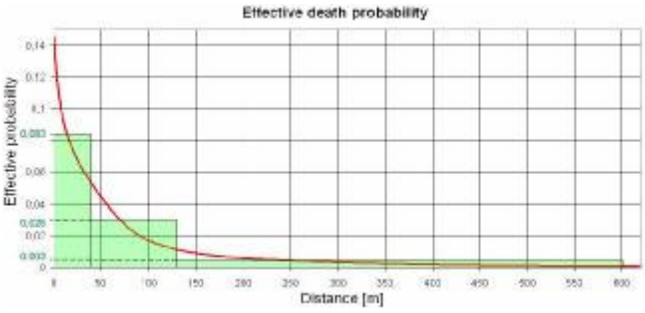

Figure 3: Effective death probability depending on the distance from the source

Tab. 2: Polygon parameters

Interval Index *j*	Probability interval [%]	Distance r_j [m]	Average probability in the interval P_j [%]
1	>5	40	8,3
2	5 - 1	130	2,6
3	1 - 0,1	600	0,3

Unit social risk

$$SR_j = 0{,}136 \cdot \left(0{,}083 \cdot H_1 + 0{,}026 \cdot H_2 + 0{,}0034 \cdot H_3\right)$$

7 Data import to GIS

For import to GIS software it is useful to define areas with approximatelly identical individual risk value. Individual risk decreases from accident source. When we do not thing over wind direction, then the individual risk is distributed round about source uniformly. In examples shown below the polygons have annulus form, but generally it is possible to define any areas.

8 Outflow calculation and display from mobile sources

The mobile source moves on the defined trajectory. The accident can happen at any point of trajectory, but only at one point for concrete transport. Individual risk at one point round about the road is given by the sum of risk from single road segment. The situation is schematically shown on the figure 4.

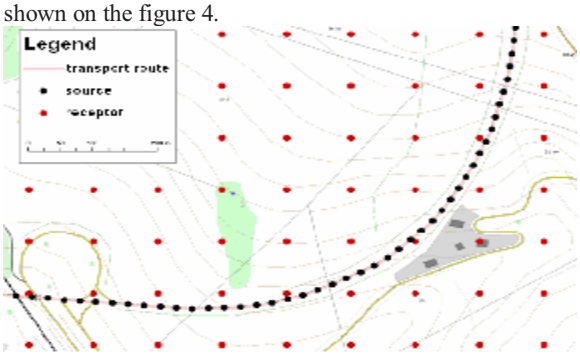

Figure 4: Schema of segments road distribution and reference point network lay-out.

The road is divided into small segments *s* so, that the distance *r* between reference points $[x_s, y_s]$ and each point of defined segment could be thought as constant. Then the cloud width $E(r)$, probability $P(r)$ for single meteorological situations and average (total) probability $P_\varphi(r)$ is constant for the defined segment. By the road segmentation it is necessary to take into account that the accident probability $P_h(si)$ is constant inside the segment. Then:

$$P(x_s, y_s) = \sum_i P_h(s_i).P_\varphi(r)_i.s_i$$

Where $P(x_s, y_s)$ is total death (injury)/(lethal dose) probability in single point $[x_s, y_s]$,

$P_h(s_i)$ accident probability in sigle segment outspread to the route unit length [m^{-1}],

s_i length of route single segment *i* [m],

$P_\varphi(r)_i$ average death (injury) probability/(lethal dose) in cloud axis,

i route segment index.

Individual risk is possible to determine in point network in death or injury impact contours round about the traffic route. The illustration of network distribution and final individual risk maps is on the next figure. It is evident, that the enhanced risk is curve inside the meandering road, where the interest point can be affected at more parts of the traffic route by the accident.

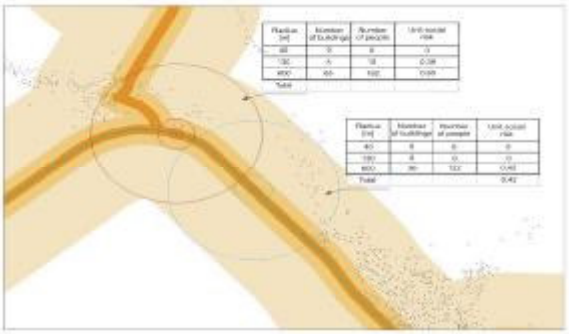

Figure 5: Individual risk distribution nearby the traffic route

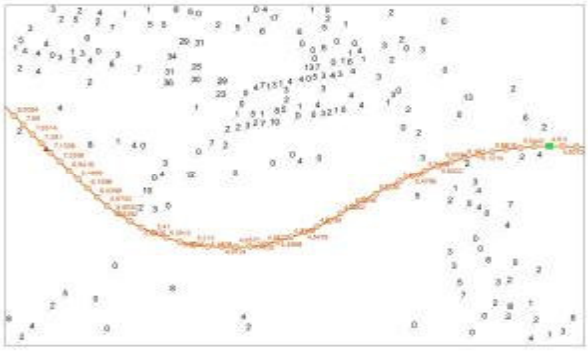

Figure 6: Adress points, number of people, unit social risk for single road parts (20 m)

Example

The sum of unit social risk for 20 m parts in 4 km road: **234,4**

The major accident probability by gas transport on the first class route:

- for 1 km **$5{,}95 \cdot 10^{-6}$**
- for 20 m **$1{,}19 \cdot 10^{-7}$**

Social risk for displayed part of the road by 1000 kg ammonia transport: **$2{,}79 \cdot 10^{-5}$**.

9 Road network assessment for dangerous goods transport

Based on risk maps it can be determined the segments of roads, by witch it is possible to transport the dangerous substances so, that the individual a social risks will be minimal. It is possible to:

1. Display risk maps
2. Use the data/maps for assessment of dangerous object transport recommended routes.

Figure 7: Possible version of chosen road network segments for dangerous goods transport with implemented exposures in the Czech Republic (pink color – dangerous goods transport ban according to law).

10 Conclusion

In this paper there is presented present form of operation status of the project 2B08011 BIOTRA. The research team is in present in the first half of solution so there are presented only partial outcomes and it is not possible to present complex software tool, which is among other things able to compile route maps for dangerous goods transport automatically, simulate the risk from these transport, determine individual and social risk of mobile and stationary sources. As well because of limited space there is not presented the model of dangerous substance fluiding to the environment.

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Training Appropriate for Computer Certification at Two-Year Institutions

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ABSTRACT

This paper presents research results on the relevance and need for information technology certification with a particular focus on CompTIA A+ certification. The study focused on the opinions of employers on certification, a critical review of certification provider literature, and an opinion survey of two-year institutions. The study investigated the training two-year institutions should be providing for CompTIA A+ certification to meet the needs of employers. The paper presents the historical overview, types of programs, development details, outcomes, professional, and considerations for the future information technology certification.

Keywords: Information technology, certification, IT training.

1. INTRODUCTION

The rapidly advancing technology requires evolving skills of technology staff. This evolution has created a new requirement of certifications for Information Technology (IT) professionals. According to Shore, "IT company professional certification is now so common that it has become an expectation for vendors. It is the rare IT company that does not provide some level of certification for its products and the technical professionals who use them" [13].

Certifications for Information Technology have become innovative and increasingly important over the past decade. They have become standard practice for health care practitioners, teachers, accountants, pilots, engineers, architects, home inspectors, therapists and other professionals with some involving intensive evaluation by examination boards. Some take weeks, months, even years to complete; others involve a simple checklist from a local agency [13]. According to the Computing Technology Industry Association (CompTIA), over 800,000 individuals have earned the A+ credential worldwide, and 20,000 member organizations exist in more than 190 countries. CompTIA celebrated its 25th anniversary in 2007.

Professional certification in the IT industry is a relatively recent phenomenon [13]. It originated in the late 1980s when Novell, Inc., a networking vendor from Provo, Utah, started building the skill levels of the IT staff members to maintain market share and manage support costs. Novell was one of the first companies to recognize the links between education/skills and product success. Novell created a process to measure and validate the required skills to effectively work with NetWare. Thus, the Certified NetWare Engineer (CNE) was created.

The growing success of Novell's program encouraged other IT vendors to follow the same path, and certification became the standard for measuring skills in the late 1990s. IT education firms and community colleges started advertising certification preparation courses, both vendor-authorized and unauthorized, for the leading certifications. Other firms offered vendors services on the creation of examination and training, program management, certification study guides, and self-assessment "readiness" exams. Instructor performance and student satisfaction were often judged by certification exam pass rates, rather than the actual quality of job preparation.

Certification proponents in the IT fields see certifications as important. "We believe employees don't have to be certified to be proficient, but we do think that certification means the employee has gone above and beyond," [10]. On the other hand, detractors claim that a certification only proves that a worker is smart with a book work. Such critics believe that certifications do not offer the hands-on knowledge that comes with experience. Conversely, proponents argue that certifications validate skills, establish a baseline for new hires and can be very useful in corporate retention strategies [10].

Moreover, "IT certifications are neither a guaranteed money magnet nor a guaranteed waste of time. They may indicate drive as well as knowledge. But they can't measure experience or non-IT skills" [11]. Baird asserts, "IT certification programs offered at community colleges should demonstrate skills that are portable and marketable to maximize the career options for the certified professional" [1].

Most IT companies provide some level of certification for their products and the technical professional users. Most technology-related companies and IT professionals are seeking every advantage in the job market where certification can often make the difference in the hiring process.

Organizations such as the Computing Technology Industry Association (CompTIA), jCert, and the Linux Professional Institute are consortia of IT vendors, training and certification companies. These groups produce certifications that validate entry-level and advanced IT skills in areas such as PC support, networking, security, and skills related to popular technologies such as Java and Linux. These certifications have become popular with companies staffing help desks and support centers

and are often cited as among the most valuable certifications in media and consultant research [13].

Certification is an asset to employers who are interested in verifying the skill levels of employees. Hiring companies prefer candidates with IT real experience and not just paper certifications through "book learning." However, all other factors equal, certification is often the tiebreaker because employers often pay employees to pursue relevant training and certifications.

Certification has become the standard for IT resellers and service providers. The vendors who sell or service products often require business partners to have staff certified in the vendor technologies. Customers often require certifications specific to the job as a condition of a services contract. Service providers frequently charge higher rates for certified staff members to promote and use certifications as a competitive differentiator, even those with the "paper" reputation. This expectation motivates prospective employees to aggressively pursue certification. The most commonly cited reasons by individuals who pursue certification are: to gain the respect of their employer and peers, to get a better job either within their current firm or with a new firm, and to obtain higher compensation.

The achievement of the expected outcome of Information Technology certifications should combine teaching methods that include both theory and practice. One major criticism of IT certifications is that it is possible to read books, take an online examination and get certified. However, it is crucial that every IT professional possess a combination of not only software and hardware skills, but also soft skills for successfully satisfying job requirements. Is there an appropriate course delivery method for helping students at two-year institutions to be CompTIA A+ certified? Is CompTIA A+ certification relevant and needed for employment and professionalism?

2. PURPOSE AND ASSUMPTIONS

The research study investigated the most effective teaching methods for helping students at 2-year institutions to become CompTIA A+ certified. Technology is constantly evolving, as are the skills of individuals working with technology. This evolving technology has created a new requirement for certifications for Information Technology professionals. Becoming professionally certified as to meet needs of employers will fundamentally depend on finding an effective teaching method.

The term instructional design "refers to the process of translating principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation," [12]. Three educational philosophies with strong influences on instructional design are: constructivism, empiricism, and pragmatism [12]. Gagné divides learning outcomes into five large categories or "domains": verbal information (or declarative knowledge), intellectual skills, cognitive strategies, attitudes, and psychomotor skills [3].

Each educational philosophy and learning outcome suggests different instructional methodology. In other words, finding out the appropriate instructional design method for teaching CompTIA A+ certification was important in this research. The applicability of certification to academia stems from the fact that most students enter college to train for a career, and students in computer science typically gain a strong background in theory, as well as exposure to a variety of technologies [13]. However, many employers prefer the broad grounding in information technology that a computer science degree denotes. Most academic programs provide hands-on experience through labs and industry co-operative programs. Yet, certification might be advantageous on the résumés of graduates. A computer science program that offers students the opportunities to attain one or more valuable IT certifications during the course of study is likely to insure a successful career placement.

Ragan and Smith reiterate that "the result of the front-end analysis stage of design is a clear description of the learning environment, the learners, and the learning task," [12]. They also suggest that the learning task should clearly specify terminal objectives and instructional analysis, enabling objectives and be classified according to the types of learning outcomes required in Gagné's learning outcomes taxonomy [7].

As an integrated part of an instructional design process, the present research assumes that besides identifying the target teaching methods, it is equally important to determine the specific IT teaching characteristics favored by teachers and students. In the process of creating the research survey instrument, it was assumed that participants have some knowledge about information technology's certifications, and have had previous experience in teaching a class or taking a class related to IT at a 2-year institution.

Information Technology certifications are not new to IT professionals and businesses. However, the design of teaching methods that fit the need of potential employers is a major challenge in today's global business world. This study has impact on those working toward teaching CompTIA A+ using a method that combines theory and practice. The research results go beyond certification requirements in books or study materials on the Internet for A+ certification.

Given the interests of IT professionals and employers in certifications, this study, though limited to CompTIA A+, has potential influence on other certification teaching methods at 2-year institutions. CompTIA A+ is the most popular entry level certification [3].

3. DEFINITIONS

Attitude is a mental state that predisposes a learner to choose to behave in a certain way [8]. Gagne describes attitudes as having cognitive, affective, and behavioral components that interact. Attitudes influence the choices that learners make [12].

CCIE –Cisco Certified Internetwork Expert.

CISCO –A large supplier of networking hardware and software, including router and security products.

CompTIA–CompTIA is the organization that sponsors the A+ Certification, a non-profit organization made up of individuals from various large companies [4, 5].

CompTIA A+ Certification–This certification indicates that the individual possesses the knowledge and skills essential for becoming a successful computer service technician. The two-part exam covers hardware and software technologies and is not related to any vendor-specific products [6].

Concrete concept –responding in a single way to all members of a particular class of observable events. Seeing the essential similarity among a class of objects, people, or events, in a single response. Example: Classifying music as jazz, country western, rock, etc.; saying "round" upon seeing a manhole cover, a penny, and the moon [9].

Constructivism –an educational philosophy within a larger category of philosophies that are described as "rationalism." It is a rationalist philosophy that is characterized by the belief that reason is the primary source of knowledge and that reality is constructed rather than discovered [12].

Declarative knowledge –sometimes described as "knowing that" something is the case [8]. It is also comparable to Bloom's taxonomy [2] levels of recall and understanding [12].

Design –activity or process that people engage in that improves the quality of their subsequent creations [12].

Discrimination –making different responses to the different members of a particular class is seeing the essential differences between inputs and responding differently to each. Example: Distinguishing yellow finches from house finches on the basis of markings; having to tell the differences between gauges on an instrument panel [9].

Empiricism –also termed as objectivism, is a postulate that knowledge is acquired through experience.

Instruction –deliberate arrangement of learning conditions to promote the attainment of some intended goal [12].

Instructional design –systematic and reflective process of translating principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation [12].

Intellectual skills –Intellectual skills include: 1) Discrimination, 2) Concrete concept, 3) Rule using, and 4) Problem solving. These are the four levels within the intellectual skills domain in Gagné's taxonomy [12].

Microsoft –A software company, best known for the Windows operating system.

Pragmatism –considered as a middle ground between rationalism (constructivism) and empiricism. Pragmatists, like empiricists, believe that knowledge is acquired through experience; they believe that this knowledge is interpreted through reason and is temporary and tentative [12].

Problem solving –combining lower level rules to solve problems in a situation never encountered by the person solving the problem. It may involve generating new trial and error rules until the solution to a problem is derived [9].

Psychomotor skills –coordinated muscular movements that are typified by smoothness and precise timing [7]. The psychomotor domain includes physical movement, coordination, and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures, or techniques in execution [12].

Rule using is applying a rule to a given situation or condition by responding to a class of inputs with a class of actions. It is relating two or more simpler concepts in the particular manner of a rule. A rule states the relationship among concepts. It is helpful to think of rules or principles as "if-then" statements. Examples include: "If a task is a procedure, then use flowcharting to analyze the task;" "If you can convert a statement into an 'if-then' statement, then it is a rule or principle," [9].

4. RESEARCH METHODOLOGY

Professional IT skills and technology are constantly evolving. The progression of technology has ushered in new certification requirements for IT professionals. The integration of theory and practice into instructional course delivery methods are perhaps relevant for achieving the expected outcome of IT certifications and employment goals. The research questions investigated in this study are:

a. Is there an appropriate course delivery method for helping students at two-year institutions become CompTIA A+ certified?
- Is the combination of face-to-face and online learning adequate for CompTIA A+ training?
- Is on-site, face to face learning sufficient for CompTIA A+ training?
- Is online learning sufficient for CompTIA A+ training?
- Are CD/DVDs, books and self-learning materials adequate for CompTIA A+ training?

b. Is CompTIA A+ certification relevant and needed for employment and professionalism?
- Is there any preferred training needed for CompTIA A+ certification?
- Is CompTIA A+ a necessity for IT professionals?
- Is CompTIA A+ useful for IT professionals?
- Should CompTIA A+ certifications be a requisite for employment?
- Is CompTIA A+ certification meaningful?
- Is CompTIA A+ certification adequate?
- Is there a balance between theory and perception in reward of CompTIA A+ certification?

The research hypotheses investigated are:

H_0: There is not a significant difference between the students who are CompTIA A+ certified and those who are not certified on their perceptions of the training.

H_1: There is a significant difference between the students who are CompTIA A+ certified and those who are not certified on their perceptions of the training.

The objectives of the survey were to:

1. Determine the percentage of survey participants who (a) are aware of CompTIA A+ certification, (b) are CompTIA A+ certified, (c) would like to become CompTIA A+ certified, (d) believe that the actual training method combines theory and practice, (e) believe that the training method is more theoretical, (f) believe that CompTIA A+ is necessary for job seekers, (g) would like to see a continuous evolution of CompTIA A+ certification, and (h) believe that being CompTIA A+ certified can improve job skills.
2. Ascertain the degree of appreciation the survey participants have for the performance of CompTIA A+ certified technicians and to gather suggestions for improving CompTIA A+ (certified technicians) or certification training.

The target survey population includes students and instructors at 2-year institutions. The subgroup includes computer science students and instructors. The sample consisted of students and instructors from Minnesota School of Business Globe College, St. Cloud, Minnesota; Rasmussen College, St. Cloud, Minnesota; and St. Cloud Technical College, St. Cloud, Minnesota with a target of 80 students and 10 instructors. St. Cloud Technical College was used as the pilot test center where the surveys were administered to 10 computer science students and two computer science instructors. Both students and instructors were asked at the end to complete an opinion survey that tap suggestions for improvement.

The survey was mailed to a staff or faculty member at each of the three two-year institutions for distribution and collection in class. This method of distribution and collection helped to procure an adequate response percentage. Each survey was coded for tracking and tabulation. For *tracking*, each survey was coded in the top left corner with three digits for students' survey (ex., 001-080), and two digits for instructors' survey (ex., 01-10) coding system. To facilitate t*abulation*, all questions and response items were numbered for tabulation. Open-ended questions' responses were pre-coded by hand prior to data entry.

The Statistical Package for Social Sciences version 15.0 was used to perform all data analyses in two stages. First, descriptive statistics were generated for all variables relevant to answering the teaching and student learning research questions. Means and standard deviations were calculated on the Likert-type scale items. Frequencies and percents were computed for nominally scaled variables. The second stage of the analyses used inferential statistics to compare the survey results of students and instructors from the three locations, and to compare the survey results at individual locations.

5. RESULTS AND INTERPRETATION

The total number of instructors who participated in this research project was seven. The total number of students who participated in this research project was 71. Unfortunately, some of the instructors did not respond to all of the survey questions, thus the total response is not evenly seven on all items. The limited number of participants did not allow for an inferential statistics analysis to be performed on the survey data of the instructors. Consequently, only the descriptive statistics are reported for the instructors. The statistical level of significance for investigating all null hypotheses in this study was set to 0.10, rather than the traditional 0.05, because of the nature of self-reported, somewhat subjective opinions and the limited number of student participants.

Is there a difference of the background training on awareness of certification for instructors and students? All of the instructors surveyed and 84.5% of the students surveyed were aware of CompTIA A+ certification as indicated in Figure 1. This is not surprising because CompTIA A+ is gaining in popularity as an entry level certification for IT professionals.

Is there a difference in the perceptions of the need for CompTIA certification of students and instructor? Take a look at Figure 2. Only 33.5% of the instructors who participated in the survey are CompTIA A+ certified, which is not surprising because the CompTIA A+ certification is not necessary for teaching jobs at 2-year institutions. Only 2.8% of the students who participated in this survey are CompTIA A+ certified, which is not surprising because CompTIA A+ certification is not a requirement for the majority of IT entry level jobs.

Are the majorities of the faculty and students becoming interested in CompTIA A+ certification? The responses are illuminated in Figure 3. The majority of instructors (60%) and students (85%) expressed an interest in becoming CompTIA A+ certified. This result shows the willingness of students in obtaining CompTIA A+ certification, in compliance with the expectations of employers who require certification for IT entry level jobs.

More than half of the instructors (67%) believed that students in a computer science major at their institutions are well prepared to take the CompTIA A+ certification exam. In addition, 81% of the students expressed positive opinions on training that combines theory and practice. This result in Figure 4 contradicts the claim of IT certification detractors that certification proves only that a worker is book smart.

The percentage of instructors and students surveyed who expressed opinions that CompTIA A+ is a legitimate certification and validate both the knowledge and application of concepts and skills necessary for entry-level IT professional is 67% and 57% respectively. This finding, in support of IT certification proponents, indicates the certified employee has demonstrated skills above and beyond the minimum requisite knowledge.

Among the computer science instructors and students who participated in the survey, approximately half of each group at least agreed that the blended learning methodology is appropriate for CompTIA A+ certification. The majority of the participants, 83% of the instructors and 64% of the students, agreed that the face-to-face learning methodology is appropriate for CompTIA A+ training at 2-year institutions.

Only half (50%) of the instructors surveyed said that CompTIA A+ certification is necessary for IT job seekers while a very small number of students surveyed (37%) expressed opinions that CompTIA A+ certification is necessary for a job. A high percentage of instructors (83%) and 70% of students expressed opinions that CompTIA A+ certification can improve the service and support offered to end users by CompTIA A+ certified IT

professionals. This finding strongly supports the IT certification proponents' claim that "employees do not have to be certified to be proficient, but do think that certification means the employee has more than the required minimum IT skills and knowledge".

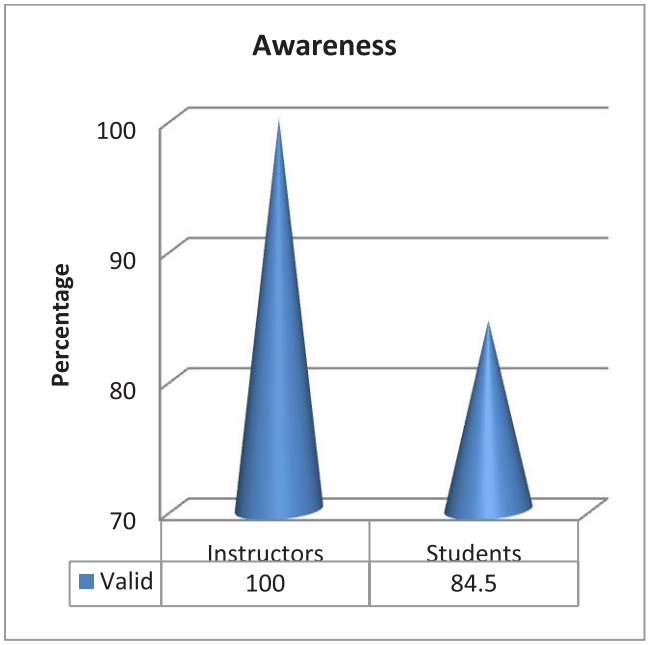

Figure 1. Awareness of CompTIA A+ Certification

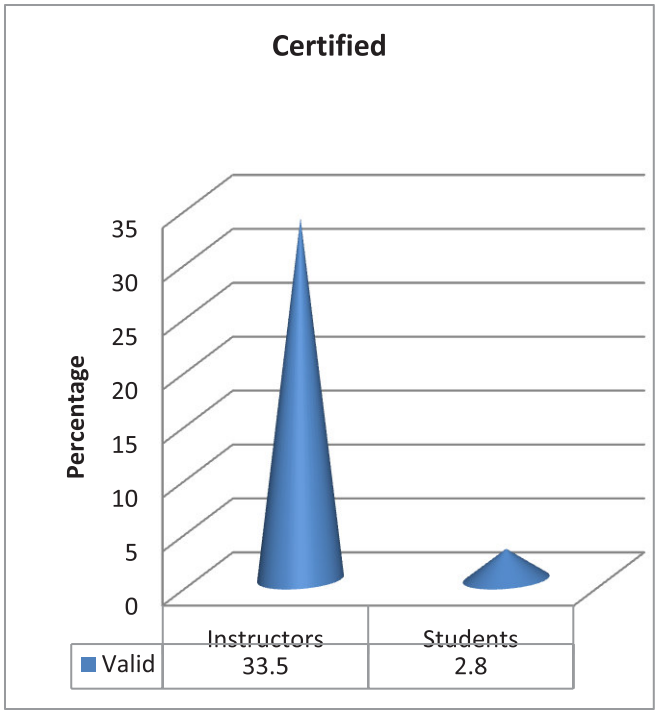

Figure 2. CompTIA A+ Certified Instructors and Students

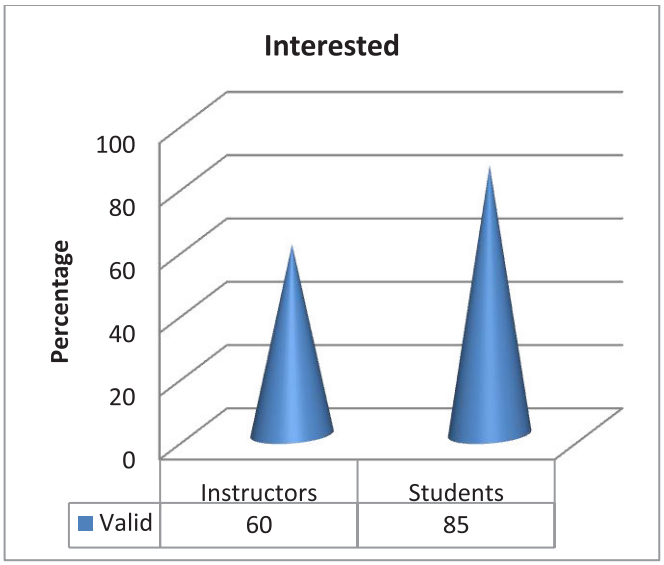

Figure 3. Interests in Certified ComTIA A+

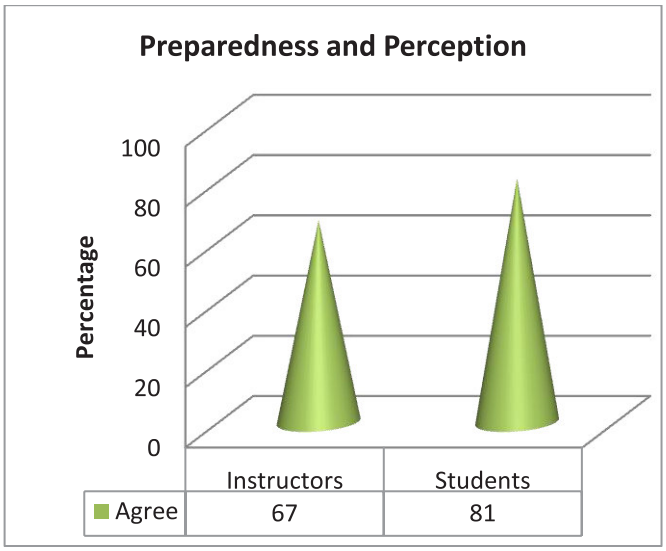

Figure 4. Perceptions of CompTIA A+ Certification Exam and Training Effectiveness Method

All instructors (100%) and a good majority of students (66%) at least agreed that certification proves that its holder has gone beyond proficiency. This finding supports the claim of IT certification proponents that employees do not have to be certified to be proficient, but do think that certification means the employee has more than required IT knowledge. Less than half (33%) of instructors and 25% of students expressed opinions that certification means only being smart in book knowledge. This percentage is not enough to support the claim of IT detractors that a certification proves only that a worker is book smart.

Among the participants, 83% of the instructors disagreed that the online learning methodology is appropriate for CompTIA A+ training at 2-year institutions. However, only a small percentage

(33%) of students disagreed. This could be related to the fact that instructors and students do not have the same level of teaching experience. It seems to be more difficult for students to investigate what works and what does not work in training. The majority of instructors (83%) disagreed that using CD/DVDs and books courses as a training tool for the CompTIA A+ certification exam is appropriate while only 37% of students disagreed.

6. CONCLUSIONS AND DISCUSSIONS

The major limitation of this study is in the imperfect neutral party engaged in the IT certifications. The popular IT certifications have been produced by sponsors or certificate companies. Moreover, the number of CompTIA certified or certification-trained students, at two years institutions are limited. There are also a limited number of 2-year institutions in St. Cloud, Minnesota, just like many real-life academic communities who embed CompTIA A+ certification exam objectives into Computer Science and IT curriculums. The research also targeted only students and teachers with previous knowledge of IT certifications. This limits the generalization of the findings in this study to only IT professionals with knowledge of CompTIA A+ certification or topics related to IT certifications.

The survey about CompTIA A+ certification showed that the majority of instructors and students were aware of CompTIA A+ certification but only a few were certified. However, a high number of students were interested in becoming CompTIA A+ certified. In contrast, very few instructors and students perceived CompTIA A+ certification as necessary for job seekers, but felt that CompTIA A+ certification could improve the service and support offered to end users by CompTIA A+ certified IT professionals.

The CD/DVDs and books approaches to learning are the least popular among instructors and students, and then the online approach. This finding is not surprising due to the nature of Information Technology. Most students and instructors prefer the face-to-face delivery method that allows participants to learn the theoretical part as well as combine both hardware and operating system concepts with domains such as security, safety, environmental issues, communication, and professionalism.

The opinions expressed by instructors and students in regard to CD/DVDs and books, and the online delivery method do not provide a clear conclusion due to the extremely small number of instructor and student respondents. We do not know how students and faculty perceive the CD/DVDs and books approach of delivery. Do they see a CD/DVD or a book as providing interactive instruction with high level simulation or simply a page of text that learners read and then answer questions? We simply do not know what content and instructional strategies they think of when they reflect on this delivery strategy.

Our second research question investigated the relevancy and need of CompTIA A+ certification for employment and professionalism. According to Gilhooly, certifications in the Information Technology field are important [10]. On the other hand, detractors claim that certification proves only that a worker is smart with books. Such critics believe that certifications do not offer the hands-on knowledge that comes with experience. Conversely, proponents say certifications validate skills, establish a baseline for new hires and can be very useful in corporate retention strategies.

Two-year intuitions should continue the practice of using face-to-face, hands-on instruction with a high level of interaction to prepare students for the workforce. High-level interactive simulation exercises for IT job skills are essential for effective certification training. CD/DVDs certification training tools should be equipped with best IT practices, job simulation exercises and performance feedbacks on individual tasks, to provide real world experiences for students.

The method of delivery instruction was investigated in this research. The appropriateness and preferences for blended learning, face-to-face learning, online learning, and learning using CD/DVDs and books were investigated. In future, we will conduct a case study to examine the best delivery method for preparing students for certification tests.

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A blended Approach of Ngee Ann's Professional Learning Community (PLC)

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Ngee Ann Secondary School, Singapore

ABSTRACT

Ngee Ann Secondary School has established a Professional Learning Community (PLC) whereby all teachers are put into learning teams with the objective of giving teachers the opportunities for collaborative inquiry and to develop and share a body of wisdom gleaned from their experiences

The PLC is built on the research-based Teaching for Understanding (TfU) framework as a tool to design, revise and review instruction that helps students develop understanding with focus on pedagogies like Artful Thinking and Socratic Questioning. Using the elements of the TfU framework, teachers in different learning teams plan, execute and evaluate a lesson with the intention of helping students develop good understanding of the subject concepts or topics.

Aside from the face to face sessions, the school has also tapped and harnessed the potential of the Web-based applications in the emerging cloud computing services to develop a collaborative school community with its own identity, Ngee Ann 2.0. The school has adopted Microsoft's Live@Edu at zero cost to harness a suite of applications to collaborate and communicate with department teachers on projects, and stay connected with friends in an increasingly Web-connected world.

Keywords - innovation, technology, professional learning community.

1 INTRODUCTION

Ngee Ann Secondary School (NAS) is one of the 51 pilot schools to implement Professional Learning Community (PLC) across Singapore. Living in the ever-changing 21st Century education paradigm, in order for teachers to adapt to the challenging learning needs of our technology-savvy students, it is pertinent that teachers work alongside each other to share resources and expertise so as to achieve positive student outcomes. In establishing the PLC, NAS went on a whole school approach to include all teaching staff on the PLC journey, leveraging on the power of technology to create a collegial learning environment to share our views and resources.

2 DEVELOPING A PROFESSIONAL LEARNING COMMUNITY IN SCHOOL

2.1 Rationale and Principles of Professional Learning Community (PLC)

PLCs provide participants with "the opportunity to articulate and analyse their thinking and their practices, reconcile individual questions and issues with organisational needs, compare contexts and situations and then find meaningful patterns and search for the big picture without losing sight of particulars" (GiselleO. Martin – Knip, 2008, p 6). NAS, with a strategic outcome to develop a First Class Teaching Force, is committed to promoting a collaborative environment where teachers are put into department-based Professional Learning Teams (PLTs) so that they can gain collective wisdom and share strategies on effective teaching and learning in the classrooms. To ensure that, NAS followed through 3 central ideas by Dufour (2004) in order to sustain the effectiveness of PLCs.

Idea 1- Ensure that students learn: The shift in focus on teaching to a focus on learning is core and has led NAS to establish a blended-approach PLC so that teachers can identify gaps in teaching and ultimately meet the needs of students.

Idea 2 – A culture of collaboration: Putting teachers into collaborative PLTs allows teachers "to work together interdependently to analyse and impact professional practice in order to improve results for the school". (Dufour,Dufour & Eaker 2008, p 16)

Idea 3 – A Focus of Results: Effectiveness of the PLC must be evaluated on the basis of results. When teachers work together, they participate in an ongoing process to identify the current level of student achievement, establish a goal to improve the current level, work together to achieve that goal and then provide periodic evidence of progress.

Having these ideas in mind, NAS set to develop an awareness of the tenets of professional learning communities and reflective practice whereby teachers can experience a process that can ground a collaborative culture among them. The PLC is also a platform for teachers to explore, share and employ creative strategies to engage students in class and then to be able to use data and evidence in students' work to determine goals, drive decisions and make progress.

2.2 Structure of the Professional Learning Community

All teachers are grouped into department PLTs which meet every week. There will be online sessions interspersed with face to face meeting sessions. Instructional Programme Heads of Department will assume the role of coaches and will facilitate the face to face discussions. The School Staff Developer (SSD) sets the agenda and posts the forum questions to set the direction for the online discussions. After each online session, the SSD will collate and summarise the key points, quoting teacher' responses, including at least one from each PLT as a way to affirm teachers' good works.

2.3 Framework for Ngee Ann's Professional Learning Community

The PLC in NAS is built on the research-based Teaching for Understanding Framework (TfU), a tool to design, revise and review instruction that helps students develop understanding in the concepts taught in class. Every staff in NAS is trained by WIDE WORLD (developed at Harvard Graduate School of Education) in TfU. This has developed a common pedagogical language among the staff. Strategies such as Socratic Questioning and Artful thinking are also employed in the classrooms to encourage students to think beyond the syllabus, and then allow them to delve deeper so that they can achieve a greater understanding of the topics covered.

In using TfU as a framework, teachers are focussed on setting overarching goals, understanding goals, performances of understanding and on-going assessments (refer to appendix) for a lesson unit they have planned together in their respective PLTs

3 HARNESSING THE POWER OF USING MICROSOFT LIVE@EDU

3.1 Using an Integrated Platform

Microsoft Live@Edu is a unified platform consisting of a suite of online applications that enable a user to view and share files, to collaborate with other online users and for easier communication. All the online applications (Live Mail, Live Messenger, Live Space, Live Skydrive, Live Groups and Live Office Workspace) are accessible by just a single account called the Windows Live ID. It is beneficial for an integrated system to have single-sign on capability. With technological advances, each day there are new sites emerging..Personal data and files are spread in different sites, making work disorganized. Microsoft Live@Edu reduces the inconvenience of having to remember many passwords by integrating all the online applications together and lets users consolidate their data and files in one place.

Windows Live Groups is a place for real-world interactive groups to collaborate online. It provides an online discussion tool for people to gather and discuss common interests. Students and teachers can easily create and invite people to join the group just by selecting contacts from their Windows Live Contacts list. People can interact and collaborate through posting announcements on the Group page, broadcasting an email to everyone, or using group chat features in Windows Live Messenger to connect informally. The groups can also have photo sharing and keep everyone up-to-date on upcoming events with a shared calendar.

NAS's PLC has been created using Live Groups where teachers are grouped in professional learning teams based on departments and they work collaboratively on a subject unit. Besides posting their reflections and comments in the online forum, lesson plans are also posted in Live Skydrive for easy evaluation.

Below are some screen captures of the online discussion which took place among teachers during the PLC time slots which was structured into the curriculum time frame.

4 BENEFITS

NAS, being the East Zone Centre of Excellence for ICT , has adopted a blended delivery approach in its implementation of the PLC pilot, offering a mix of face-to-face and online interactions via the Microsoft Live@Edu platform for all teachers. The main reason is to build teachers' expertise through the right mix of virtual and live learning.

Using the TfU Framework is one way to promote a shared professional language among teachers as they are able to set clear stages in lesson planning and execution. The framework also allows milestone checks on the progress of the Performances of Understanding in planning the lesson units. At the same time, it provides opportunities for critique and reflection on our teaching craft.

In a survey conducted on the PLC journey, 100% of teachers felt that there was greater sense of collective responsibility towards student learning and better engagement of students as a result of the establishment of a PLC. Teachers also agreed that there was greater collaboration and higher morale amongst staff.

5 LIMITATIONS

While the blended approach of PLC is able to promote school wide collaboration, there is a contiunal need to provide training and support to level up teachers' competencies. As much as the Live@Edu platform has met the learning needs and provided a collaborative climate among staff, it is not available on browsers other than Internet Explorer; as such, some respondents have difficulty accessing it.

6 CONCLUSION

Ngee Ann Secondary School has adopted Microsoft Live@Edu platform to develop and create a collaborative learning environment. As the full potencial of Live@Edu is yet to be harnessed, Ngee Ann Secondary School will continue to explore so as to meet the ever changing educational landscape for our teachers.

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APPENDIX

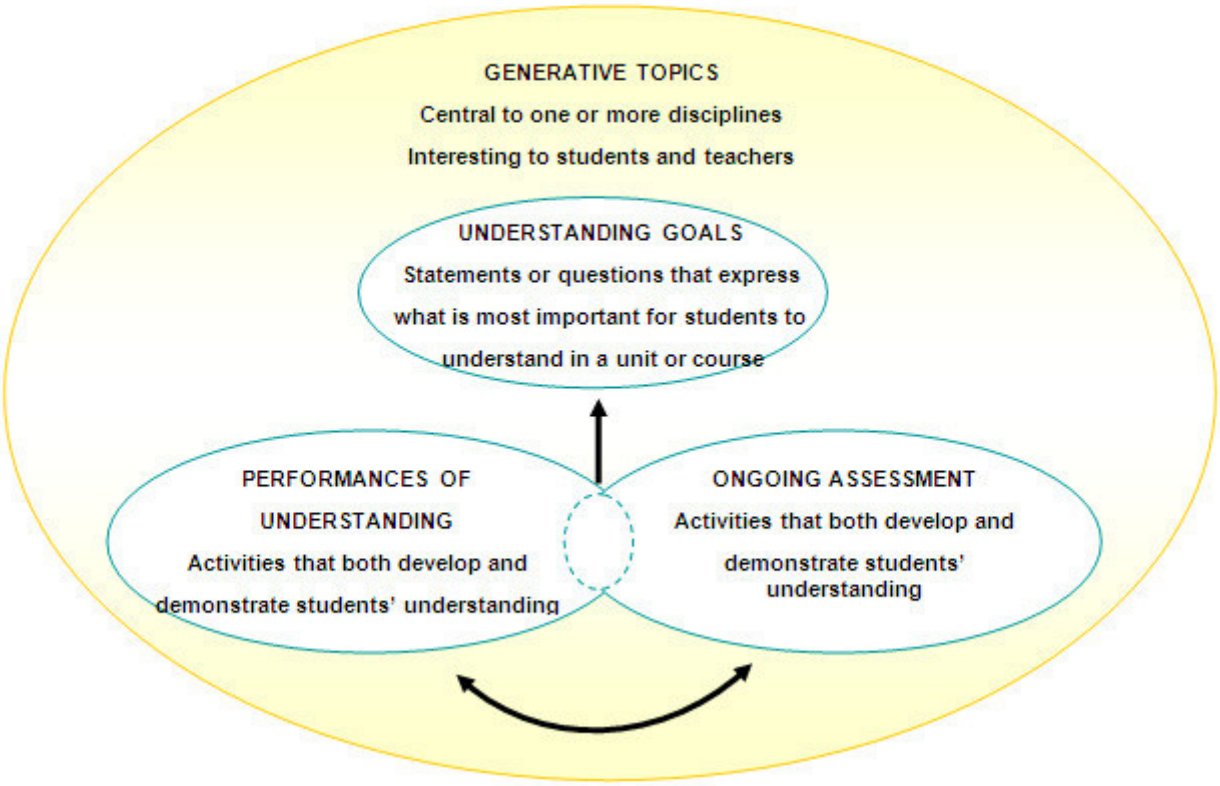
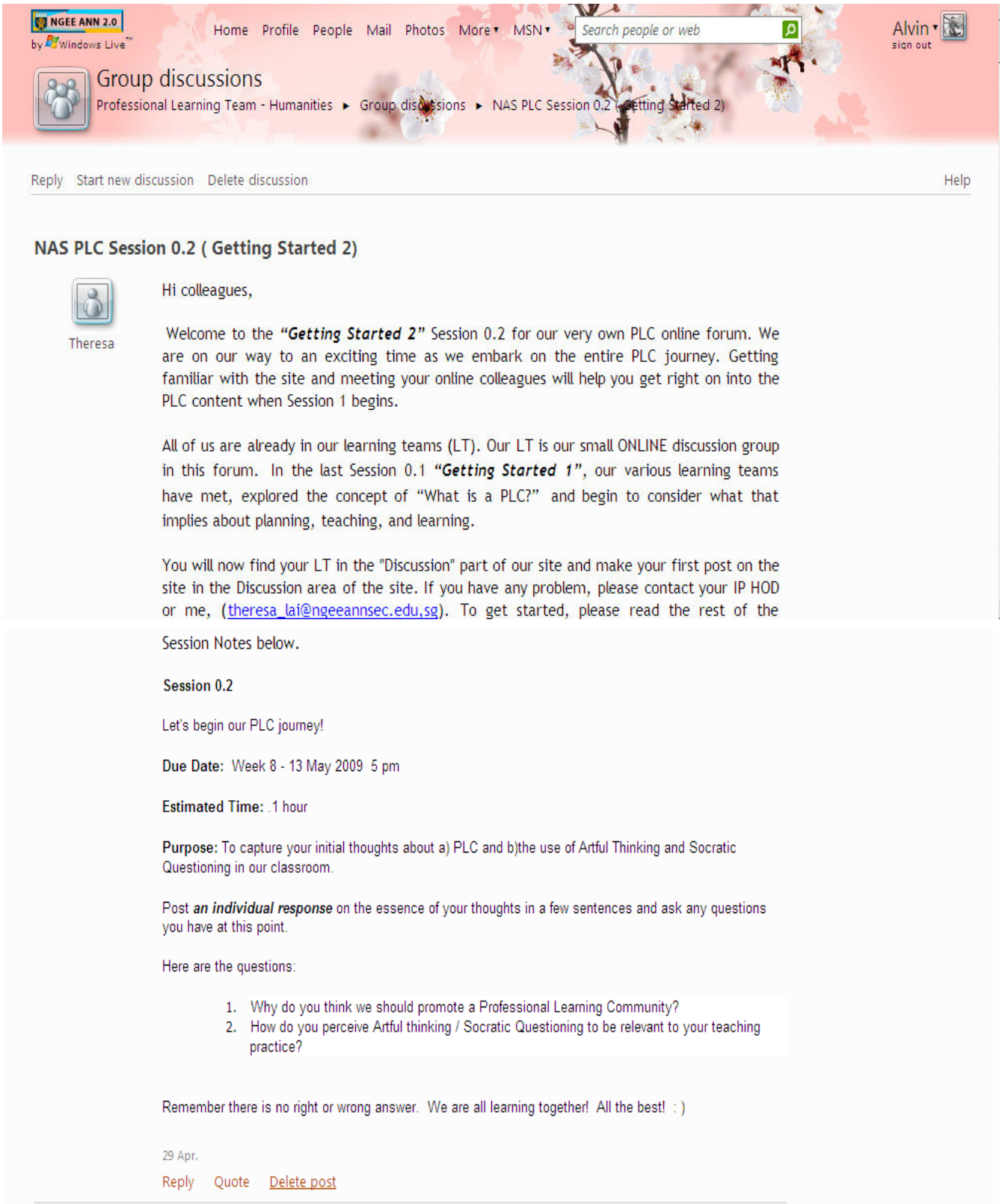
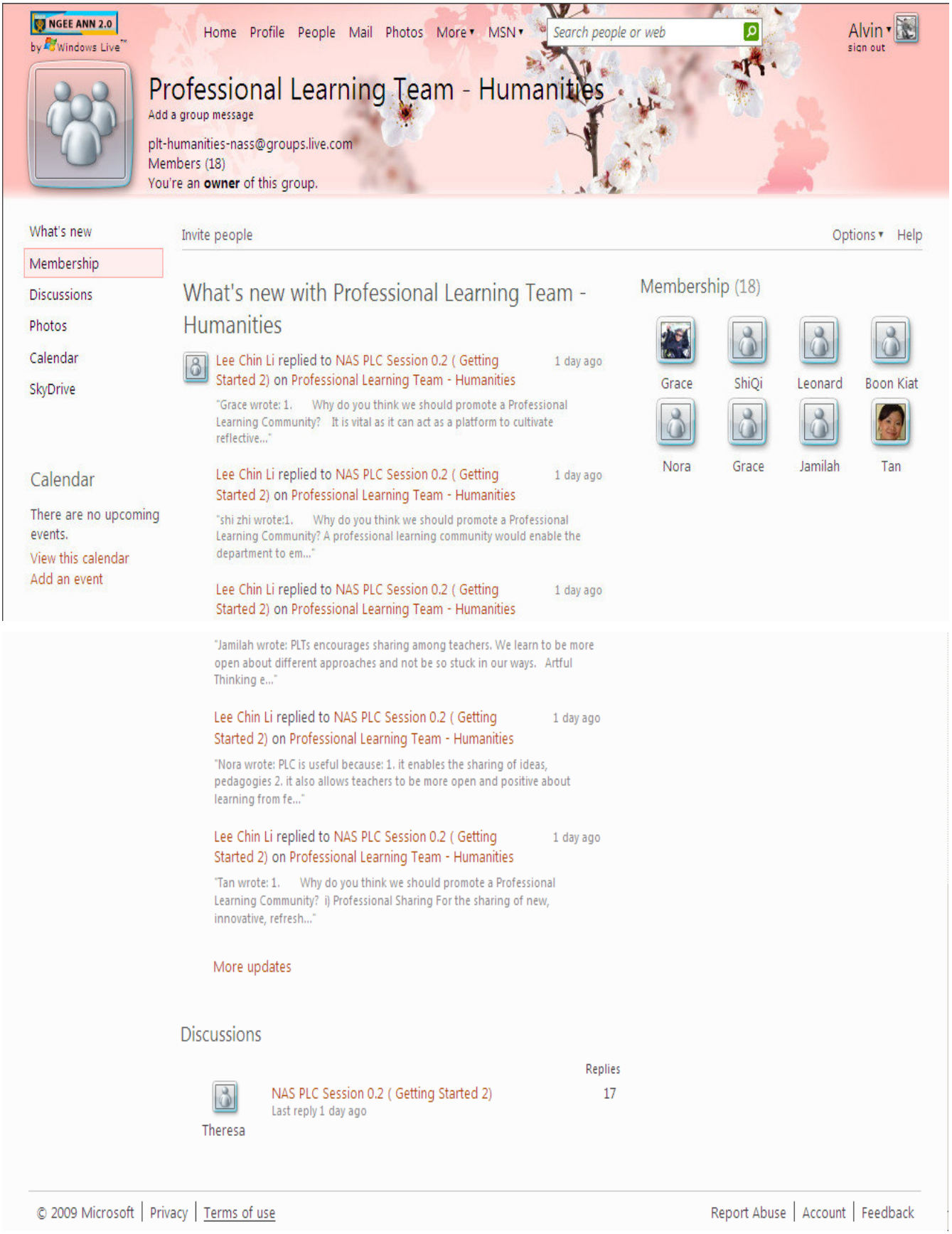


Diagram 1. TfU framework

Below are some screen captures of the online discussion which took place among teachers during the PLC time slots which was structured into the curriculum time frame.




NGEE ANN 2.0
by Windows Live
Home Profile People Mail Photos More MSN
Search people or web
Alvin
sign out
Professional Learning Team - Humanities
Add a group message
plt-humanities-nass@groups.live.com
Members (18)
You're an owner of this group.
What's new
Membership
Discussions
Photos
Calendar
SkyDrive
Invite people
Options Help
What's new with Professional Learning Team - Humanities
Lee Chin Li replied to NAS PLC Session 0.2 (Getting Started 2) on Professional Learning Team - Humanities 1 day ago
"Grace wrote: 1. Why do you think we should promote a Professional Learning Community? It is vital as it can act as a platform to cultivate reflective..."
Lee Chin Li replied to NAS PLC Session 0.2 (Getting Started 2) on Professional Learning Team - Humanities 1 day ago
"shi zhi wrote:1. Why do you think we should promote a Professional Learning Community? A professional learning community would enable the department to em..."
Lee Chin Li replied to NAS PLC Session 0.2 (Getting Started 2) on Professional Learning Team - Humanities 1 day ago
"Jamilah wrote: PLTs encourages sharing among teachers. We learn to be more open about different approaches and not be so stuck in our ways. Artful Thinking e..."
Lee Chin Li replied to NAS PLC Session 0.2 (Getting Started 2) on Professional Learning Team - Humanities 1 day ago
"Nora wrote: PLC is useful because: 1. it enables the sharing of ideas, pedagogies 2. it also allows teachers to be more open and positive about learning from fe..."
Lee Chin Li replied to NAS PLC Session 0.2 (Getting Started 2) on Professional Learning Team - Humanities 1 day ago
"Tan wrote: 1. Why do you think we should promote a Professional Learning Community? i) Professional Sharing For the sharing of new, innovative, refresh..."
More updates
Membership (18)
Grace
ShiQi
Leonard
Boon Kiat
Nora
Grace
Jamilah
Tan
Calendar
There are no upcoming events.
View this calendar
Add an event
Discussions
Replies
NAS PLC Session 0.2 (Getting Started 2)
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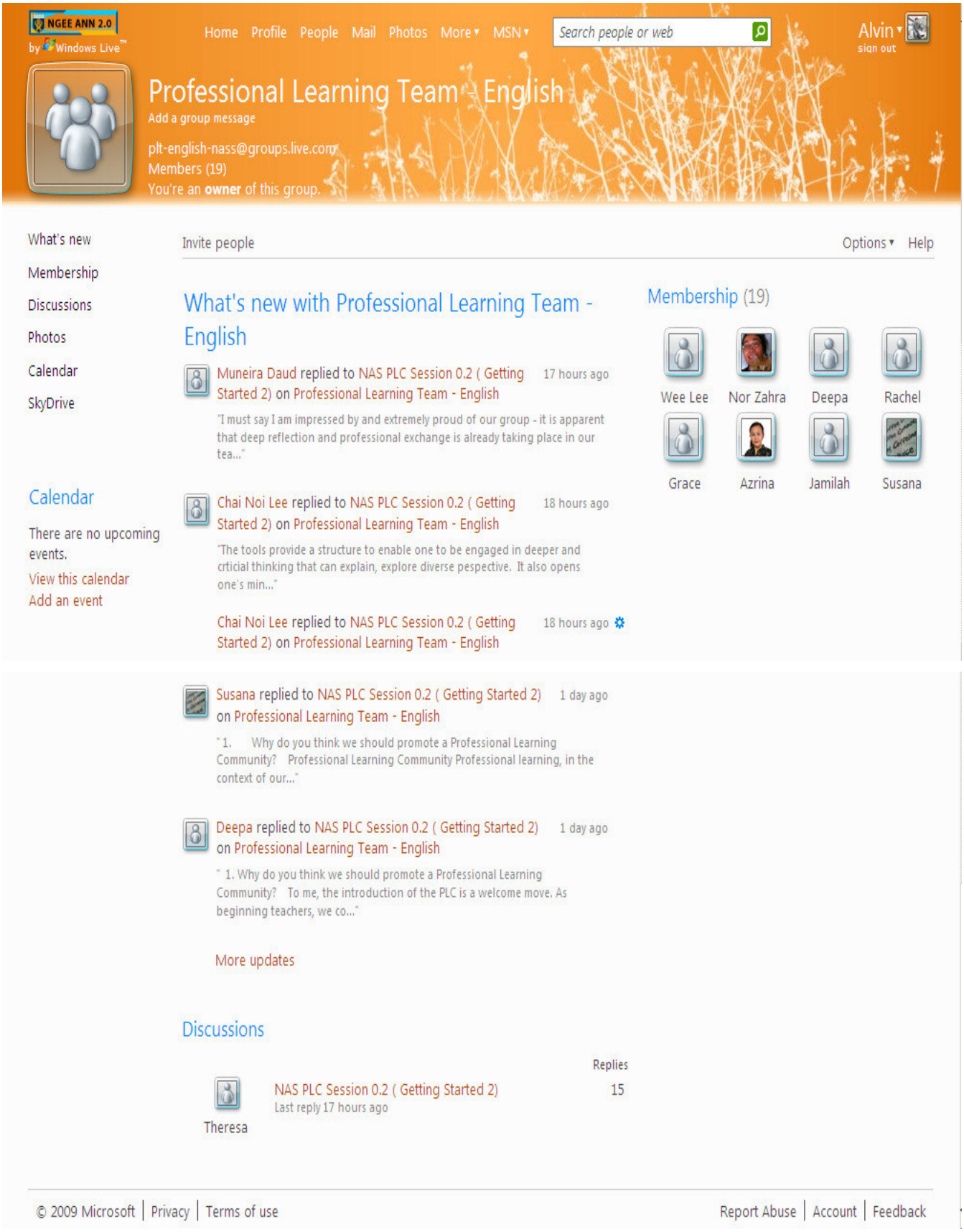
Report Abuse | Account | Feedback


NGEE ANN 2.0
by Windows Live
Home Profile People Mail Photos More MSN
Search people or web
Alvin
sign out
Professional Learning Team - English
Add a group message
plt-english-nass@groups.live.com
Members (19)
You're an owner of this group.
What's new
Membership
Discussions
Photos
Calendar
SkyDrive
Invite people
Options Help
What's new with Professional Learning Team - English
Muneira Daud replied to NAS PLC Session 0.2 (Getting Started 2) on Professional Learning Team - English 17 hours ago
"I must say I am impressed by and extremely proud of our group - it is apparent that deep reflection and professional exchange is already taking place in our tea..."
Chai Noi Lee replied to NAS PLC Session 0.2 (Getting Started 2) on Professional Learning Team - English 18 hours ago
"The tools provide a structure to enable one to be engaged in deeper and crticial thinking that can explain, explore diverse pespective. It also opens one's min..."
Chai Noi Lee replied to NAS PLC Session 0.2 (Getting Started 2) on Professional Learning Team - English 18 hours ago
Membership (19)
Wee Lee
Nor Zahra
Deepa
Rachel
Grace
Azrina
Jamilah
Susana
Calendar
There are no upcoming events.
View this calendar
Add an event
Susana replied to NAS PLC Session 0.2 (Getting Started 2) on Professional Learning Team - English 1 day ago
" 1. Why do you think we should promote a Professional Learning Community? Professional Learning Community Professional learning, in the context of our..."
Deepa replied to NAS PLC Session 0.2 (Getting Started 2) on Professional Learning Team - English 1 day ago
" 1. Why do you think we should promote a Professional Learning Community? To me, the introduction of the PLC is a welcome move. As beginning teachers, we co..."
More updates
Discussions
Replies
NAS PLC Session 0.2 (Getting Started 2)
Last reply 17 hours ago
15
Theresa
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Report Abuse | Account | Feedback

The Dialogue Intensive Online Classroom

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Introduction

Recently I was sitting in a noisy Internet café on the Via Veneto in Rome facilitating a discussion on the importance of leadership communication during change initiatives in a US graduate online course. The beauty of online education is its ability to transform time and space into a 24x7 classroom, allowing me to teach from 6000 miles away and 6 hours ahead. The "anywhere, anytime" notion of online education comes alive in situations like this.

The discussion element of an online course, in theory, is the "classroom" where much of the instructor-student and student-student interaction takes place. To a large degree it is intended to approximate the on-campus class experience. As most online instructors know, the online discussions, if designed appropriately, can far exceed the interactions in the campus classroom. As Rossman (1999) notes, discussions in online courses "are a rich source of learning, enjoyment, and an integral part of the course." Students often comment on the differences in interaction between online and on-campus classes. I have learned, however, that not all online discussions are created equally. In my online experiences, I have witnessed three types of online discussions; the "Q&A" Model, the "1+" Model and the "dialogue intensive" model.

Discussion Models

The "Q&A" model, used in some online programs, is built around a structured unit environment where the student has specific response tasks. Typically, the instructor will post a question related to the unit's topic and the students are required to post a single response to the question. There is little to no instructor-student interaction or student-student interaction. The instructor will often post a summary of the week and the student input at the end of the unit. The primary value of this model is the sharing of approaches and perspectives in response to the specific question.

The "1+" model, used in other online programs, is built around a limited interactive model. Students are required to respond to a specific question in each unit as well as responding to at least one of their peer's postings. This model has the potential for more instructor-student interaction depending on the level of the instructor's engagement. However in my experience, student-student interaction has been limited. Many students just post the obligatory one response to a peer's posting. Others try to engage in more discussion but with limited responses, the discussion energy tends to dissipate.

The "dialogue intensive" model is built around the notion that much of the learning occurs with active instructor-student and student-student interaction. An initial discussion question is posed as a foundation and as students respond and the instructor engages, the discussion is extended through the sharing of professional experiences, personal insights and other source materials. It is not atypical in a dialogue intensive model for a week's unit to have 150+ postings in a 10-student class.

I have been monitoring online student feedback for the last three years, specifically focusing on comments about the discussion elements of the class. The sample pool is relatively small: approximately 80 students from each discussion model but there are clear patterns in the feedback. The dialogue intensive model garnered the most commentary, the Q&A model the least. Approximately 67% of the students in the dialogue intensive courses provided comments on the discussions. The +1 model received 29% comments and the Q&A model 17%. The dialogue intensive model received predominantly positive comments (87%), while the other two models were generally mixed. The main difference in the

commentaries was the emotion and depth in the comments. The dialogue intensive model received significantly more in-depth and reflective comments than the other two models. For example:

> *"My learning team included professionals from the nuclear power field, healthcare, industry, human services, education, and manufacturing. Thanks to insight from these outstanding professionals, coupled with the intense, fast-paced curriculum, I now approach problems from a more strategic perspective and with greater global insight than ever before."* Online Student, 2006

This is not to say that the "Q&A" Model or the "1+" model are pedagogically weak or to suggest they do not have their value. However, it does seem clear from this anecdotal evidence that the dialogue intensive model can create a deeper and richer learning experience for the students.

Framing the Dialogue Intensive Model

It is very important to create an appropriate climate for this model. This starts with the proper expectations. The course syllabus must be very specific about discussion expectations in terms of its relative grade value and student engagement. The discussion's grade weight should be high enough to really matter (20-30%) and also divisible so that each course unit can be graded. Many of the dialogue-intensive models break down the discussion points into individual units. For example, in a 15 week course, the student can earn 2 points per week or 30 points overall for active discussion participation. Students also need to understand how discussion points are earned. The ideal method for discussion grading should be a blend of quantity and quality. Too little quantity and the dialogue-intensive model dissolves into the "1+" model, too little quality and the intensive nature of the model becomes watered down. Too much quantity can be overwhelming. It can be intimidating to re-enter a discussion board after missing a day and finding 40+ unread postings. The syllabus should have specific metrics for quantity as well as a rubric for quality. Often, this rubric is expressed two ways; a description of a "good" posting and some examples of inadequate postings.

The instructor should also ensure a proper balance between "knowing and doing" in the discussions. Using course or outside materials (knowing) is important to the learning objectives but the discussion comes alive with examples (doing). Students should be encouraged to share relevant professional experiences or to comment on relevant current events to illuminate the underlying discussion question. To encourage interaction, the instructor should emphasize the minimum number of days required for participation. For example, "you are expected to post a minimum of 7 postings over 4 days in the discussion week." This ensures the discussions are spread out a bit and also countermands the tendency to either post early and disappear, or to post frantically in the last day of the discussion. It is a good practice to expect the students to post their initial response on the first or second day of the discussion week.

The issue of discussion "etiquette" also needs to be addressed. If you have ever participated in a chaotic chat session, you understand the need for some basics. I usually post a document called "A Survival Guide to Our Discussions" which covers again some of the discussion topics noted in the syllabus. I do this because I have learned that I can't overstate this. It also covers issues related to organization of the discussion room (use of the subject line, how to respond to a posting and how to post new threads), tone, language use, expectations about grammar and writing style, proper citations, and an admonition about respecting the discussion area. Finally, in this document, it is helpful to provide some advice on how to manage the workload in a dialogue intensive class. Ideally, the student would enter the discussions twice per day, 6 days a week. This makes an intensive discussion manageable and enhances the learning experience by reducing stress. Since life gets in the way and the ideal does not occur very often, the students should be encouraged to enter

the discussions at least once per day and to never miss two days in a row, if at all possible.

Creating the Right Climate

Once expectations have been set, the instructor must now create an active, positive climate for the discussions. It all starts with the discussion question. Creating the "right" question that will engender intensive discussions is a bit of an art. It cannot be a "close-ended" question obviously and it should also not be a question that seeks a specific answer. It should allow for different answer approaches as well as room for expansion. A good discussion question addresses the topic and aligns with the learning objectives but also allows the student to bring in personal, relevant experiences or to extend the point by asking a tangential question or bringing in outside materials. The key ingredient to the dialogue intensive model is active engagement by the instructor. Without the instructor's energy and guiding hand, the discussion can easily spin out of control and undermine the learning objectives. Ideally, the instructor bookends the course and actively guides the discussion every day in between. It starts with the initial discussion question as discussed above and ends with a summary posting on the last day of the unit which captures the key learning points of the discussion. This ensures that the students leave the discussion unit with what the instructor thinks are the critical learning points. Citing specific students in this summary creates further positive energy for the coming discussions units.

It is also helpful if the instructor mixes up his instructional style during the discussions. Many instructors have a favored style in the discussions (e.g. the Socratic style). I have found that shifting styles can help foster more interaction. Students respond well to "expert" postings where the instructor shares specific experiences or knowledge. Students respond especially well to "learn it, apply it" type postings. Ideas, practices or experiences that they can apply the next day at work not only create more discussion engagement but they also help translate the course material into easily understood concepts or practices. Too many expert postings and dialogue diminishes because the students are wary of challenging the professor or offering a "wrong answer." The Socratic method is very useful because it forces the student to think and offer his own perspective. Too much of this method and the students can get frustrated.

Another style is the Devil's Advocate. Discussions really sing with engaged, professional debate. Students are often hesitant to challenge each other or the instructor. Playing Devil's Advocate can break down the hesitation and get students off the fence and into a debate. Of course, the debate must never be personal and should always be respectful. Debate can be fueled by asking follow-up questions ("Yes, but have you thought of this…" or "I understand your point but I would argue that…").

One of the challenges experienced in online discussions is that the discourse can often be superficial. The students answer the discussion question and respond to each other but the dialogue remains predictable or filled with "stating the obvious" type postings. A shifting engagement style by the instructor will change the dynamic a bit and often entice the students to dig deeper. Additionally, posing questions that demand deeper reflection will help (e.g. "what would you do in this situation…" or "taking it a bit further, what do you think of this…").

Above all, the instructor must maintain a positive, safe atmosphere where students feel comfortable engaging.

Student Behaviors – Be on the Lookout

A dialogue intensive model can be daunting. Not every student embraces the model just as not every student participates in the on-campus classroom. It is the instructor's job to make them comfortable enough to engage or to prevent them from hiding. There are several student behaviors that if not managed, will undermine the learning experience.

The beauty of the online class is that the student really can't hide. Virtually every electronic classroom allows the instructor to see

the student's activity level and postings. We know when they post and even how many words they average. Despite this, "the invisible man" will try and hide. The best methods I have found to deal with them are to specifically engage the student and to provide discussion feedback both formally and informally during the class. I try to engage every student at least once in each discussion unit. I also provide informal discussion feedback every 3 weeks. I will comment on their activity level, the quality of their postings and interaction and will often cite an example of their good work (if any). Usually, this will get them and keep them in the game.

Another form is the "Jane come lately": the student who appears in the last 2 days of the discussion unit and posts madly to get to the minimum expected. Obviously, this behavior adds no real value to the discussion and can be very disruptive. The student needs to be called out right away and stopped by encouraging them to spread out their work. Also, reminding them that the requirements are to post over 4 days of the discussion week.

As mentioned earlier, the "You're wonderful, I could not agree more" student tries to look active without actually adding to the learning experience. The best method to change this behavior is to engage the student in the discussion area as well as to send a private email encouraging them to engage in a more meaningful manner. I have had success with The this type of response to their posting: "Thanks, "Mark" I am glad you agree with Judy's point about trust and leadership. What have been your experiences in dealing with untrustworthy leaders"? On the other end of the spectrum is the "dominator." The dominator often comes in two forms; the overachiever and the egotist. The overachiever dominates by sheer presence. I have had students posting 30+ times in a week; the record was 44 times. We all appreciate commitment and a strong work ethic but overachievers need to be corralled a bit. They are valuable because their postings tend to be very strong but 15-20 postings is actually better for the intensive dialogue than 30+ because they serve as an example and add energy into the discussions without intimidating the other students. The best method is a soft email praising their work while also cautioning about burnout and reminding them to give other students a chance. Asking them to ratchet it down a bit is generally received well if approached correctly. The egotist is disruptive and difficult to manage. His opinion is the right opinion and he finds it difficult to engage in equal discourse. I find this type the most difficult to manage because egotists tend to be thin skinned and resistant to feedback. The only way that has seemed to work is direct contact off line, usually a live conversation where specific examples and suggestions can be discussed.

Two other student behaviors you may encounter can be very disruptive; the contrarian and the therapy seeker. The contrarian delights in being outside the mainstream, often taking positions that are illogical or combative. This can be valuable at times but also can get old quickly, especially if other students get offended. The contrarian can instigate arguments in the discussion area. The instructor must monitor this carefully and intervene if necessary. The best method to manage the contrarian is to directly engage them in the discussion board, professionally challenging their points. This tends to call them out a bit and often softens their positions. The other is the "therapy seeker." Discussion areas are not the therapy couch but I often experience students sharing things from their personal or professional lives that are not only inappropriate but often uncomfortable. A general, soft reminder about staying on topic in the discussion board and a personal email or call to the student tends to take care of this.

Instructor Roles

The dialogue intensive model requires focused and active engagement by the instructor. The instructor must be a facilitator, boundary setter, traffic cop and chief cheerleader. The main role of facilitation is well understood by online instructors. If the instructor is only minimally engaged, the discussion often loses energy or structure. In some cases students may be engaged and active, despite the instructor's absence, but the discussions tend to meander and rarely meet the learning objectives. As stated

earlier, if at all possible, the instructor should be in "class" every day or at least not miss two days in a row. Discussions can easily get off topic or take unproductive tangents. The instructor needs to manage the discussion boundaries by nudging the discussions back on track without undermining student engagement. A posting that seems to work is "I appreciate your point about x, let's talk about how it relates to…" This polite redirection helps get the discussion back on track without sapping the student's energy.

The roles of traffic cop and chief cheerleader are two sides of the same coin. The instructor must regulate traffic flow; the level of discussion postings. If the class is slow to start, he must remind the students of the need to post the initial responses early in the discussion unit. If the quantity or quality is drifting, the instructor needs to energize them. If individual students are not doing their part, he must "ticket" them and get them on track. The other side, cheerleading, is just as important. Creating a positive environment is critical to intensive dialogue. Praising in public and criticizing in private, acknowledging focus and commitment, or thanking the class for a productive week are examples of how the instructor can motivate the class.

A CEO, Nun and Rabbi

I taught a recent class with a CEO, Nun and Rabbi as well as a social worker, police officer and marketing representative, among others. The beauty of the dialogue intensive model is the learning that emerges from the shared experiences and varied perspectives. There are very few opportunities that bring together this type of diversity of backgrounds and experiences and it would be a shame not to leverage the discussions to enable the students to share their insights and practices. Students often report that the relationships they form in dialogue intensive models far exceed that of on-campus courses. They know more about their online classmates than someone who sat next to them all semester every Thursday night in class. Palloff and Pratt (1999) argue that "it is the relationships and interactions among people through which knowledge is primarily generated. The learning community takes on new proportions in this environment and consequently must be nurtured and developed so as to be an effective vehicle for education (p.15)." The discussions are a living thing and the instructor is the primary source of energy and pace for the discussions in this model. The dialogue intensive model requires a consistent commitment from the instructor, but if led well this model offers a richer and deeper learning experience for the instructor and students alike.

> *"I have done both traditional and online programs and I found the communication and sharing of ideas to be greater and more effective in this particular online program" (dialogue intensive model).* Online Graduate Student, 2006

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THE PROBLEM OF VERACITY IN COMPUTERIZED EDUCATION
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ABSTRACT

THE PROBLEM OF VERACITY IN COMPUTERIZED EDUCATION

Although humans are social animals, they can prevaricate. Prevarication is always possible because appearing like honesty and knowledge. Humans being resentful when discovering to have been lied to or misinformed, and distrustful when uncertain of being lied to or misinformed, society cannot survive if humans cannot detect prevarication. Society surviving, humans must be able to detect prevarication. As biological creatures, prevarication must be exhibited biologically if exhibited at all, and humans must have evolved the ability to detect it. A computer being mechanical, not biological, it can exhibit neither characteristics of truth nor falsity. Unformed and formed elements are observationally indistinguishable. Formed elements can be informed or uninformed, the prefix "in-" identifying "before." Observationally indistinguishable, being informed or uninformed is contextually distinguishable. Human biological character provides distinguishing context. Computer mechanical character provides no distinguishing context. Unable to judge credibility of the computer as teacher, credibility of what is taught by the computer cannot be judged. Either the computer educated must be credulous or incredulous, unable to distinguish truth and falsehood.

THE PROBLEM OF VERACITY IN COMPUTERIZED EDUCATION

> 'The Internet Chat Room as a Learning Tool:' . . . *is a truly authentic communicative device*. . . . the sense of real time is a little more forgiving than a face to face spoken encounter. Firstly, there is that all important thinking time between seeing what the other person has written and making one's reply. Secondly, there is the factor of anonimity [sic] which potentially increases the learners' confidence.[1]
>
> ***Technology can liberate the learner***. students learn more from each other than from their teachers and administrators. . . . Today, . . . Internet chat rooms and threaded discussions . . . are in some ways better. . . . By their nature, the present generation of students is ready for learning technology. "Maybe we're just more, you know, advanced."[2]

INTRODUCTION. Assuming learning is becoming knowledgeable, a test of electronic learning is whether it facilitates knowing, which is an epistemological matter. Does it prepare the student for distinguishing between prevarication and probity? Foundational for these identities is "Visuo affective mapping," which is that "part of the human neural mechanism that allows us to interpret the actions of others in immediate, first person terms," and "In people with conditions such as Autism and Asperger Syndrome, this process has gone awry."[3] Excluding participants engaging in "first person terms," computer education proceeds as if they suffer "Autism and Asperger Syndrome." Even accepting "machines can enter into meaningful – if limited – social exchanges with human operators," it is not for naught the computer preoccupied are designated "geeks."[4]

UNIVERSALITY. Geneticists observe, "When we examine the living world, we see . . . individual organisms are visually clustered into collections that resemble one another more or less closely and are clearly distinct from other clusters."[5] Species being nominal—"resemble one another more or less closely"—then species characteristics are nominal, determined by axiomatic truth functions. A truth function identifying species as real, and evolution identified as constituent of the species, then no property being shared by every species member is explainable as incomplete evolution.

Accommodation is made by generally shared properties, designating their being absent abnormal, a pathological state. Following St. Augustine, an absent trait is presumed existing *en potencia*, assuming induction within an evolutionary convergent universe constrained by conservation of energy. Now common species properties become universal.

So proceeding, although humans can understand differently, order among them requires commonly conceiving reality to at least some extent. Otherwise any concurrence is impossible since individuals cannot arrive at an understanding by agreement, for this requires another understanding, and this still another, etc. Identified is "dispositional nature" in contrast to "constitutional nature." Constitutional nature is the criterion of class membership, and dispositional nature is the character of class members.[6] Since something can behave in any way and still be a class member, only after class members are identified is dispositional nature determinable.

Evolutionary theory provides a basis for "the human neural mechanism [allowing] us to interpret the actions of others in immediate, first person terms." Survival of a socially reproductive species requires members ordinarily behave credibly, there being no trust if not. Social interaction ceases without trust, a socially reproductive species disappearing, when evolution presupposes species seek survival. Consciously choosing

credibility being time consuming, when behaving credibly need be the norm, the extent to which a species member can pay to doing what is necessary to personally survive is diminished, endangering personal survival if credibility need be consciously chosen to occur. Because personal survival of every socially reproductive species member is endangered by consciously choosing credibility when species are presumed seeking survival, credibility among socially reproductive species members must occur unthinkingly generally.

Presumed is a genetic common sense whose extension[7] proceeds by consensual agreement, integrating genetic and consensual criteria.[8] However developed, "Explicit enumeration of"[9] elements is unattainable because "I do not know if any idea ever achieves complete precision."[10] Irrespective, "all that matters for a formal theory, is that the idea is sufficiently precise for what you intend to do with it."[11]

Accepting resolving ambiguity is by a name "'passed from link to link'" in a causal chain, identity is historic. Thus "a credible theory . . . . cannot gain, and it cannot deserve, credence if it disagrees with too much of what we thought before."[12] This is because the time consuming process of continually reconsidering how to behave is alleviated. Constantly considering self-preservation is self-defeating, minimizing doing what is needed for self-preservation, endangering the very self-preservation sought. Presuming species evolve in a self-preservative manner, such self-destructive behavior will be at least uncommon.

Additionally, assuming the human being a social animal, unable to fulfill desires independently of a division of labor, a name "'passed from link to link'" facilitates the communal order necessary for mutual sustenance. Proceeding thus, a common social resolution of ambiguity determining the limit of common sense is implemented. This avoids "the condition which is called war" where "the life of man" is "solitary, poor, nasty, brutish, and short."[13]

PROBITY. Social interaction being a criterion of human species identity, and species sustaining species identity, the human species sustains social interaction. Human species social interaction being consensual, probity is essential for it. A species characteristic being sustained genetically, the human species sustains probity genetically. Probity constituting a set of characteristics, the human species sustains these characteristics genetically.

Some characteristics are ambiguously shared by both probity and prevarication, though. Probity and prevarication sharing all characteristics are indistinguishable, probity not existing. Social interaction being a criterion of human species identity, and probity being necessary for consensual human species social interaction, probity exists. Therefore some probity characteristics are not shared by prevarication, these being unambiguous probity characteristics. Unambiguous probity characteristics are necessary for consensual human species social interaction nominally resolving ambiguous probity characteristics. Thus the human species sustains unambiguous probity characteristics genetically.

These "we can very freely *call to mind*," identifying intuitive judgment generally exhibited by humans to constitute genetically founded nature, corresponding genes identified ex post facto.[14] Such judgment can be linked to environmental markers to form a catalogue facilitating evaluation. Testimony can be immediate or mediate, face-to-face or not. Environmentally relative secondary properties accompanying primitive properties are relevant to identifying probity when not face-to-face. Excluding behavioral characteristics, mediate testimony necessarily presents numerically diminished probity criteria, rendering identity of its probity more problematic.

Difficulty occurs considering Ernst Zermelo's "'axiom of choice'" stipulating, "for any set whose members are sets that are non-empty and mutually exclusive, there exists at least one set having exactly one element in common with each of the sets belonging to the original set."[15] For any nonempty set, it always is possible to imagine a member constituent of another set, this composing a set limit. Such an element constitutes ambiguity, concurrently constituent of two or more "non-empty and mutually exclusive" sets.

Also rendered ambiguous are the sets containing the common element, either separate or joined, "*A* and *B*" or "*C*." Whether considering an element or sets, ambiguity is ubiquitous, deduction of an ambiguous element identifying a contradiction. Resolution of ambiguity being normative, resolution is nominal, preferential as so. Preference constituting free will, identity of a set at its limit(s) manifests free will.

Presupposition of dispositional probity among socially reproductive species members is not susceptible to scientific verification, because scientific verification presupposes it. Scientific challenge to the proposition, therefore, is self-contradictory. Assuming humanity a socially reproductive species, as biological science certainly does unchallenged by other sciences, then science as the set of all sciences presupposes human free will. Being so, prevarication is possible.

CONSCIOUSNESS. How, though, is prevarication known? By behavior, perhaps, or neural functioning. How, though, is relevant behavior or neural functioning known? If definitionally, how is definition known? If behaviorally or neurologically, how is this known without reintroducing the indeterminacy behavior and neurology are intended to resolve?

Resolution is by identity of phenomenal experience. But, this is unknowable by others, consciousness being observationally privileged. Only the public is knowable because observationally common. The public being known privately, though, how is it known the public is observationally common? Only if the private is universally accessible is universal accessibility of the public knowable.

How it is accessible is provided by Adam Smith's sympathetic sentiment. Hereby, "As we have no immediate experience of what other men feel, we can form no idea of the manner in which they are affected, but by conceiving what we ourselves should feel in the like situation."[16] Introduced is the phenomenal character of "consciousness" into the criteria of testimonial evaluation.

Thus, consciousness is not necessarily privileged. That phenomenal experience occurring when in another's circumstance *is* the other's phenomenal experience.

Entailed behavior not conforming to entailed behavior of the other constitutes inaccurately identified or altered circumstance of the other.

Empiricism is founded on the myth of a universal object effecting universal human sensory organs in a universal manner. Psychologism is founded on the myth of a universal phenomenon occurring in universal human consciousness in a universal manner. Only in the case of the empirically aberrant is consciousness deemed inaccessible, because presumed uncommon.

Both empirical and phenomenal character being nuanced, identity of both is iterative. Recursion and iteration are mechanisms of identity, determining the membership of a set. This occurs by a process of sequencing. Common to both recursion and iteration is identity of sequence members by analogy with an archetype, this archetype constituting the intensional criterion of sequence membership.

Distinguishing recursion and iteration is the nature of the identifying archetype. Each initiates with identification of a base case, but differs according to the nature of the base case. Recursion is essential identity from a constant base case, and iteration is accidental identity from an inconstant base case. Limit of an essential identity is necessary, then, and limit of an accidental identity is arbitrary.

Iterative, the empirical and phenomenal criteria determining testimonial knowledge are indeterminate. Veracity being conceptually indeterminate, testimonial knowledge is ultimately uncertain. Programming being determinately limited, computerized education presents a certain world, when human intercourse presents an uncertain world.

This is of concern considering how the human genetic criteria of probity and prevarication are extended to identify the nuance of individual human character. Primary is familiarity with real human beings, both as teachers and classmates. Secondary is literature. No computer can provide for the subtle differences of human physical and personal variation.

LITERATURE. Because biological social creatures, presumably the criterion of human testimonial knowledge has evolved in biological manifestation to foster social interaction. These criteria are learned in human interaction, which practically has limited extent. Its primary extension is storytelling, which introduces private and public manifestations of human character in diverse circumstances, facilitating judgment of the probity and prevarication of human testimony.

Being endemic to all human societies, this provides at least one reason humans appear so fascinated with literature. Relevant is the epistemological principle of testimonial knowledge. Testimony being fundamental to human social life, story-telling is the means by which we transcend personal experience, facilitating social interaction. Unfamiliar circumstances are sympathetically experienced, revealing the behavior and thought of participants.

However, critics of literature dismissively pronounce, "There are only so many stories." Unacknowledged is shared human nature endlessly divides into character subtypes. Literature models these character subtypes in compositional *characters*, both behaviorally and phenomenally, identifying constituents of character subtypes in the sequential order in which they occur. Composed is an axiomatic system identifying dispositional axioms defining a character type, from which behavioral theorems are deducible. Deductive derivation of textual depiction of a compositional character, in turn, verifies initial axiomatic characterization.

Quantum theorist David Bohm notes the indistinguishability of the observer from the observed until nominally defined.[17] Indicative is observer as constituent of the environment, until its limit is explicitly enumerated. Literary critics identify character in this extended manner, understanding its constituents and order relative to the extension of environmental identity.

AXIOMATICS. Certainty might be thought possible by substituting an axiomatic probity only incorporating objectively identifiable criteria. Presuming such certainty lends itself to the uninterpreted syntactic axiomatic system of a computer program. Interpreted semantic systems are still comparatively uncertain because referent can be indeterminate, even when not phenomenal, *practically* impossible to identify. Now, like the autistic, the "face to face spoken encounter" becomes unnecessary, so that, "we're just more, you know, advanced."

Sought is to emulate axiomatic mathematics. Often portrayed is axiomatic systems are syntactic and linguistic systems are semantic, superficially rendering axiomatic systems certain and linguistic systems uncertain. Presumed is the Logical Positivist differentiation between ordinary and logical language whereby,

> ordinary language is of such a character that rigorous logical analysis cannot be carried on within its limits. . . . In a logically perfect language the sense of every proposition is determined by the elementary propositions to which it is reducible. The rules for such a reduction are explicitly given in the proposition.[18]

Descent is from Rudolphus Agricola and Peter Ramus' groundwork avoiding Zeno's infinity paradoxes.[19] Basic are William James' "sudden *contrasts*"[20] and Ferdinand de Saussure's "process of segmentation"[21] within continuous consciousness. Constituted is the genetic intentionality[22] of Noam Chomsky's transformational grammar[23] rendering mathematical proof inconsiderate of anything "in between" functional identity.[24]

Alfred Tarski summarizes the format of an axiomatic system with, "In the . . . so-called *axiomatic method*, an arbitrary, usually finite, set X of sentences—an *axiom system*—is given, and the set $Cn(X)$, i.e. the smallest deductive system over X, is formed."[25] If "a fully deductive treatment is aimed at," though, induction cannot be incorporated into what is identified as axiomatics.[26] However, if an "*axiomatic method*" is constituted by "arbitrary" "*assumptions*,"[27] and this is inductive, then induction is constituent of axiomatics.

Ignoring this provides false certainty, regarding necessary deductive argument, while disregarding unnecessary inductive argument necessary for generating it. If "an *axiom system*" is to form "the smallest deductive

system over *X*," it must be "well-ordered," consistent.[28] Arbitrariness of being "well-ordered" is revealed when considering,

> '[a world in which induction would fail as often as lead to truth] would not be disorder, but the simplest order; it would not be unintelligible, but, on the contrary, everything conceivable would be found in it with equal frequency.'[29]

Consistency is a matter of definition, incompatibility understandable as inconsistency of the law of the excluded middle, or clarification of casuistry.

Escape from indeterminacy is often thought possible by a "*formal consistency*; nothing more."[30] Precision is presumed possible with unambiguous syntactic place holders devoid of ambiguous semantic meaning. Meaning is ubiquitous, however, semantic indeterminacy unavoidable. Place holders have relational properties constituting their meaning, shown by their not necessarily being interchangeable, which they would be if place holding was wholly syntactical. Holding a specific place constitutes their meaning, rendering them not interchangeable.

INDETERMINACY. Mistaken is since "modern logic was designed with the language of mathematics largely in mind," when, "Most mathematical fields these days begin with a collection of undefined objects and a set of axioms which govern the behavior of the objects,"[31] David Hilbert reputedly concludes, "One must at all times be able to replace 'points, lines, planes' by 'tables, chairs, beermugs.'"[32] One is unable "at all times . . . to replace 'points, lines, planes' by 'tables, chairs, beermugs,'" or even by one another, lest they no longer be "'points, lines, planes.'" Indeed, one is unable to replace *this* point with *that* point, lest *this* point no longer be *this* point.

Since place holders have relational properties constituting their meaning, language is semantic, not syntactic. Elements differing in every occurrence, at least in time and/or space, place holding becomes the set of all possible occurrences of the place holder. Now language functions like Boolean algebra, a commutative sequence of overlapping sets whose meaning is the set of all common constituents of the overlapping sets. "Jane loves John" and "John loves Jane" illustrate sentences need not be commutative since love need not be reciprocal. Indicated is if a symbol has more than one meaning, syntactical location is an additional symbolic device identifying which possible meaning the symbol has.

Still, symbolism cannot completely identify meaning because it must be infinite. A computer program being deductive, it has the form,

A is *B*
a is *A*
Therefore *a* is *B*.

How is "*a* is *A*" known? "*A* is *B*" is insufficient because, "the sign for a function already contains the prototype of its argument, and it cannot contain itself."[33] David Hilbert's "distinction . . . between a subject matter under study and discourse about the subject matter" is required, a "discourse about the subject matter" constituting an extra-axiomatic axiom.[34] A "discourse about the subject matter" requiring its own "discourse about the subject matter," entailed is an infinite regress. Constituents of an axiom system being "arbitrary," identity of each subsequent "discourse about the subject matter" is arbitrary, there needing be no consensus on any. As individuals increasingly diverge in criteria individually identifying *a* as *A*, communal identity of *a* as *B* becomes increasingly unpredictable.

Convergence is assumable iff distinguishing common human genetic identifiers. Deception presumes disjoint phenomenal and physical occurrences. Evolutionary neurological manifestations being genetic, they are identifiable as manifesting psychological occurrences by mapping to phenomenal manifestations. Phenomenal manifestations are the primary psychological criterion, allowing prevarication.

UNDERSTANDING. For any axiomatic system, difficulty arises in identifying for "*An ordered set* $\mathfrak{M}$ *. . . a first element under the order prescribed for its elements by* $\mathfrak{M}$*.*"[35] How is "*a first element*" distinguished when a computerized axiomatic system is simply self-contained bits, "an electronic signal which is either on (1) or off (0)?"[36] Are the bits ungrouped or grouped, and if grouped, how grouped? Comprehension of bits constitutes the understanding objective of computer provided education. As "the smallest unit of information the computer uses," it is all the computer "understands."[37]

Educational content is *in*formed content, formed prior to presentation, which presumes consciousness.[37] Even wholly mapping computerized characterization of veracity to human biological veracity manifestations, it is unlinked to consciousness which is a condition of veracity manifestations. Identifying mind as neural not phenomenal, cognitive scientists overlook that neural events as autonomous or coterminous is observational indistinguishable. Formed and unformed elements being observationally indistinguishable, form is an abstract identification occurring only within consciousness.

Being unconscious, computers cannot distinguish formed and unformed elements. Whether the informational "bits" composing its program are coherent or incoherent are indeterminate to it. Indeed, a computer program is unidentifiable independently of a conscious identity of its constituents as such. Gilbert Ryle claiming mind as phenomenal rather than material commits a category error. He effects the ontological fallacy by reifying form. Alan Turing presupposing objectivity of a computer program recommits the fallacy by reifying form, as does Wittgenstein denying private language while affirming public language. Form is phenomenal, not material.

Understanding distinguishes formed and unformed elements. Formed elements are coherent, when coherence is a condition of understanding. Unformed elements are incoherent, when incoherence is a condition of misunderstanding. Understanding, in turn, is a condition of learning. A computer is unable to distinguish formed and unformed elements because unconscious, and students are able to distinguish formed and unformed elements because conscious. Thus electronic learning wholly depends on student achievement of understanding. A human can distinguish formed and unformed elements

because conscious. Therefore human learning depends on teacher and student achievement of understanding. A teacher can be *in*formed and a computer cannot.

CONCLUSION. Ultimately derivative of primitive biologic criteria of testimonial knowledge, axiomatic criteria of testimonial knowledge are not definitive. Biologic criteria verify axiomatic criteria by the shared membership of equivalency (*A=B*). Constituted is the ambiguous mutual limit of the biological metasystem and nominal axiomatic system.

Unable to transcend its program, a computer can train, it cannot educate. A human can train and educate. Training is familiarization with an algorithm. Education is familiarization with extension of an algorithm. So it is,

> a well-*trained* teacher is an *educated* teacher [who] above all, has a sense of the larger picture: the function of the specific lesson in the child's whole life and the function of his learning in the society's commonweal.[38]

Considering "there is the factor of anonymity which potentially increases the learners' confidence," opportunity for error is greater in "The Internet Chat Room" because avoiding the "little [less] forgiving . . . face to face spoken encounter." . . . or possibly not. Using devices such as "mood tones," perhaps "machines can enter into meaningful – if limited – social exchanges with human operators." ☺

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Using Spreadsheets and VBA for Teaching Civil Engineering Concepts

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ABSTRACT

Spreadsheets are becoming increasingly popular in solving engineering related problems. Among the strong features of spreadsheets are their instinctive cell-based structure and easy to use capabilities. Excel, for example, is a powerful spreadsheet with VBA robust programming capabilities that can be a powerful tool for teaching civil engineering concepts. Spreadsheets can do basic calculations such as cost estimates, schedule and cost control, and markup estimation, as well as structural calculations of reactions, stresses, strains, deflections, and slopes. Spreadsheets can solve complex problems, create charts and graphs, and generate useful reports. This paper highlights the use of Excel spreadsheet and VBA in teaching civil engineering concepts and creating useful applications. The focus is on concepts related to construction management and structural engineering ranging from a simple cost estimating problem to advanced applications like the simulation using PERT and the analysis of structural members. Several spreadsheet were developed for time-cost tradeoff analysis, optimum markup estimation, simulating activities with uncertain durations, scheduling repetitive projects, schedule and cost control, and optimization of construction operations, and structural calculations of reactions, internal forces, stresses, strains, deflections, and slopes. Seven illustrative examples are presented to demonstrate the use of spreadsheets as a powerful tool for teaching civil engineering concepts.

Keywords: Spreadsheets, Engineering Education, VBA, Civil Engineering.

1. INTRODUCTION

Spreadsheets are among the earliest software innovations that had a profound effect on the widespread use of personal computers. Spreadsheets made their first appearance for personal computers in 1979 in the form of VisiCalc, an application designed to help with accounting tasks [1; 2]. Since that time, the diversity of applications of the spreadsheet program is evidenced by its continual reappearance in scholarly journals. Spreadsheets are, therefore, among the earliest software innovations that had a profound effect on the widespread use of personal computers. Among the strong features of spreadsheets are their intuitive cell-based structure and the simple interface that is easy to use, even for first time users [3; 4]. Underneath the structure and the interface is a host of powerful and versatile features that can be utilized in teaching from data entry and manipulation to a large number of functions, charts, and word processing capabilities. This is in addition to its visual basic for applications (VBA) powerful programming capabilities. Newer spreadsheet versions have also added many productivity features for Internet connectivity, workgroup sharing, powerful programmability options, and a number of add-in programs. With their wide use, spreadsheets have been used as tools for developing computer models that can be used as a tool for teaching construction management concepts, for which ease of use, versatility, and productivity are the main issues. Hegazy and Ersahin [3] used Excel and VBA to develop an information system for subcontractors and small/medium-sized contractors. Their developed spreadsheet stores resource data for labor, equipment, crews, material, subcontractors, and alternative methods of construction for various tasks. In addition, a separate worksheet is designed for each project to be used for estimating and control purposes.

Ickert and Huston [5] developed a spreadsheet that can be used to analyze multiple solutions for engineering problems efficiently and accurately, and to produce graphs that convey the solution to the end users. Thiriez [6] developed several spreadsheets as educational tools for students. One example is to use the drawing capabilities of Excel to represent decision trees and where window switching and macros allow the educator to animate his presentation. Another example presented by Thiriez [6] is the use of Excel in dynamic programming, deterministic or stochastic, where Excel functions facilitate the development of specialized models. From primary to tertiary levels, the spreadsheet is gradually increasing in its importance as a tool for teaching and learning.

In this paper, Microsoft Excel 2007 [7] is used for developing spreadsheets that can be used for teaching civil engineering concepts. Two areas in civil engineering were selected namely construction management and structural engineering. Spreadsheet applications related to these two areas were developed including construction data management, time-cost tradeoff (TCT) analysis, optimum markup estimation, simulating and scheduling construction activities with uncertain durations, scheduling linear and repetitive projects, schedule and cost control, and optimization of construction operations, as well as the structural calculations of reactions, internal forces, stresses, strains, deflections, and slopes. First, the use of spreadsheets as a tool for teaching construction management and structural engineering concepts in general is discussed. Seven illustrative examples are then presented to demonstrate

how spreadsheets can be used as a powerful tool for teaching civil engineering concepts.

2. SPREADSHEET AS A POWERFUL TEACHING TOOL

Among the strong features of spreadsheets are their intuitive cell-based structure and the simple interface that easy to use even for first time users. Underneath the structure and the interface is a host of powerful and versatile features, from data entry and manipulation to a large number of functions, charts, and word processing capabilities. Newer spreadsheet versions have also added many productivity features for Internet connectivity, workgroup sharing, programmability options, and a number of add-in programs. With their wide use, spreadsheets have been used as tools for developing computer models in domains such as construction, for which ease of use, versatility, and productivity are the main issues. In this paper, a spreadsheet program, Microsoft Excel 2007, is used to develop applications to solve civil engineering problems. Several powerful and infrequently used Excel features are available and can be used to develop practical and powerful models for teaching civil engineering concepts. These features include data lists, data menu options, data filtering, referencing and searching lists, basic spreadsheet functions such as "Vlookup", and pivot table reports. In Excel, a data list is a simple structure of columns and rows that contain data. Entering data into a large spreadsheet list may become extremely tedious and prone to error. The "Data-forms" menu option in Excel provides a simple way for editing or deleting existing records in a list or adding new records. Sorting the data helps bring similar records together for visual inspection or other purposes such as preparing reports and charts. Using the "Data, Sort" menu option, the list's data can be arranged in an order that is chosen by sorting the records. Filtering the data is also a useful way to view a subset of the records that compose a list. To filter a list is to extract records from it, based on criteria set by the user. Referencing and searching the list is another important part of the data management process. In realistic systems, where several lists of data are available, a link needs to be established among them (similar to the relational database concept). One simple and important spreadsheet function ''Vlookup'' can be used to link separate lists of information by making a reference to where the original data are. Accordingly, it is possible to determine the a cost of a certain project item, for example, by using a Vlookup function to search the original list and determine its associated rate per hour value. The "Match", "Index", and "Offset" are other functions that provide further control over the data in a list. Reporting is another essential requirement for obtaining summary data. In Excel, the pivot table wizard provides an automated report generator.

In addition to the features and functions of Excel, its programming capabilities, called visual basic for applications (VBA) are very powerful and can be used to solve complex civil engineering problems. Excel can also be used in linear programming, where the solver is used, and where the spreadsheet's graphing capabilities are used both to represent the feasible set and the objective function, and to interactively animate the objective function or constraint movements. Excel can also be used in simulation, where stochastic simulation may be facilitated through the use of an add-in, and a decision support system may thus be built from scratch.

3. USING SPREADSHEETS IN TEACHING CIVIL ENGINEERING CONCEPTS

The basic paradigm of an array of rows-and-columns in Excel spreadsheets with automatic update and display of results has been extended with libraries of mathematical and statistical functions, versatile graphing and charting facilities, powerful add-ins such as Microsoft Excel's Solver, attractive and highly functional graphical user interfaces, and the ability to write custom code in languages such as Microsoft's Visual Basic for Applications. Spreadsheets with these powerful features and programming capabilities can be used as an effective tool for use in civil engineering applications. Examples include construction data management, TCT analysis, optimum markup estimation, simulating and scheduling construction activities with uncertain durations, scheduling linear and repetitive projects, schedule and cost control, optimization of construction operations, design of bolted steel connections, and analysis and design of different steel members such as beams, columns, base plates, etc. Since the core of any information system is the storage of the data and information for management operations, database capabilities in spreadsheet programs can be used as an effective tool to develop complex data management system for construction information. Few basic, but infrequently used, spreadsheet features need to be known and can be used to develop practical and powerful models, which can be used for teaching civil engineering concepts. In this study, several spreadsheets were developed to be used for teaching civil engineering concepts. In the following subsections, example applications are presented in two areas in civil engineering: 1) construction management, and 2) structural engineering.

Applications in Construction Management

Four examples are presented in this paper to demonstrate the use of spreadsheets in teaching construction management concepts. The first example illustrates the use of Excel for the management of construction information. In Excel, a data list is a simple structure of columns and rows that contain data. Entering data into a large spreadsheet list may become extremely tedious and prone to error. The ''Data-forms'' menu option in Excel provides a simple way for editing or deleting existing records in a list or adding new records. This option can be used to develop a construction data management system to manage information related to construction equipment, labor, material, cost, methods of construction, and bills of quantities. Sorting the data helps bring similar records together for visual inspection or other purposes such as preparing reports and charts. Using the "Data-Sort" menu option, the list's data can be arranged in an order that is chosen by sorting the records. Filtering the data is also a useful way to view a subset of the records that compose a list. To filter a list is to extract records from it, based on criteria set by the user. Referencing the list is another important part of the data management process. Also, Excel has several important and powerful functions. For Example, one simple and important spreadsheet function "Vlookup" can be used to link separate lists of information by making a reference to where the original data are. For example, consider the situation when a new list is used for estimating purposes (Figure 1) and this list refers to the "Code" of the labor being used. Accordingly, it is possible to determine the cost by

using the "Vlookup" function to search the original labor list and determine its associated "Rate/hr" value (Figure 1).

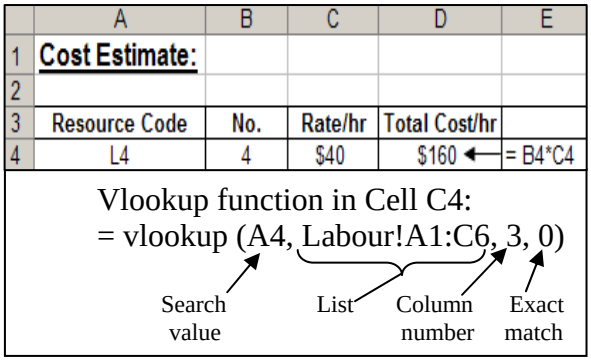


Figure 1: Using the Vlookup Function.

If the resource code specified in cell A4 of the estimate is changed (e.g., L5 is used), the costs will be adjusted automatically in cells C4 and D4 of the estimate. In addition to the ''Vlookup'' function, the ''Match'', ''Index'', and ''Offset'' functions provide further control over the data in a list. The help system of Excel can be used to obtain information about the syntax and use of these important functions. Reporting is another essential requirement for obtaining summary data on resources and operations. In Excel, the pivot table wizard provides an automated report generator. Pivot tables can be used to arrange projects' information in the needed format, summarize long lists in a compact format, find relationships within lists that are hidden by all details, display data in the form of averages, percentages, summations, etc.

The second example illustrates the use of probabilistic models to analyze the behavior of a contractor's competitors bidding for a job in order to optimize the markup used in bidding for a job. The probability approach has historically been the most popular technique for the construction of bidding models. Most bidding models based on probability theory have been derived from the work of Friedman [8]. Friedman claimed that, in a tender, it was possible to model each bidder's behavior as a function of the estimated cost by means of a probability distribution. The general approach assumes that there are a number of bidders competing regularly against each other in the same market place and, given a sufficient number of opportunities to tender against known competitors, any one player can collect sufficient information to model the relationship between its own markup on future projects against the probability of submitting the lowest tender. This approach also assumes that the basic prime cost is similar for all competitors, and by comparing the competitors' tender figures for past projects with its own estimate of prime cost, a contractor can therefore develop a probability distribution for each of its competitors showing the likelihood of winning future tenders with different markups. Using Friedman's model, the probability of winning against a range of contractors $P(win_{all})$ is the product of the chances of beating them each individually, and the maximum expected profit (EP) can be calculated as follows:

Expected profit (EP) = Profit x $Pwin_{all}$

Where: $P(win_{all}) = Pwin_1 \times Pwin_2 \times \ldots\ldots\ldots\ldots \times Pwin_n$

and n: is the number of competitors.

Gates [9], on the other hand, suggested that by comparing its own bid to the winning bid a contractor could calculate the markup which would have been needed in order to win the contract. Again this implies that cost is the most important criterion:

$$P(win_{all}) = \frac{1}{[(1-P(Win_1))/\ P(Win_1)]+\ldots+\ [(1-P(Win_n))/P(Win_n)]+1}$$

To illustrate this concept to, the two approaches were modeled using Excel and a spreadsheet was developed to calculate the optimum markups using both Friedman and Gates approaches. When a contractor bids for a new job, it is assumed that he/she knows other competitors bidding for the same job. To estimate the optimum markup for the contractor, the user will only enter the number of previous bids for each competitor bidding for the job, the competitors' bid values for these bids, and the contractor's estimated cost. Excel then counts the number of bids for each competitor and the bid to cost ratio for each bid and for and each competitor. It also calculates the mean and standard deviation of the bid/cost for previous bids of each competitor. The mean is calculated based on the summation of the bid price to bid cost ratios for all available bids for each competitor divided by the number of available bids. Excel will also calculate the probability to win each competitor separately and the probability to win all competitors (Figure 2), using Friedman and Gates models. For both models, the maximum expected profit (max. EP) is found using the "Max" function. As shown in Figure 2, the maximum expected profit using Friedman's model is found to be $2,389.47 (cell I27) and using Gate's model is $23,361.82 (cell J27). Excel will then find the markup corresponding to the maximum expected profit for both Friedman and Gates models using the "Vlookup" function. For example, the "Vlookup" function used to calculate the markup corresponding to the maximum expected profit for Friedman's model (Cell I28) = Vlookup(I27, I15:K25, 3, 0). For the example in hand, the optimum markups using Friedman and Gates models were found to be 3% and 7%, respectively.

	G	H	J	K	L
15	Freidman $Pwin_{all}$	Gates $Pwin_{all}$	Freidman EP	Gates EP	Markup
16	0.0288	0.1411	1437.72	7053.28	0.01
17	0.0216	0.1260	2156.90	12595.30	0.02
18	0.0159	0.1120	2389.47	16798.41	0.03
19	0.0116	0.0991	2316.04	19826.43	0.04
20	0.0083	0.0873	2070.92	21834.18	0.05
21	0.0058	0.0766	1748.79	22967.24	0.06
22	0.0040	0.0667	1412.06	23361.82	0.07
23	0.0027	0.0579	1098.21	23144.75	0.08
24	0.0018	0.0499	826.51	22433.42	0.09
25	0.0012	0.0427	603.79	21335.71	0.10
37		Max. EP:	2389.47	23361.82	
38	Optimum Markup:		3%	7%	

Figure 2: Optimum Markup Estimation Sheet.

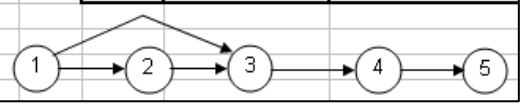
The third example illustrates the use of spreadsheets for scheduling construction activities with uncertain durations using the Program Evaluation and Review Technique (PERT). Using this technique, each activity has three durations; the optimistic time (*a*), the pessimistic time (*b*), and the most likely time (*m*). PERT uses a weighted average of the three times to find the overall project duration. This average time is called the

expected time (t_e), which is equal to (a+4m+b)/6. To determine the probability of a project to be completed earlier or later than expected, the variance (v) of each activity along the critical path is calculated as follows: $v = (b - a)^2/36$. Sine the duration of each activity is uncertain; the time of occurrence of each activity is also subject to uncertainty. The measure of uncertainty of the final event in a PERT diagram is the standard deviation of the expected time (σ_{TE}). The σ_{TE} for the last event is the square root of the sum of the variance of all activities along the critical path. Also the expected time of the last event in the project is denoted as T_E. To determine the probability of completing a project earlier or later than expected, the deviation (z) needs to be calculated; where $z = (T_S - T_E)/\sigma_{TE}$ and T_S is the scheduled time to finish the project. A spreadsheet was developed to illustrate the PERT concept using MonteCarlo simulation. For the five-activity project shown in Figure 3 (b), the user needs to enter two times only (a and b) for each activity and their corresponding variances ($v = \sigma^2$) will then be calculated automatically.

	C	F	G	H	I	J
1		Duration				
2	Activity	Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5
3	1-3	19.90	20.22	20.21	19.60	20.78
4	1-2	9.19	9.66	9.23	9.02	9.42
5	2-3	11.83	11.47	11.84	11.31	11.14
6	3-4	12.96	13.93	15.62	14.84	12.49
7	4-5	11.34	13.24	12.21	11.77	13.23

(a) Input of Activities' Durations.

	A	B	C	D	E
1	PERT (MonteCarlo Simulation):				
2					
3		σ^2 =	Activity	Min duration (a)	Max duration (b)
4		0.444	1-3	19	23
5		0.028	1-2	9	10
6		0.028	2-3	11	12
7		0.444	3-4	12	16
8		0.25	4-5	11	14
9					
10					
11					
12					



(b) Activities Random Durations.

Figure 3: Activities' Durations Using PERT.

Several iterations are used by selecting random numbers between the optimistic and pessimistic times using the Excel "rand()" function. For the purpose of this example, four iterations are used. Each path in the network is then identified and, following the logic of the network, the critical path is automatically calculated by identifying the longest path in the project. The expected time of the last event in the project (T_E) is calculated and the standard deviation (σ_{TE}) for critical activities in each path for each of the four iterations is also calculated. Excel then calculates the average expected time (T_E) and the average standard deviation (σ_{TE}). For a scheduled time (T_S) = 47 days; for example, the probability (*Prob.*) to complete the project in this duration using iteration 2 is calculated using the "normdist" function and found to be 68.74%. For example, using iteration 2, the number of days that corresponds to completing the project with a probability of 68.74% is calculated using the "norminv" function and found to be 47 days.

The last example is a VBA application. In this example, an Excel spreadsheet was developed and a VBA macro code was written for time-cost trade-of analysis. The sheet provides information about project activities with their logical relationships and their corresponding durations, resource requirements, methods of construction, and costs associated with each method of construction. The VBA macro was developed to find the optimum method of construction for all project activities. The basic premise of the model is to allocate optional construction methods for each activity, varying from cheap and lengthy to expensive and short. Using the model, users will be able to select different construction methods and find the corresponding total project cost. The proposed model, as such, is usable not only at the planning stage but also during construction. The VBA macro then automatically generates a Microsoft Project file for the project using the data of the spreadsheet. The code was written to generate a Microsoft Project file for the project example in hand. The code copies activities' data such as activities' names, durations, and start times, construction methods, and activities' actual costs from the spreadsheet and then transfers the data to a newly generated Microsoft Project file for the project. A complete schedule for the project using the selected data is finally automatically generated.

Applications in Structural Engineering

Three examples are presented in this paper to demonstrate the use of spreadsheets in teaching structural engineering concepts. The first example illustrates the use of Excel to enhance the concept and efficiency of moment distribution method when spreadsheet is used. A continuous beam subjected to uniform distributed load was used (Figure 4) to illustrate the concept and to show that spreadsheets reduce the number of random arithmetic errors and time in doing the tedious moment-distribution computations. Moment distribution method is a classical method that has been included in every civil engineering program. It is one of the first numerical methods for structural analysis. The procedure of the method for prismatic members can be summarized as follows: 1) compute the relative stiffness k = I/L for each member that is either connected or supported at both ends. This excludes overhang members; 2) compute the distribution factor (DF) for each member connected to a joint or support; 3) compute fixed end moments (FEM) for members with intermediate loads; 4) compute end moments for overhanging members; 5) pre-determine a tolerance limit; 6) balance the moments at each joint and distribute the balancing moment according to DF of each member; 7) carry over the balanced moment to the adjacent end of each member; 8) repeat steps 6 and 7 until the unbalanced moments are within the tolerance limit; and 9) sum the moments in each column for each member end.

UNIFORM LOAD ON ZA	=	1.241	k/ft						
UNIFORM LOAD ON AB	=	1.241	k/ft						
UNIFORM LOAD ON CD	=	1.241	k/ft						
UNIFORM LOAD ON DZ	=	1.241	k/ft						
LENGTH OF CANTIL. ZA	=	1.00	ft						
LENGTH OF SPAN AB	=	30.00	ft						
LENGTH OF SPAN BC	=	30.00	ft						
LENGTH OF CANTIL. CZ	=	1.00	ft						

Z A B C Z

MOMENT DISTRIBUTION

P LOAD	10.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	
DIS. TO P	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	
JOINT	ZA	AB		BA	BC		CB	CZ	
DF	0	1		0.50	0.50		1	0	
FEM	-10.62	93.07		-93.07	93.07		-93.07	10.62	
DIST.		-82.45		0.00	0.00		82.45		
C.O.		0.00		-41.23	41.23		0.00		
DIST.		0.00		0.00	0.00		0.00		
C.O.		0.00		0.00	0.00		0.00		
DIST.		0.00		0.00	0.00		0.00		
NEG. MOM.	-10.62	10.62		-134.30	134.30		-10.62	10.62	
UL REA.	1.241	18.61		18.61	18.61		18.61	1.241	
MOM. REA.		-4.12		4.12	4.12		-4.12		
PL REA.	10	0		0	0		0	10	
SUB TOT.	11.241	14.49		22.74	22.74		14.49	11.241	
TOTAL	Reaction @ A	25.73		Reaction @ B	45.48		Reaction @ C	25.73	

Figure 4: Moment Distribution Calculation Sheet.

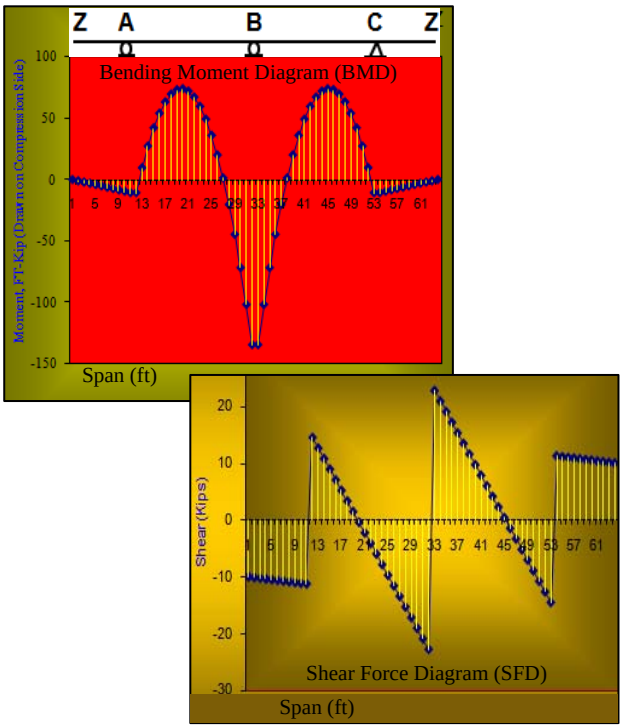
The second example illustrates the construction of the shear force and bending moment diagrams for any structural member using a spreadsheet. Figure 5 shows the shear force and bending moment diagrams for the continuous beam used in the first example (the moment distribution example). Beams are long and slender structural elements that support transverse as well as axial loads. Figure 5(a) shows the bending moment and shear force values at different span distances while Figure 5(b) shows the bending moment and shear force diagrams.

These diagrams are important in structural engineering as they show not only the variation of the internal forces along the length of the structural member but also the most critical values that the structural engineer needs to design the relevant structural member. They are the most popular techniques to show the changes in the internal forces of a structural member along its length. These diagrams are obtained using the relationships between the external loads on the member and the internal forces generated in the member and the free body diagrams (FBD's) to the left or right of sections that cut the member transversely and show all the forces on those FBD's. Then equations of equilibrium are applied to ensure equilibrium is satisfied. The shearing forces and the ending moments obtained are basically the internal stress distribution resultants. Typical examples of beams include bridges, roof structural elements, floor beams, machine elements such as levers, cranks, manipulator arms, etc.

The third example illustrates the use of Excel in calculating the internal stresses and deflection in a beam. Having calculated the design bending moment and shear force for the beam above, all that remains to be done now is to assess the size and strength of the beam. The process involved in a selection depends on whether the construction material behaves elastically or inlastically. For the demonstration in this paper, elastic behavior has been presented. The calculation of the internal stresses, whose resultants are the shearing forces and bending moments produced by the external loads, and the deflections in a beam of know section and geometry uses the section modulus (*S*) and the cross section area (*A*) and its moment of inertia (*I*).

Span-Distance along span			Moment	Shear
1	Cantilever ZA	0.00	0.00	-10.00
2		0.10	-1.01	-10.12
3		0.20	-2.02	-10.25
4		0.30	-3.06	-10.37
5		0.40	-4.10	-10.50
6		0.50	-5.16	-10.62
7		0.60	-6.22	-10.74
8		0.70	-7.30	-10.87
9		0.80	-8.40	-10.99
10		0.90	-9.50	-11.12
11		1.00	-10.62	-11.24
12	Span AB	0.00	-10.62	14.49
13		1.50	9.72	12.63
14		3.00	27.27	10.77
15		4.50	42.03	8.91
16		6.00	53.99	7.05
17		7.50	63.17	5.18
18		9.00	69.55	3.32
19		10.50	73.14	1.46
20		12.00	73.93	-0.40
21		13.50	71.94	-2.26
22		15.00	67.15	-4.12
23		16.50	59.57	-5.98
24		18.00	49.20	-7.85
25		19.50	36.03	-9.71
26		21.00	20.08	-11.57
27		22.50	1.33	-13.43
28		24.00	-20.21	-15.29

(a) Bending Moment and Shear Force Values.

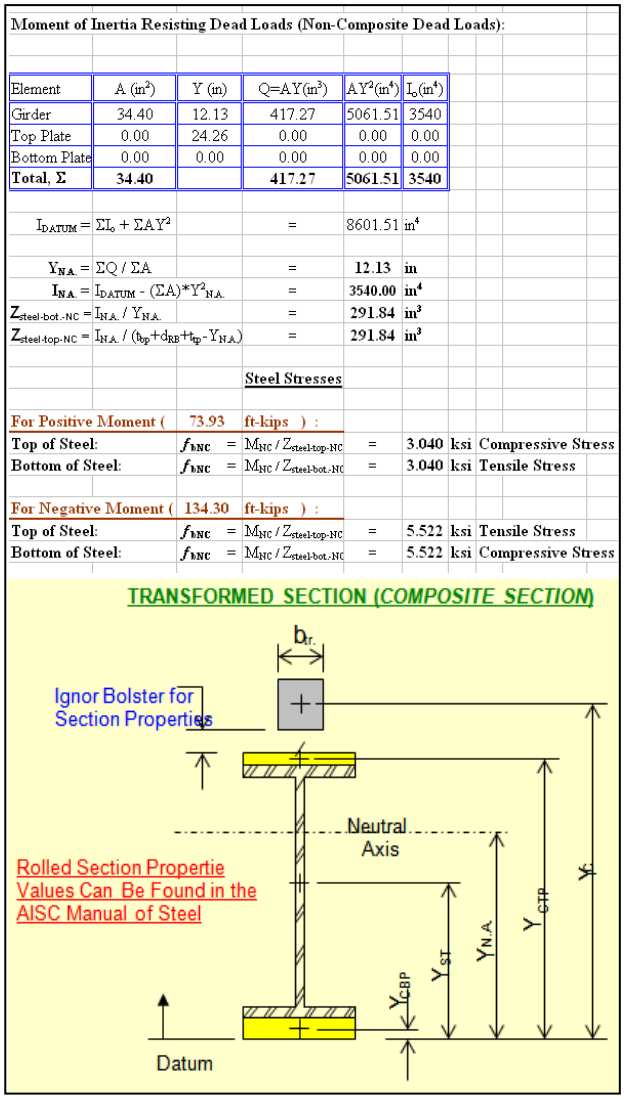


(b) Bending Moment and Shear Force Diagram.

Figure 5: Bending Moment and Shear Force.

As shown in Figure 6, the spreadsheet reduces the arithmetic errors of computing the *S*, *A*, and *I*, the frustrations, and the time doing the tedious stress calculations. The procedure for

computing stress briefly involves: 1) computing the maximum moment and determine the required section modulus (S) using the flexural formula, $S = M/f_b$; 2) selecting the most economical (lightest) structural steel shape using the AISC Allowable Stress Design Method; 3) checking the beam for shear by comparing the actual shearing stress and the allowable shearing stress; and 4) computing the maximum deflection due to the design load and compare it to the allowable deflection.



Moment of Inertia Resisting Dead Loads (Non-Composite Dead Loads):

Element	A (in²)	Y (in)	Q=AY(in³)	AY²(in⁴)	I_o(in⁴)
Girder	34.40	12.13	417.27	5061.51	3540
Top Plate	0.00	24.26	0.00	0.00	0.00
Bottom Plate	0.00	0.00	0.00	0.00	0.00
Total, Σ	**34.40**		**417.27**	**5061.51**	**3540**

$I_{DATUM} = \Sigma I_o + \Sigma AY^2$ = 8601.51 in⁴

$Y_{N.A.} = \Sigma Q / \Sigma A$ = 12.13 in

$I_{N.A.} = I_{DATUM} - (\Sigma A)*Y^2_{N.A.}$ = 3540.00 in⁴

$Z_{steel\text{-}bot\text{-}NC} = I_{N.A.} / Y_{N.A.}$ = 291.84 in³

$Z_{steel\text{-}top\text{-}NC} = I_{N.A.} / (b_{tp}+d_{RB}+t_{tp}-Y_{N.A.})$ = 291.84 in³

Steel Stresses

For Positive Moment (73.93 ft-kips) :						
Top of Steel:	f_{bNC} =	$M_{NC} / Z_{steel\text{-}top\text{-}NC}$	=	3.040	ksi	Compressive Stress
Bottom of Steel:	f_{bNC} =	$M_{NC} / Z_{steel\text{-}bot\text{-}NC}$	=	3.040	ksi	Tensile Stress
For Negative Moment (134.30 ft-kips) :						
Top of Steel:	f_{bNC} =	$M_{NC} / Z_{steel\text{-}top\text{-}NC}$	=	5.522	ksi	Tensile Stress
Bottom of Steel:	f_{bNC} =	$M_{NC} / Z_{steel\text{-}bot\text{-}NC}$	=	5.522	ksi	Compressive Stress

Figure 6: Section Properties and Stress Calculations.

4. CONCLUSIONS

Spreadsheets are becoming increasingly popular for use as a powerful tool and are considered among the earliest software innovations that had a profound effect on the widespread use of personal computers. Among the strong features of spreadsheets are their intuitive cell-based structure and the simple interface that is easy in education. This is in addition to its powerful programming capabilities. Underneath the structure and the interface is a host of powerful and versatile features that can be utilized in teaching, from data entry and manipulation to a large number of powerful functions. In this paper, several spreadsheet applications are developed for use in teaching civil engineering concepts. For the purpose of illustration, seven of these spreadsheet applications are then presented. The examples demonstrate the simple and powerful features of spreadsheets and its capability in solving complex construction management and structural engineering problems. These examples can be used by civil engineering students as templates for solving similar problems or for developing models to solve other problems. In addition, the developed spreadsheets, as such, represent a transparent methodology that allows for quick what-if analysis in cost estimation, optimum markup estimation, risk analysis, and structural members optimization. Finally, the availability of Excel and its VBA programming capabilities makes it a powerful tool in developing applications for teaching civil engineering concepts and concepts related to other engineering disciplines.

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Educational Leadership's Literacy Needs for Informatics and Cybernetics Agenda

Abstract

At the heart of many forms of societal change is leadership that is aware of the necessary change that may best suit emerging technological paradigms. However, the informatics and cybernetics agenda is one that may be unknown in policy on the federal and many state levels towards educational K-12 value. Specifically, Executive Order 12906, a federal mandate known as the Coordinating Geographical Data Acquisition and Access: The National Spatial Data Infrastructure, by the federal government in 1994 has interested educators in exploring their possible roles in spatial thinking, broadly defined as the use of space to define, formulate and solve problems (Branch, 2009). As such, literacy towards informatics and cybernetics may be needed to stimulate such pipeline considerations by next generation educational leadership (NGEL).

Thus, educational leadership's literacy towards informatics and cybernetics may need to be an intentional interdisciplinary collaboration of change where issues of climate change and a green economy are injected into a K-12 data experience which could possibly address the NCLB (2001) mandate and to increase mandated geosciences outcomes. Such state compliance to Executive Order 12906 is coordinated by the National States Geographic Information Council (Branch, 2009). Moreover, educational leadership is directed to ensure such data driven activity occurs within its infrastructure, because in most cases a state's department of education has to compliance like all other state agencies as a state seeks compliance with the federal Executive Order 12906.

Keywords: informatics, cybernetics literacy

Introduction

This work may serve as a brick in the new educational foundations of NGEL. Such proclaims that leadership must have pragmatic solutions and refrain from political rhetoric. NGEL should address, represent and bridge pragmatic solutions to long standing educational issues left behind due to a lack of effective interaction between communities, school leadership, such policy makers and the scientific community. Lastly, this work may imply that informal and formal community informatics and citizen science programs may be the plausible venues to address Science, Technology, Engineering and Math (STEM) outcomes. In addition, this paper focuses on Earth Science and space informatics as K-12 literacy need because it linked as outcome of the STEM outcome as defined by the United States Department of Education. Thus, the terms informatics and cybernetics are assumed to be linked to Earth Science and space concepts.

For example, as the [1] National Academy of Sciences (2006) defined spatial thinking as an likely medium of scientific communication for all levels of education, the stakeholders in control may develop a new age literacy and involvement towards [2] Executive Order 12906, state mandates, the societal needs of climate change and a green economy. At the root of such effectiveness is what infrastructure and what type of investment in such infrastructures will cost effectively benefit society. As school districts are hit with budget crises, informatics and cybernetics have to re-

define themselves into cost effective and pragmatic community based frameworks that support an interdisciplinary ontology of communication across disciplines as referenced in [3] knowledge representation in the semantic web for Earth and environmental terminology (SWEET). Such may be a defining collaborative skill development towards a global citizen mindset. Such a definition should be considered a NGEL literacy for the global citizen of tomorrow which is illustrated in this conceptual framework in Figure 1.

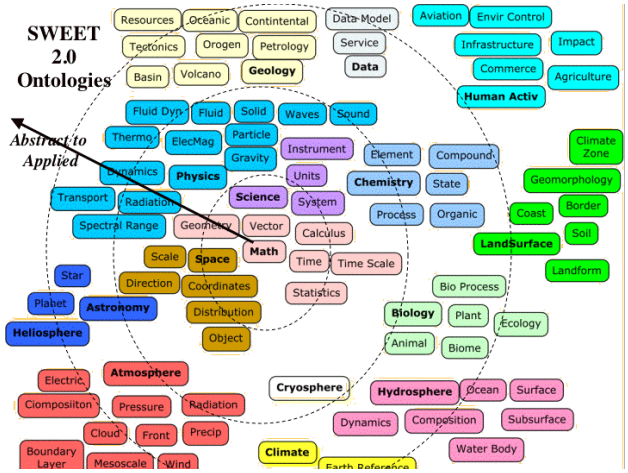

Figure 1 [3] SWEET 2.0

In the [3] SWEET implementation, math may be the root of relating the value of informatics or cybernetics across disciplines. Hence, data processes along with Earth Science investigations may need a synergistic value and intentional support by NGEL to sustain K-12 implementation and assessment.

The foresight of education leadership should have the ability to always define or anticipate the next generation of pedagogical need of its impending data and infrastructure requirements. For example, if grid or cloud computing becomes an cost effective norm in society, then perhaps education should consider a bee hive approach to societal needs where the entire society must input a more equitable role in the brainpower of its citizens to address future climate change and green economy needs. Simply, if informatics and cybernetics are critical to climate change response, then data driven practices along with computational Earth Science training must be a common occurrence.

Hence, educational networks must transfer more knowledge in future generations. For example, National Aeronautical and Space Administration's (NASA) Cryosphere and Dynamic Earth public outreach materials suggest a 3-foot sea level rise by 2100 A. D. that may affect millions of persons in the world. If the potency of effective educational leadership does not have spatial thinking, informatics and cybernetics development on its radar, then how can it steer future generation towards a state of self determination in the face of a complex world where Earth Science data computation is a valuable commodity?

Therefore, society may be challenged with a spatial thinking literacy as well as an informatics and cybernetic literacy. Clearly, "the spatial thinking experience of data collection, data verification, and data analysis is not on the radar of educational leadership" [4] (Branch, 2009). As such, informatics literacy and cybernetics literacy may too be non-evolved within the educational K-12 community.

K-12 literacy needs

This paper suggests that applicable policy exists for spatial literacy to be embraced and supported from [2] 1994 Executive Order 12906. Such is the basis for literacy towards informatics and cybernetics to take root in the K-12 experience after projected based spatial thinking or Earth Science base experienced reach the K-12 standard course of study. This work argues that after school experiences are not enough to prepare the next generation of global citizens to deal with the green economy or climate change implications. The [5] 2009 White House "Educate to Innovate" campaign by the Obama administration should address the K-12 standard course of study on the state level and supported by the US Department of Education because of [2] Executive Order 12906. Furthermore, since past Presidential Initiatives such as Bush administration's 2005

support of geospatial technology in the K-12 and college community should not be ignored.
The states and the federal government laws applicable to [2] Executive Order 12906 should provide rationale for educational leadership and NGEL to ensure spatial literacy applied to the K-16 standard course of study. Literacy towards informatics and cybernetics by educational leadership may be a secondary response to [2] Executive Order 12906.

NGEL should utilize the practice of community informatics, a collection of community remote sensing, community geographical information systems and environmental study, where cost effective Earth Science could be implemented by partnership between educators and the community. Here, a literacy of climate change is justified in the terms and practices of informal to formal Earth Science data collection, analysis and presentation with cost effective Earth Science tools of GIS, remote sensing or Earth Science investigation.

Successful implementations may even become applicable solution to economically stricken school districts. Moreover, a possible benefit to government agencies could be stimulation in STEM disciplines outcome in a cost effective manner if collaboration between academic institutions, the community and scientific agencies desire such synergy.

Moreover, implications to Earth Science and Space informatics pipeline, climate change, interdisciplinary research and collaboration; accreditation change, and grant funding issues should be well versed by educational leadership to address the data driven needs and skills of next generation considerations of global citizens. NGEL has a morale obligation to create the next global competitive citizens with literacy in spatial tools, Earth Science data processes, climate change debate and logistics of a global economy.

Keywords: Spatial literacy, community informatics, next generation educational leadership, climate change literacy

Spatial thinking for social scientists

Other researchers, including [6] Allen (1999), have referenced a continuation of Dewey‘s (1916) notion that time and space are key influences on educational experience, suggesting that education in general has not formally optimized the importance of space in terms of its educational potential. [6] Allen (1999) and others have argued that the concept of space is a vital consideration for social scientists stated “that space is an irreducible, essential quality of humanness and social being” [7] (Lefebvre,1991), [8] (Foucault and Miskowiec, 1986); [9] (Soja, 1989, 1996). Widespread use of spatial thinking models, such as those described by [10] Legates (2005), might not occur due to barriers in a spatial thinking culture in education, such as a lack of spatial literacy. Hence, similar literacy issues may stall Earth Science informatics and cybernetics development unless championed by NGEL.

Spatial Literacy

The social contract between educational leadership and the public may arguably center on helping students to prepare to be productive citizens. Such a commitment resonates in efforts to incorporate 21st century skills within the student experience. Central to the argument of this work is that before the student experience can credibly reflect 21st learning, the leaders of the educational system must themselves possess sufficient knowledge and awareness to direct, evaluate and access instruction in spatial thinking related paradigms.

Literacy-informatics and cybernetics

[11] "Leadership is the single most important factor affecting the successful integration of technology. This is true at the state level and at the school level. Schools which have made the most progress are those with energetic and committed leaders." Hence, NGEL frameworks should build constantly among leadership to incite change towards spatial thinking, informatics and cybernetics literacy.

Informatics and cybernetics defined respectively as information science and “use

models of organizations, feedback, goals, and conversation to understand the capacity and limits of any system" [12] (Pangaro, 2007).

More importantly [13] No Child Left Behind (NCLB) stated that funds can be used to ''(1) acquire and use advanced technology, incorporated into the curricula of the school, to develop and enhance the information literacy, information retrieval, and critical thinking skills of students". Such implies that NCLB funds may be applicable to addressing spatial thinking, informatics and cybernetic literacy in education.

Thus, such communication issues may involve the management of data and its presentation to stakeholders. "While increased accountability is just one part of NCLB, all schools must gather data and overcome barriers to analyzing and using the data" [14] (Bernhardt, 2004). Thus, spatial thinking should be a normal part of overcoming barriers or adjusting to changing metrics and methods of data collection and analysis. Likewise, with an interdisciplinary effort borrowed from Earth Science, NGEL may utilize informatics and cybernetics to overcome data barriers of implementation, assessment or operation.

[15] Dewey (1916) clearly acknowledged that student experience was dependent on factors such as time and space. Dewey (1916) stated, "As a societies[sic] become more complex in structure and resources, the need of formal or intentional teaching and learning increases". [6] Allen (1999) stated that "Dewey believed that all schools, whether traditional or progressive, are essentially about experiences that lead to growth". "We need to invest in a systematic educational program to enhance levels of spatial thinking in K–12 students" [1] (National Academy of Sciences, 2006).

Conclusions

Education professionals should not ignore this bold call for educational change by a major policy maker like the [1] National Academy of Sciences (2006), whose research reputation is second only to Nobel Prize researchers. The [1] National Academy of Sciences (2006) advocated, "Our goal must be to foster a generation of students (1) who have the habit of mind of thinking spatially, (2) who can practice spatial thinking in an informed way, and (3) who adopt a critical stance to spatial thinking".

Such may not be fully sustainable without data skills involving informatics and cybernetics because of the inter-relationships of math, computing and science. As the National Academy of Sciences Academy (2006) advocated spatial literacy for student learning, NGEL must have such skills as well as any informatics or cybernetics literacy. This paper argues that educational professionals should be spatially literate and have a formal set of standards before they attempt to use or teach this in the classroom. Thus, educational professionals are not able to promote spatial literacy effectively to students if they themselves are not spatially literate.

Certainly, a growing spatial culture in education exists, which seeks acceptance, reform, and policy consideration for greater spatial literacy and implementation in education. [11] Legates (2005) stated, "A small number of faculty in each of the social science disciplines and public policy fields have sufficiently mastered GIS concepts and operations to use GIS effectively in their own research and are able to incorporate GIS into their teaching. Literacy towards informatics and cybernetics by educational leadership may have the similar low numbers across disciplines.

Furthermore, efforts by United States Department of Labor, 1991, Hill, 1995, Jacobs, 1989, Furner and Ramirez, 1999 and Sarnoff, 2000 (as cited in [16] Kerski's 2000) indicated, external factors are obvious drivers of the spatial movement in education as the following:

> The U.S. Labor Secretary's Commission on Achieving Necessary Skills (SCANS) stated that the most effective way to teach skills is in the context of an established subject matter (U.S. Department of Labor 1991).

> The SCANS competencies include identifying and using resources, working with others, acquiring and using information, and understanding complex interrelationships (Hill 1995a and 1995b). Interdisciplinary education, rather than teaching each subject in isolation from the others, may be a more effective means to help students solve problems (Jacobs 1989). Implementing GIS into the curriculum may encourage students to examine data from a variety of fields (Furner and Ramirez 1999; Sarnoff 2000).

Hence, spatial thinking, informatics, and cybernetics literacy may appear logical in interdisciplinary learning which may be an effective Earth Science modality as demonstrated in [3] SWEET 2.0 implementation.

A [4] Branch (2009) study participant echoed NGEL sentiment. "People have to be introduced to the concept of spatial order. They seem to be more spatially aware to understand to actually extract information; location, where you're at and what's available; that's important" (study participant 6, personal communication, September 14, 2007).

As policy for spatial literacy exists on manner levels, further literacy interests towards informatics and cybernetics have to pushed by educational leadership dedicated towards the increase in STEM outcomes. However, without spatial think framework as recommended by the national Academy of Sciences (2006), the momentum of educational change led its stakeholders may linger longer than 14 years after the [2] 1994 federal Executive Order 12906.

Thus NGEL is set aside to lead when risk to the society can not ensure the self determination described as inalienable rights of the United States Constitution. All nations can not be held hostage to a robust and healthy pipeline of scientific and Earth Science thinkers intertwined in the mindset of educational leadership.

Thus, as spatial literacy reaches a foothold in education, literacy towards informatics and cybernetics should follow especially if spatial literacy can achieve a K-12 standard course of study implementation. Then, the likelihood of spatial data processes and the awareness of cost effective and efficient informatics and cybernetics development should be formally considered in STEM outcome numbers, furthering the diverse needs of the geosciences pipeline.

Here, the experience of a 21st century or NGEL skill may later transfer to the classroom for student experience. Spatial thinking, informatics and cybernetics require awareness and literacy with beneficial linkages to Earth Science pipeline issues where funding may be a present concern. Present federal policy such as importantly [12] NCLB states that funds can be used to ''(1) acquire and use advanced technology, incorporated into the curricula of the school, to develop and enhance the information literacy, information retrieval, and critical thinking skills of students".

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Program Visualisation tool for teaching programming in C

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ABSTRACT

This paper presents a visualisation tool for novice C programmers. It is well known that programming is perceived to be difficult among novice learners. The aim of this tool is to graphically visualise the code that the student is working on to give them a coherent computational model. It is hoped that this tool will help the learner achieve a coherent mental model in common with the instructor and the rest of the class. This could allow valuable class time to be concentrated on problem solving issues earlier in the teaching semester.

Keywords: programming, novice programmers, Jeliot-C, Software Visualisation, Program Animation

INTRODUCTION

With the introduction of C++ and Java to the programming world, a lot of programmers have moved away from the C language but C remains important in the Engineering industry. Most program visualisation tools currently available for the C language deal with algorithm visualisation (Figure 1) and ignore fine grained program visualisation. For novice programmers the main emphasis is on basic programming skills such as variable declaration, functions and pointers and not on sophisticated algorithms such as sorting. This project aimed to produce a program Visualisation tool for the novice programmer in C.

Figure 1. Pancake Sorting Algorithm Visualisation

The reason that this new tool has been developed for C and not C++ is twofold. One reason is that the C computational model is simpler than the C++ model which includes all of the C concepts plus additional object oriented capacities. The second reason is that C is often used as the introductory language in engineering programming – as is the case in the authors' institution.

Program visualisation. Program Visualisation involves presenting the learner with a visual representation of an executing computer program. It has been the experience of the authors that many learners struggle with programming as they do not have a coherent mental model of how a basic program executes. By allowing beginner programmers to observe a graphical representation of their program in execution they are greatly helped in developing this computational mental model and thus the learning of programming is simplified. It has been found that Program Visualisation tools help in the teaching of the Java[1] programming language but there is no easily available such tool for the C language which is still a major language used in Computer Engineering education.

JELIOT

Jeliot is a program visualisation tool developed in the University of Joensuu, Finland, which visualises Java code at a fine grained level aimed at beginner programmers. Figure 2 shows Jeliot, with its rich visualisation engine, which highlights the part of the program that is being currently executed.

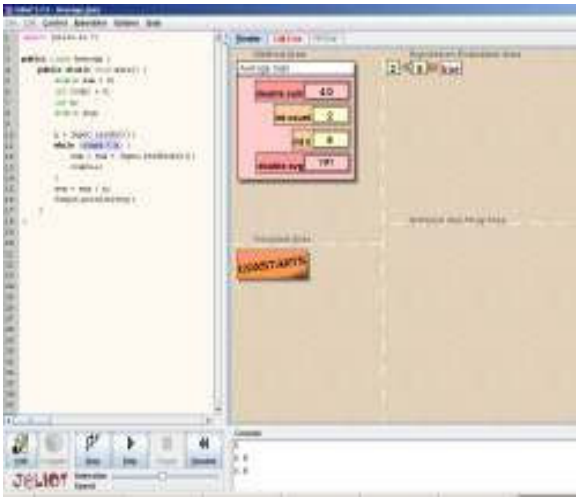

Figure 2. Jeliot

Jeliot has been designed with modification in mind so that the animation engine component can be used to animate other programming languages. To achieve this, the Jeliot team have used a novel technique to decouple the interpretation and execution of the source language (Java) from the visual animation engine. The key to this technique is a new intermediate language called MCode. The source language interpreter interprets the source code and outputs a trace of the program execution expressed in MCode. This MCode trace is then fed into the visualisation engine to produce the animation. Thus the Jeliot team hoped that others could replace the source code interpreter with a different one, e.g. a C++ interpreter that would also produce MCode and so not need to modify the animation engine part for a new language.

The Jeliot team used a 3rd party command line Interpreter (Dynamic Java [3]) as the basis of their source language interpreter. This interpreter was modified to produce an MCode trace of the program execution including all runtine information. This MCode trace was then fed into the visualisation engine to render the animation on screen. Figure 3 illustrates the functional structure of the Jeliot program [2].

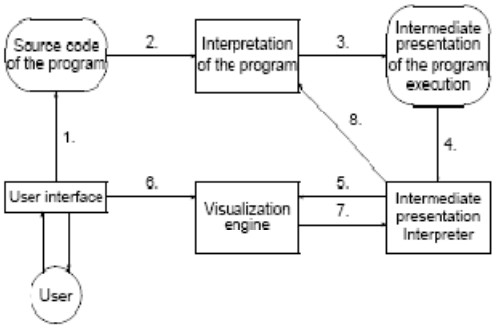

Figure 3: Jeliot Functional Structure

INITIAL PROJECT SCOPE

Thus the initial idea of this project was to find a third party C interpreter, modify it to produce MCode and simply replace the Dynamic Java interpreter. The first problem with this plan was finding a suitable C interpreter. As Jeliot is itself developed in the Java language a C interpreter written in Java was sought.

VISUAL INTERPRETER

Visual InterPreter (VIP) [4] is a program visualisation tool for a subset of the C++ programming language called C--. VIP was developed in the University of Tampere, Finland. Figure 4 shows VIP in operation. As can be seen, VIP is not as visually appealing as Jeliot. However, it does at its core have a C-- interpreter which could possibly be modified to suit the purpose of this project.

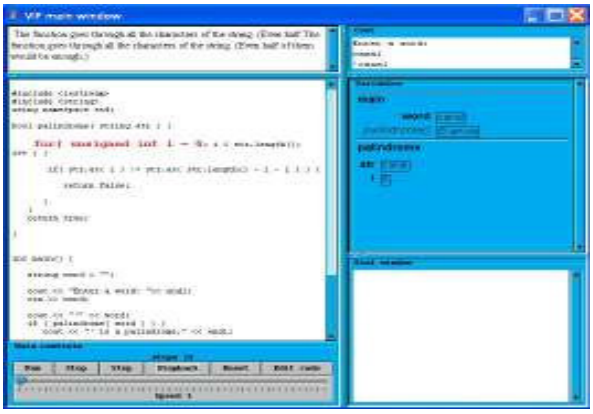

Figure 4. VIP

VIP is based on a C-- Interpreter developed in Tampere called Command Line InterPreter (CLIP). CLIP [5] is built using a “compiler-compiler” tool called SableCC [6] which generates fully featured

object-oriented (Java) frameworks for building interpreters. Frameworks include intuitive strictly-typed abstract syntax trees (AST) and tree walkers. This is the basis of how MCode can be created in VIP; as a tree walker walks across the AST, MCode can be produced and fed into the animation engine that can be viewed by the novice programmer. This is the approach taken in this work.

The subset of C++ implemented by CLIP, C--, falls between C and C++. As such it is neither a full C++ interpreter nor a full C interpreter. Key C concepts missing from CLIP include global variables, standard I/O functions and bit operators.

JELIOT-C

The new tool developed is called Jeliot-C as it takes advantage of the animation engine of the Jeliot system and the interpreter of the VIP project to produce an animation tool for C.

MCODE

MCode is an intermediate language developed by the University of Joensuu to allow them to decouple the components of their Jeliot program.

To get a better understanding of MCode an example is shown below. We begin with a simple Java statement:

```
int y;
```

For the above statement in Java the following MCode is produced by the interpreter [7].

```
VD, y, 0, ?, int, 1, 4,3,4,7
```

Where the various fields refer to the following:

```
VD, Name, NO_REFERENCE/ir,
      value,  type,
   FINAL/NOT_FINAL, Loc
```

“Name” is the name of the variable. In this case “y”.

“NO_REFERENCE/ir” is a field used in complex statements to refer multiple lines of MCode to one source line.

“Value” is the value of the variable if known otherwise a ? will be inserted.

“Type” is the type of variable. Example of types include int, double, char

“FINAL/NOT_FINAL” is whether the value is final or can be altered later on.

“Loc” is the location of the statement in the source code document.

MCode was designed with Java in mind and so while MCode can express any of the concepts found in Java, and so by extension many other object-oriented languages, it cannot express some of the concepts found in procedural languages such as C and the non object oriented concepts of C++. These include:

1. Pointers
2. Structures
3. Global variables

To address this problem the MCode language had to be modified/extended to allow the use of these concepts. Below is the same example as above but expressed in the new extended MCode that supports the C language.

```
VD, y, 0, ?, int, 1, 4,3,4,7,
          0x0054
```

Where the various fields refer to the following:

```
VD, Name, NO_REFERENCE/ir,
value, type,
FINAL/NOT_FINAL/
GLOBAL/NOT_GLOBAL/
STATIC/NOT_STATIC,
Loc, Address
```

There are two fields to look at which are:

“FINAL/NOT_FINAL/GLOBAL/NOT_GLOBAL /STATIC/NOT_STATIC” is an extended field that now includes not only whether the variable is a constant (FINAL) but also whether it is a global variable or is declared to be static. This field can be any combination of the possible values.

“Address”. This is a new field inserted into the declaration to include the physical memory address of the variable. This will allow the use of pointers in the animation engine to be implemented and

possibly a "memory view" animation showing the physical locations of the variables in the program.

These alterations to MCode have been agreed with the team from the Jeliot project.

The alterations to the MCode specification was the first modification required to the Jeliot architecture. Afterwards it was necessary to change the visualisation engine of Jeliot so that it could accept and visualise the new MCode. For example Figure 5 shows an initial mock-up of how it the visualisation engine would visualise pointers and structures.

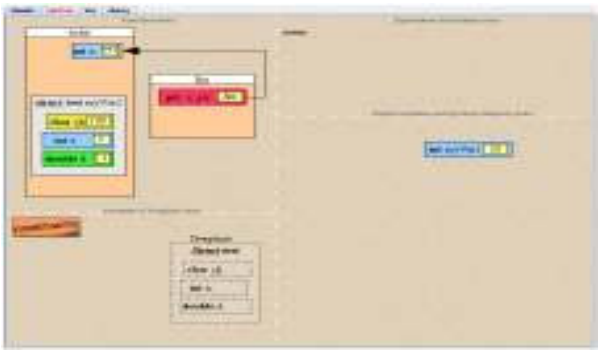

Figure 5. Visualisation of Pointers and Structures

IMPLEMENTATION

As mentioned previously MCode was designed with Java in mind and therefore it had not been designed for other programming languages that are not object orientated, such as C. This meant that the MCode language had to be modified/extended to include other concepts that are in the C language.

In implementing the project an attempt was made to extend rather than simply modify the CLIP interpreter. This would hopefully reduce the work required to re-integrate any new future versions of CLIP released.

CLIP is designed to implement C-- a subset of C++ which as mentioned previously does not fully implement all of C's features either. This posed the question of whether the attempt to only extend CLIP would in fact be feasible. At the time of writing the authors were still adopting the approach of extending rather than modifying CLIP

The animation engine of Jeliot had been designed with Java in mind. Because of this it could not represent C concepts such as global variables, pointers or structures and so additional animation capabilities had to be added. The animation engine also had to be updated to be able to accept the new MCode specification. Again, an attempt to extend rather than modify the animation engine code was made to try and reduce the re-integration effort required if a new version of Jeliot were to be released in the future.

CONCLUSIONS

According to a current research project [8] in the authors' institution analysing the learning styles of incoming students in engineering and computing 71% have been found to be visual learners. Visual learners are students who prefer the use of visual techniques, such as diagrams and colour to aid their learning. Given these statistics the authors believe that this tool will be of great benefit to many novice programmers.

A fully working prototype of the tool has been developed and will be trialled in the Autumn semester of 2010. These trials will be conducted on novice programmers and will survey the students as to their preference to use of the tool to learn a new concept as opposed to the traditional method. The Jeliot team have done similar trails on students [1] and although they have not found definitively that the tool has an impact on exam performance, it was found that the students who did use the tool found it useful. Students who regarded themselves as weak or who struggled in programming reported most favourably on the use of Jeliot.

The authors expect similar results in the trialling of Jeliot-C with novice Engineering students. While no quantitative measure of improved examination performance is expected (or will be measured) it is hoped that both learners and instructors will report benefit through the use of a highly visual and common mental model.

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Programme Accreditation - Experiences at a University Of Technology in South Africa

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Abstract:
Tshwane University of Technology is a leading higher education institution offering career-focused academic programmes. It is the largest residential University of Technology on the African continent. The university offers academic programmes that are compliant with internal quality assurance requirements as well as external legislative requirements. All academic programmes offered by higher education (private and public) institutions in South Africa, must be approved by the Department of Education, accredited by the Higher Education Quality Committee (HEQC) of the Council on Higher education, and in the third instance, be registered on the National Qualifications Framework (NQF) of the South African Qualifications Authority (SAQA). The Directorate of Quality Promotion is responsible for the quality assurance of all academic programmes institutionally, before submitting them externally.

Keywords: Accreditation, merger, programme, Technikon, University of Technology.

1. INTRODUCTION

With the advent of a democratic dispensation in South Africa, a new constitution was developed. This marked the beginning of a process that included amongst others, a unitary higher education system. As part of the changes that affected the higher education sector, three tertiary institutions, Technikon[1] Northwest, Technikon Northern Gauteng and Technikon Pretoria, were merged to form Tshwane University of Technology (TUT). TUT was established on 1 January 2004 [1]. As a leading residential university of technology on the African continent, it enrols more than fifty thousand students yearly with six campuses. The university cares for underprivileged students, and enrols students from neighbouring countries, and some international students. The university has seven faculties namely the Arts; Economics and Finance; Engineering and the Built Environment; Humanities; Information and Communication Technology; and Management Sciences; Science. Being a University of Technology (UoT) the university offers career-focused academic programmes an emphasis on entrepreneurship.

2. OUR MANDATE AND APPROACH

The Directorate of Quality Promotion (DQP) is the central unit responsible for quality and quality assurance functions of the university. It has a staff component of nine and is headed by a director. The DQP has been mandated by the university council to quality assure, review and audit academic and non-academic processes (excluding financial processes); monitor, evaluate and report academic and non-academic processes; and promote the quality of products and services of the institution.

Our approach to quality assurance as applied to one of the functions of the central quality unit, programme accreditation, is based on the Approach, Deployment, Results, and Improvement (ADRI) cycle [2]. There are two objectives of the approach to quality assurance namely accountability and development. Currently the two objectives are pursued asymmetrically with development enjoying a greater portion of the two. The reason for promoting development over accountability is amongst others, to assist faculties to generate baseline data for their programmes, whilst at the same time to experience the various quality assurance processes.

3. PROGRAMME ACCREDITATION

Legislative requirements
The offering of academic programmes by both private and public institutions is regulated. Private institutions need to be registered with the Department of Education (DoE). Once registered, they are further required to register all academic programmes with the DoE. On the other hand, public higher education institutions are promulgated by an act of parliament. TUT is a public higher education institution. Public higher education institutions are required to apply for approval of all their academic programmes with the DoE, for funding purposes. Once programmes are approved, the DoE advises higher education institutions to be accredited with the Higher Education Quality Committee (HEQC) of the Council on Higher Education. The HEQC is responsible for assuring the quality of all academic programmes offered in South Africa. The HEQC executes its function through:

- Programme Accreditation and Coordination
- Institutional Audits and
- Quality Promotion and Capacity Development [3]

The DoE advises higher education institutions to register all qualifications on the National Qualifications Framework (NQF) by the South African Qualifications Authority (SAQA). One of the latest improvements of the NQF is the introduction of the new Higher Education Qualifications Framework (HEQF) [4]. The old NQF consisted of a maximum of eight (8) levels whereas the new HEQF improves the NQF to ten (levels).

Internal Accreditation
TUT is offering career-oriented programmes and focuses on a three year diploma programme. The majority of programmes offered by the university require students to spend about six months of the three years at a workplace related to their programme. This forms part of the Work Integrated Learning (WIL) component of the curriculum. Institutionally academic programmes need to be

[1] A Technikon is now called a University of Technology

approved by various structures. Programmes are conceptualised at Departmental level and academic departments submit their programme applications to their Faculty Boards, who in turn submit the application, after their inputs, to the university Senate for approval. The Senate is the main institutional structure responsible for programme approval. The Directorate of Quality Promotion (DQP) is responsible for the quality assurance of all programme applications before they are submitted externally. The process of accreditation covers both whole programmes and short learning programmes (short courses). This paper focuses on full programmes, and excludes accreditation of short learning programmes. The internal accreditation process is aligned to the HEQC accreditation process. The HEQC has developed a criteria manual [6], which guides the programme accreditation within the higher education sector. New programmes undergo a two phase accreditation, namely, candidacy phase and the accreditation phase.

During the candidacy phase of new programme accreditation, nine criteria are used to provide the minimum standards for each criterion. The following are the nine criteria of the candidacy phase, namely:

- Programme design (Criterion 1)
- Student recruitment, admission and selection (Criterion 2)
- Staffing (Criterion 3 - 4)
- Teaching and learning strategy (Criterion 5)
- Student assessment policies and procedures (Criterion 6)
- Infrastructure and library resources (Criterion 7)
- Programme administrative services (Criterion 8)
- Postgraduate policies, procedures and regulations (Criterion 9)

The programme will be provisionally accredited and may be offered based on the decision of the HEQC Accreditation Committee. Once the first cohort of students in the programme qualifies, a second phase, the accreditation phase has to be fulfilled. The following are the criteria used during the accreditation phase, namely:

- Programme coordination (Criterion 10)
- Academic development for student success (Criterion 11)
- Teaching and learning interactions (Criterion 12)
- Student assessment practices (Criterion 13 - 14)
- Coordination of work-based learning (Criterion 15)
- Delivery of postgraduate programmes (Criterion 16)
- Student retention and throughput rates (Criterion 17)
- Programme impact (Criterion 18)
- Programme review (Criterion 19)

Based on accreditation application documentation submitted for the accreditation phase, the decision of the accrediting body, the HEQC, will either provide unconditional accreditation when the programme exceeds minimum standards or when it complies with minimum standards. The application will be accredited with conditions when the application needs improvements. Finally, the application will not be accredited if it does not meet the minimum standards.
The Directorate of Quality Promotion advises and quality assures programmes within the parameters of the HEQC accreditation criteria.

External Accreditation

The programme application is submitted to the DoE as mentioned above. The DoE approves the application and recommends that the application be submitted to both the HEQC and SAQA. The HEQC accreditation process needs a special mention in that it is online [5]. The HEQC-Online system requires that a single system administrator be appointed and notification of this appointment be sent to the HEQC. The system administrator has rights to allocate usernames and passwords institutionally. At TUT the administrator interacts with the academic community in quality assuring the application internally. Before the application process begins, the DQP arranges for orientation workshops for working on the HEQC-Online system. A number of consultation meetings are held with programme teams to address their needs. Once the needs of the academic programme team are clarified, the application process begins. Various versions of the application form are exchanged between the system administrator and the applicant (representing the programme team). Upon finalising the application process, the system administrator submits the application online to the HEQC on behalf of the applicant. The HEQC processes the application and responds to the institution, giving the decision of the Accreditation Committee of the HEQC. The decision of the HEQC may contain conditions that the institution would have to address. Once an improvement plan is developed, a progress report addressing the conditions is sent to the HEQC. The HEQC responds to allow the institution to offer the programme.

The SAQA registration of programmes on the NQF is a statutory requirement which finalises the application process. As mentioned earlier, the higher education component of the NQF, called the HEQF, came into effect during 01st January 2009. Its implementation was a challenge as the different faculties were already grappling with the merger process. The application for the SAQA registration addresses the following areas, namely [7],

- Title (including qualification type, NQF level and credits)
- Rationale
- Purpose
- Level, total credits, modules (including fundamental, core and elective modules) and learning assumed to be in place.
- Field and sub-field of the qualification
- Exit level outcomes and associated assessment criteria
- International comparability
- Recognition of prior learning
- Articulation possibilities with related qualifications
- Moderation options
- Critical cross-field outcomes and
- Criteria for the registration of assessors.

4. CONTINUOUS IMPROVEMENTS

In order to be true to being a learning organisation, the DQP performs a meta-evaluation on challenges encountered during the accreditation process. A earlier pilot meta-evaluation was based on the use of international standards [8]. The standards are classified into:

- Utility standards
- Feasibility standards
- Propriety standards and
- Accuracy standards.

Meta-evaluation has since become part of our process improvement initiatives. The outcomes of the meta-evaluation are used to improve future programme accreditation applications. It is also used to improve our policies and procedures.

All documentation generated within the directorate is quality assured internally. This involves submitting the document to colleagues for review. The review is usually done on electronic copies. A document version control is maintained.

The DQP maintains an electronic quality management system which archives a large variety of documents, organised systematically.

This is part of the directorates, commitment to continuous quality improvement.

5. CONCLUSION

Programme accreditation at TUT is done within the legislative requirements of the Department of Education, the Higher Education Quality Committee and the South African Qualifications Authority. The DQP is responsible for quality assuring all academic programme applications before they are submitted to external regulatory bodies.

In order to meet the needs of our clients, consultative meetings are organised to obtain clarity on their requirements. Once this is known, workshops and additional support are arranged. The DQP prepares and facilitates the signing-off of all applications to the statutory bodies. Feedback from the statutory bodies is forwarded to academic departments for attention. All quality improvement plans of new programmes are monitored and evaluated. The DQP saves both the hard and electronic copies of the applications. The process is used as a learning opportunity which culminates in continuous improvement. This commitment to quality is in line with the institutions' vision of being a quality-driven university of technology at the cutting edge of innovation.

Programme accreditation at TUT is informed by market needs. Advisory bodies consisting of industry experts, professional body members, academic peers, alumni and the community are instrumental in providing the required market needs.

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From Conception to Compliance, an Interdisciplinary Approach to Spatial Thinking and GIS Education in North Carolina

Abstract

The needs of a global citizen may be determined best by educational leadership and policy stakeholders geared towards interdisciplinary Earth Science. Open-mindedness, a means to reach collective agreement, may support spatial thinking or GIS education in North Carolina towards a formal K-12 course of study implementation.

In particular, *A Five-step Plan and Methodology to Introduce GIS to Educators State-wide* in North Carolina conceptualized the notion of expanding spatial thinking in education. Such could anchor and lead towards a greater interdisciplinary exchange of research collaboration between secondary and K-16 stakeholders. Even the National Academy of Sciences (2006) noted the following:

> Spatial thinking is *not* an add-on to an already crowded school curriculum, but rather a missing link across that curriculum. Integration and infusion of spatial thinking can help to achieve existing curricular objectives. Spatial thinking is another lever to enable students to achieve a deeper and more insightful understanding of subjects across the curriculum (National Academy of Sciences, 2006, p. 26).

Branch (2009) stated the following as,

> As such, this work proposed that before spatial thinking and geographical information systems (GIS)/global positioning satellites (GPS) could be conveyed and implemented properly in the K-12 experience, the educational practices must be in place to address such implications and potential. In addition, as local and state governments further prepare, manage, and embrace GIS in their data operations Onsrud, Johnson, and Winnecki (1996) and; General Assembly of North Carolina (2003), public education may have to do likewise.

The need for geospatial skills was defined as a legitimate workforce concern by the Bush (2005) Presidential Initiatives warranting next generation considerations of K-12 learning. As the coordination of spatial data has been progressing since 2002, in North Carolina, an interdisciplinary approach may be the perfect catalyst to consider GIS methodology as a vital medium to support the United States Science Technology, Engineering and Mathematics (STEM) disciplines and international Group Earth Observation objectives and communities that interact with the International Panel on Climate Change (IPCC).

Keywords: Spatial thinking, GIS education, Executive Order 12906

Introduction

It should be noted that [1] Branch (2009) stated that educational community would have to have a spatial thinking paradigms and experience well understood before it could lead in such advocacy. From leadership an interdisciplinary implementation of spatial thinking and GIS education paradigms must be valued, experimented, debated and collaborated with the greater scientific community. As [2,3] Stubbs Devine and Hagevik (2000) [3] Stubbs, Devine and Haegvik advocated such ideals remains spatial thinking in the K-16 experience is largely not realized. [4] White (2005) stated that such areas need attention. The conception of GIS education is approximately 20 years old in North Carolina [1] (Branch, 2009). However, compliance to [5] Executive Order 12906 since 1994 and supporting educational paradigms are not fully implemented in the North Carolina standard course of study. Hence, such a policy status may be similar nationally as well as internationally where spatial thinking and GIS education may be critical to the international debate on climate change for the global citizen.

The [6] 2009 Obama Administration works to stimulate the STEM outcomes with the "Educate to Innovate" campaign as an afterschool experience. However, in the 1960's, when [7] Kennedy saw Sputnik in the sky, his subsequent educational change sought a direct innovation more towards the K-12 standard course of study rather than after school enrichment activity. Moreover, scholarship has existed for decades per [5] Executive Order 12906 and especially in North Carolina from a proposed Five-step plan by [2] Devine, Stubbs and Hagevik (2000) and other state legislation. Even as the National Science Foundation Geosciences directorate works to augment geosciences outcomes, a subset of STEM disciplines, the issue of formally getting spatial thinking infusion into the K-16 standard course of study remain largely a void as suggested by [1] Branch (2009).

Thus, as [1] Branch (2009) suggested, educational change may require more open-mindedness, intentional learning and renewal towards spatial thinking. It remains an enormous political and morale task for a world faced by the uncertainty in spatial issues such as climate change and a global economy.

Statement of the Problem

The relevance of spatial thinking as an issue in educational policy has greatly increased in recent years as a result of actions taken by federal and state governments. At the federal level, the issuance of [5] Executive Order 12906, Coordinating Geographical Data Acquisition and Access: The National Spatial Data Infrastructure (Federal Geographic Data Committee, 1994), has required government agencies to manage data in a spatially aware manner. Corresponding actions have also been taken by the states.

The North Carolina legislature created the [8] Geographical Information Coordination Council (GICC) to coordinate the spatial data infrastructure of all state agencies via Senate Bill 895 in August of 2001, which is incorporated in the General Statutes §143-725 through 143-727 (North Carolina Geographic Information Coordinating Council 2003, 2006, 2008). In the course of its work, the GICC has made ample use of geographical information systems (GIS) as referenced by [9] General Assembly of North Carolina (2003) and the [8] North Carolina Geographic Information Coordinating Council (2008). GIS involves the use of global positioning satellites (GPS) [10] (Longley, Goodchild, Maquire, & Rhind, 2005).

Moreover, the legislation that established the GICC specifically mandates that the State Superintendent of Public Instruction, the elected leader of elementary and secondary education in North Carolina, participate as a member of the GICC. This plainly suggests that spatial thinking will be an important skill for those aspiring to top-level leadership roles within the state's elementary and secondary school

systems. Yet the extent to which practicing educators currently are equipped for such roles is uncertain.

Spatial thinking refers to the use of space to describe, formulate, and solve problems, as well as to teach and conduct research. And as described by the [11] National Academy of Sciences (2006, p. 36), the basis for spatial thinking is the structure of space and the operations that we can perform on that structure.

Research Question

What aspects of educational change do participants believe must occur in order for a GIS/spatial thinking culture to reach widespread implementation? All levels of educational professionals who support GIS policy or applications in education may be considered potential study participants.

theoretical framework

Indeed, [12] Dewey identified communication as an important societal need: "The essential need, in other words, is the improvement of the methods and conditions of debate, discussion, and persuasion. That is the problem of the public" (Dewey, 1939). This study suggests that spatial thinking and its tools such as GIS/global positioning satellites (GPS) may be a significant improvement in the methods and conditions of debate, discussion, and persuasion. Effective use of data will change a school's culture [13] (Sorenson and Goldsmith, 2006). [14] Dewey (1993) stated that, along with consulting the public for input, the solution to communicating with the public includes issues of natural sciences. For instance, the skilled use of a map, which is a very simple spatial tool, may be a means for government to enhance communication concerning the public interest.

Policy Implications

Hence, a geographical information system is just a data driven form of making maps for decision-making. In [5] 1994, the United States government took priority with spatial data in its infrastructure and the [15] Fifty States Initiatives is a policy movement for all fifty states to comply.

The [15] Fifty States Initiative is a partnership between the National States Geographic Information Council (NSGIC) and the Federal Geographic Data Committee (FGDC). [1] Branch (2009) stated, "It is designed to bring all public and private stakeholders together in statewide GIS coordination bodies that help to form effective partnerships and lasting relationships". Likewise, North Carolina has complied in 2002 with its GICC, while other North Carolina policies such as the [16] 1997 Leandro article 2 (North Carolina Administrative Office of the Courts, 1997), mention geography as part of a child's right to a sound basic education.

Limitations of Study

The limitations of the [1] Branch study were most notable in the interview process, which used a small sample size drawn primarily from a single region within the state of North Carolina. And although all interviews followed the same protocol and posed the same questions, difficulties in scheduling necessitated that some interviews be conducted by phone or email, as opposed to the preferred in-person format. Finally, the exclusive reliance on interview data and the absence of data against which the participants'statements might be triangulated must be acknowledged as a significant limitation.

Interdisciplinary Best Practice

Obstacles to the progression towards the compliance of spatial thinking and GIS education formal paradigms in education may be a combination of awareness, leadership focus and visionary transformative values by the greater society. Certainly, [1] Branch (2009) indicated that "spatial thinking is not on the radar of educational leadership". Even, with state policy directing such influence, a partial acceptance has on been fully validated in the [1] transportation aspects of education in North Carolina but ironically seldom formalized in other parts of North Carolina educational development.

[1] Branch (2009) clearly indicated that educational leadership must be spatial thinkers before they can require, assess or promote such formally in education. Obstacles to interdisciplinary approach may be formally considered as tenure constraints as discipline may not actually value interdisciplinary research of which spatial thinking may be best centered as a medium.

Plausible Approaches Compromises

Systemic educational change may be the best approach to interdisciplinary spatial thinking paradigms. [1] Branch (2009) noted the following:

> All aspects of education should consider their own experiences as being correlated to issues of time and space because a major Science Technology Engineering and Mathematics (STEM) policy actor, such as the National Academy of Sciences, has done so. Therefore we need to invest in a systematic educational program to foster spatial literacy by enhancing levels of spatial thinking in K–12 students (National Academy of Sciences, 2006, p. 22).

Such activity by a major policy maker like the [11] National Academy of Sciences (2006) may influence educational change.

Conclusions

The themes that emerged from [1] Branch (2009) findings were public interest, administrative capacity, classroom use, and, policy and research. These findings address the aspects of educational change sought in the study‘s research question: What aspects of educational change do participants believe must occur in order for a GIS/spatial thinking culture to reach widespread implementation?

One major finding was the following from [1] Branch (2009):

> A spatial thinking policy has been present twenty-five years in formal policy past for the North Carolina Department of Public Instruction‘s (DPI) Transportation Division. (See for example, North Carolina Public School Law– pupil transportation 115C-240 sub-section d) This illustrates the administrative capacity and policy themes emerging from this research. Yet, this has not evolved into spatial thinking content within the state‘s Standard Course of Study. Such emanated as a consideration for educational renewal.

Perhaps, it a plausible to take successful spatial thinking implementation from North Carolina transportations area as applicable to incite similar frameworks throughout on a state educational level where the power of spatial thinking can be verified in terms of effectiveness and levels of service. Here, should be the anchor of interdisciplinary GIS educational collaboration in North Carolina.

global interdisciplinary collaborations

Perhaps, the interdisciplinary challenge of adding spatial thinking or GIS education formally to North Carolina K-16 standards remains a simple compliance towards spatial federal and state policies where cost effective professional development may be necessary. Perhaps, a low cost cross-disciplinary research among Earth Sciences and educators should lead to formal teaching certifications for the geosciences discipline. For without such being recognize, to have a skill without a job may not be desirable or sustainable for the geospatial workforce demand, STEM outcomes or building international synergy for Group Earth Observation and International Panel on Climate Change policy formulation.

A global competitive education may benefit from more focus on Earth Science. Such, may be necessary for the future global citizen. Moreover, a green economy may need a K-16 system that fosters new thought paradigms to make the next generation globally competitive. For instance, the Group Earth Observation organization in 77 countries punctuates the value of spatial thinking in tools of remote sensing, GIS and Earth Science and vital tools of climate change examination and world policy collaboration. If 77 countries can agree then certainly a state educational agency can

summarize the value of spatial thinking formally in its curriculum.

Moreover, in the United States, as neighbor [17] Virginia is experimenting with its GIS initiative in middle school and high school experiences, certainly North Carolina can take the suggested 5 step plan to new height of involvement. In particular should be note that [1] The North Carolina educational transportation system is totally based on spatial thinking paradigms of GIS for the last 20 years. Such a proven value and state laws should be transferable throughout educational paradigms.

implications for educational change

Certainly, education should advance citizenry towards recognizing and taking advantage of policy, technology, and innovation that benefits society. Greater acceptance, awareness, and implementation of spatial thinking are the targeted goals of this study. Change in the philosophy and practice of education is vital to achieving optimal problem examination and decision-making because school issues change over time. A plausible resulting effect will be a more enhanced engagement in the public interest, administrative capacity, classroom use, and policy and research aspects of education.

Future Research

Despite these shortcomings, this study contributes to the as yet sparse literature on the role of spatial thinking in contemporary elementary and secondary education. It does so by soliciting ideas from varied practitioners and policy-makers in this field and highlights the significance of certain developments, including [5] Executive Order 12906 and the Fifty States Initiatives (National States Geographic Information Council, 2009), which seeks compliance with spatial management data by state agencies. The [15] Fifty States Initiative is a partnership between the National States Geographic Information Council (NSGIC) and the Federal Geographic Data Committee (FGDC). It is designed to bring all public and private stakeholders together in statewide GIS coordination bodies that help to form effective partnerships and lasting relationships (National States Geographic Information Council, 2009). One avenue for future research, therefore, would be broader, more intensive analyses of the possible impact of these initiatives on both classroom practice and decision making in local school systems. Future research may confirm the study‘s theory implications and define further consequences of a spatial thinking experience throughout educational functions. The work of [18] Taylor, Vasu, and Causby (1999) benchmarked GIS use by superintendents in 10 counties in North Carolina should be further investigated with this study‘s finding of a perception stating that GIS use was currently involved in nearly 100 North Carolina counties by study participant 23 (interview, August 22, 2007). More work to correlate the use of data-driven GIS tools to the superintendent retention rates should be explored further as referenced by [18] Taylor, Vasu, and Causby (1999).

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Developing Foreign Language Skills in a Hybrid Learning Environment

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ABSTRACT

The demands of contemporary societies, increasingly complex and diverse, include, among other features, citizens able to successfully function with/in a Foreign Language (FL) environment. Part of this success relies on the students' development of a foreign language competency. To achieve this goal language instructors are always looking for efficient tools that drive better practices in FL/L2 learning. In the last 20 years, the incorporation of technology such as web-based tools has diversified learning environments in which students and instructors are able to complement the traditional language learning approach based on a textbook (and other materials), with innovative tech-tools that create a hybrid learning environment. Students can expand the circle of learning independently while using web-based tools. This study presents findings on two main aspects of language learning and instructional technology in a hybrid environment: the development of foreign language skills as a vital component of intercultural competency and the efficiency of web-based tools as a means to achieve FL/L2 vocabulary competency. Preliminary results show that in addition to providing authentic language and cultural content, vocabulary development, reading, writing, and critical - thinking skills, the use of web-based tools may be instrumental in improving classroom interaction, fostering collaborative and independent learning. These are some of the characteristics of hybrid learning environments that may be instrumental for success in the personal and professional growth of a global citizen in a constantly evolving world.

Keywords: Foreign language education, L2 learning, instructional technology, hybrid learning, development of foreign language skills, web-based tools, intercultural competence

Our framework for this study is based on the definition of hybrid learning environments proposed by Aaron Doering: "a combination of online and face-to-face (F2F) instruction" [5], and their goals as described by Garnham & Kaleta, and Young: "to improve the educational experience for students by joining together the best features of in-class teaching with the best features of online learning to promote active independent learning and reduce class seat time" [6], [7]. We also refer to the language proficiency guidelines as described by ACTFL for our observations about language competence. Secondly, we base our approach to intercultural competence (IC) on two definitions: one proposed by the Tilford

Group, and another by Janet Bennett [4], The former identifies "knowledge, skills, and set of attitudes" as elements of intercultural competence. For Bennett [4], IC constitutes "a cognitive, affective, and behavioral skills and characteristics that support effective and appropriate interaction in a variety of cultural context".

The findings on vocabulary learning strategies are directly related to the ´knowledge´ and ´skills´ components of intercultural competence, therefore, examining the strategies that are most efficient in enhancing vocabulary acquisition, has a direct impact in the development of IC.

Vocabulary learning strategies (VLS) and the implications of research findings for teaching lexicon to L2 learners is "one of the central concerns of vocabulary researchers is the source of L2 vocabulary learning. Is it L2 input, enhanced input, interaction, communicative tasks, non-communicative ´artificial´ exercises, list learning, or repetitions?" [3]. Given the variety of aspects instrumental to enhance vocabulary learning and acquisition in L2, a review of the available literature shows that there are three major approaches to this topic: the traditional methods of decontextualized vocabulary versus contextualized vocabulary, and more recently, a combination of both coupled with enhancing vocabulary activities.

In general, research that supports learning words out of context have shown findings that advocate this approach at an early stage of language acquisition [12], [9], [10]. Although students can be very efficient at memorizing word lists, they are likely to forget them quickly [16]. Direct support for decontextualized learning is based on the theory that helping beginners to learn the basic 3,000 words, fundamental lexical competence, is key to enhance independent reading and acquisition of language in a natural way at later stages of proficiency [15]. On the other hand, research shows that vocabulary learned in context is better assimilated and remembered [14], and scholars seem to favor contextualized VLS in advance stages of language development for vocabulary retention [16]. Finally, even though decontextualized vocabulary learning has been discouraged since the implementation of communicative language teaching, [3] poses that "its association with the skill acquisition theory contributed to the view that this type of learning is legitimate for studying the basic vocabulary quickly" [3]. She also suggests that engaging word-focused activities and rehearsals (contextualized learning) "are likely to yield the best results" [3] in vocabulary learning.

A third strategy to learning vocabulary is increasing its presence both in research and in practice, one that combines teaching vocabulary out of context and in context. The drive to this approach comes in part from the implementation of web-based features in language instruction such as on-line reading, blogs, videos, discussion boards, etc Support for this VLS can be found in recent studies (quoted in [1], [11]), which argue that vocabulary acquisition is greater when contextualized reading is complemented with decontextualized vocabulary instruction. The findings from this study aim to validate this third approach to L2 vocabulary learning.

RESEARCH QUESTIONS

1. Do intermediate FL (L2) learners acquire vocabulary incidentally through reading?
2. Which VLS seems to help FL (L2) learners to acquire more vocabulary knowledge at the intermediate level?
3. How effective are the proposed tools (hybrid) when compared with other approaches for vocabulary learning (traditional)?
4. What is the learners' perception about their use of Internet based tools for vocabulary learning and IC development?

METHODS AND PROCEDURE

Participants

Participants in this study were 30 undergraduate college students of two Intermediate Spanish language classes (5th semester), native speakers

of English, 19-28 years old (mean 20.3), 4 males and 26 females.

Materials

A list of 20 lexical items in Spanish was created from the different sources of vocabulary input: textbooks and on-line newspaper articles. The words were nouns, verbs and adjectives associated to the intermediate level of Spanish distributed in 4 sets of 5 words each. Students were asked to translate or explain in English the meaning of each word. These four sets included: 1. Words from only textbook lists 2. Words from only on-line articles and worksheets 3. Words from only on-line articles and blogs 4. Words that appear in 1, 2 and 3. The on-line newspaper selected is "El País": elpais.es, and a Discussion Board and a Blog were created in a Learning Management System (Blackboard) to provide access to this web-based materials to learners as part of students´ coursework. Students received training to navigate through the Discussion Board and the Blog. A worksheet for articles summaries and personal reaction/opinion was also required as part of students´ homework assignments. Students provided written comments about their work and experience. Finally feedback about worksheets and blog postings was offered in written format to individual learners as they were progressing in their work.

RESULTS

To answer the first research question, which addressed the incidental acquisition of vocabulary through reading, a statistical analysis of the data was performed. Results indicate that learners acquired a total average of 6.6 words out of 20, which represents 33%.

With the second research question, the present study examined which Vocabulary Learning Strategy -VLS- (input) resulted in larger incidental lexical gains. Results show that an approach based on decontextualized learning (lists) yielded a success rate of 1.266 words out of 5 (about 25%). Meanwhile, VLS based on contextualized learning plus enhanced activities (on-line articles plus worksheet or on-line articles plus a blog), had a success of rate of .83 and 1.3 respectively (16% and 26%). Finally, the third VLS approach, a combination of words out of context and words in context plus enhanced activities, which constitutes the goal of this study, yielded a success rate of 2.97 words out of 5 (about 60%).

The third research question tried to establish a connection between these gains in lexical acquisition and the means (tools) implemented for that goal. When considering the results of vocabulary learned with the use of web-based tools on top of a traditional approach, compared to the lexical items acquired only via traditional means (list of words), or words acquired only with web-based tools, there seems to be a significant difference that favors a hybrid learning environment. This is shown in the results of the previous paragraph.

Finally, our fourth research question attempted to explore the learners´ perception about their use of on-line applications for vocabulary learning and IC development. The goal was to verify if students perceived, as the results suggest, that their progress in both areas was palpable to them. Students commented that the web-based tools helped them to expand vocabulary: 83.3%, helped to retain vocabulary: 63.3%, helped to express ideas and opinions in a different way: 76.6%, and finally, helped to become aware of certain connotations: 66.7% of words and expressions.

Regarding IC development, students indicated that it is important to learn about other cultures: 93.3% and stated that they have learned about differences between their culture and others while using the on-line articles and blogs: 46.7%. In addition, 60% said that their perception about the Hispanic Cultures and their own culture had changed at the end of the semester due to the on-line articles and blogs. Some quotes about these two aspects are: "Reading on-line helped me to see how my culture looks to other people"; "With the newspaper assignments I have gained

competence about views that they have on certain topics"; "I am more open to how the other countries see us"; "The news articles online helped to open me eyes to problems around the world". "It was a very convenient and helpful to go into further detail than the book, was more specific", "I learned about stereotypes and differences of my culture", "I got to see the point of view from other countries without the influence of the United States", "It allowed me to see how others felt about certain topics. Helped to see other sides of the argument".

CONCLUSIONS

Findings of the study corroborated previous research that decontextualized L2 vocabulary learning at the Intermediate level of Spanish has a low incidence of vocabulary acquisition when compared with results from contextualized learning. This provides support to the approach of reading with word-focused activities, which tends to promote vocabulary learning in L2. Furthermore, combining both approaches - words out of context with words in context- and enhanced vocabulary activities seems to yield the best results in vocabulary learning.

This third approach shows that incidental vocabulary acquisition while reading a text for meaning can be significant [13], with only two exposures and with post-reading vocabulary activities. In our study, students were exposed at least twice to the same lexical items through different strategies. This also suggests the potential likelihood of vocabulary growth with more exposures.

The present study sought to assess the effect of combining a traditional and a hybrid instructional approach to vocabulary learning. Two Internet based tools were implemented: on-line newspapers via a discussion board and a blog. The results showed that these web applications might have promoted vocabulary learning.

On a related area, comments from learners stated that they felt they have made progress developing their Intercultural Competence in aspects such as knowledge, skills and attitude. By reading more in-depth information about topics, or reading from "others´" point of view, and reflecting about their own culture in writing, students perceived that they might have enhanced their awareness about their own culture and other cultures.

Finally, our study was related to the receptive aspect of vocabulary learning. This acquisition of "knowledge is an initial step towards productive knowledge" [8]. However, the study did not assess this output factor in vocabulary growth. Further research can be done on this area, as well as in vocabulary retention.

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Surveillance-based Mechanisms in MUVEs (Multi-User Virtual Environments) used for Monitoring, Data Gathering and Evaluation of Knowledge Transfer in VirtuReality

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ABSTRACT

Multi-user virtual environments (MUVEs) generate a large amount of data but most of them are not accessible even to users who triggered them. What's more, most data-sets are not even stored for further use; they have only temporary character and very short "half-time of decay" limited f.e. to one-second-long screen display. Such a huge loss of data makes evaluation of knowledge transfer in MUVEs almost impossible. There is a need to both improve monitoring capabilities of MUVEs to be able to make completion assessment and use MUVEs that enable simulation (re)experience using complete data-sets gathered from environment itself. Future research in the field of simulation methodology is suggested.

Keywords:
Evaluation, Knowledge Transfer, Assessment, Monitoring, Multi-user Virtual Environment, Games

FOREWORD

This paper focuses exclusively on very special case when activities in multi-user virtual environments (MUVEs) are going to be monitored and evaluated. Following chapters are not intended to challenge issues like whether online games should or should not become a part of learning process or how to manage activities in MUVE. Suggestions and conclusions described below are based on observations and evidence gather inside the MUVEs with respect to the aim of the paper as a whole – to pinpoint future needs and future research topics in the field of evidence-based research and knowledge transfer evaluation in MUVEs.

1. ABOUT MUVE

In general (following the original meaning by Morningstar & Farmer [M]) term "MUVE" (multi-user virtual environment) refers to digital-based environment of any (visual) kind that enables communication and interaction among multiple users. MUVE as a category covers both two-dimensional (2D), world-wide-web-based platforms like chats, discussion forums and even learning management systems, and three-dimensional (3D) virtual world and online games of different kinds and types (defined f.e. by Robbins-Bell [RB2008] and [RB2009]). Both 2D and 3D MUVEs are examined in this paper.

Inside the MUVE users – represented by unique avatar and/or profile – are able to use predefined set of tools to trigger actions, for example insert a text, click a button, move a mouse etc. These actions influence the environment as a whole by affecting some other objects and/or subjects, in some cases enforce feedback and afterwards – very often – simply disappear without being logged, saved or stored. This means that we are likely not able to log every triggered action. As an example: during the process of chatting – means writing a text into the web-form and afterwards publishing such a message at the chat-board in a real time – typing single character is not logged anymore, only the result (sent and published message) is stored as a change of content of publically visible chat-board.

But there is no methodological barrier to use data gathered directly from digital-based environment for reconstruction and simulation of processes in a MUVE during specific period of time. The only question is to what extent we are able to take into consideration the "structural" lack of evidence described above – or how to challenge and falsified findings that arise from data-set we acquired. Following chapters are focused on describing issues that needs to be taken into account during monitoring (and afterwards evaluation) within MUVEs.

The main reason why researchers should focus more on monitoring of MUVEs is simple – ICT and particularly MUVEs are becoming an integral part of our everyday lives. Below mentioned MUVEs like f.e. virtual learning environments and wikis are broadly incorporated into learning process at least at the universities via so called "e-learning" and "blended learning" concepts. Game-based learning and game-elements in combination with ICT (mainly computers and notebooks) are very often used to make learning process much more effective, memorable and – last but not least – fun for students and children from very early age.

But simply using an ICT tools and services like wikis and (serious) games in not enough; there is a need to master methodology, to be able to actively work with feedback, interact with students/users and evaluate knowledge transfer. Without these "meta-activities" learning process can be enriched and more various but cannot prove usefulness of integration of these elements into learning process. Following chapters therefore address also aspect of MUVE as a frame for knowledge transfer and collecting evidence to support evaluation process.

2. VIRTUAL LEARNING ENVIRONMENTS AND WIKIS

Virtual learning environments (VLEs) – also called learning management systems (LMSs) – are online available software platforms designed to support teaching and learning. The core features are administration of students and groups of students, files and teaching materials management, collecting and comparing student grades, communication, feedback

assessment, collaboration and peer-assessment and – last but not least – tracking of activities of users.

In such an environment where teachers can set each step of learning process and afterwards have an access to students log of actual activities VLEs often cause the "creepy treehouse" effect, means lack of confidence in a controlled environment [S]. Data from logs are therefore incomplete and limited to actions that meet requirements of the course, f.e. logging into the VLE and uploading homework in time or simply "view" of particular page with no additional information about page scrolling or time spent reading (see example below, Table 1).

Table 1 – Example of automatically logged data from LMS "Moodle"; underlined parts of log are active links to web page user visited or web page that contains additional information or summary.

Time	IP Address	Full name	Action	Additional information
2010 04 10 22:29	85.X.X.X	Jakub Štogr	forum view forum	Discussion forum #1
2010 04 10 22:29	85.X.X.X	Jakub Štogr	resource update	Online conference info
2010 04 10 22:29	85.X.X.X	Jakub Štogr	resource view	Online conference info
2010 04 10 22:27	85.X.X.X	Jakub Štogr	resource view	Online conference info
2010 04 10 22:27	85.X.X.X	Jakub Štogr	course view	SEL

A **wiki** is a website that allows the quick creation and collaborative editing of web pages. The most well known example of wiki is Wikipedia.org. The basic principle of wiki content creation is free access to any web page of wiki for anyone. Due to the fact that even anonymous visitor can add, correct or delete part of the web page, every single change of content is logged and history of changes is publically available. Therefore information about history of web pages is complete but log of single user is scattered among these discrete changes (see example below, Table 2).

Table 2 – Simplified example of automatically logged data from wiki Wikipedia.org (web page called History for term "wiki"); underlined parts of log are active links to web page that contains older version of term description, information about user profile etc.

Time	User	Size	Explanation of change
00:43, 25 April 2010	Tisane	(26,365 bytes)	(→Searching)
13:08, 24 April 2010	HaeB	(25,924 bytes)	(→User communities:…)
13:03, 24 April 2010	HaeB	(26,333 bytes)	(→Research communities:…)
01:10, 24 April 2010	Tisane	(27,143 bytes)	(→User communities)

As it was already mentioned above both VLE and wiki are examples of 2D web-based and quite simple environments. There are limited possibilities how to interact with the environment, limited number of active links and/or interactive elements in general. But default data-logs of these environments are insufficient and not able to provide complete "map" of activities of users.

It's possible to oppose and argue that there are more sophisticated systems that can provide detailed overview about behavior and triggered activities, f.e. proprietary LMSs or monitoring systems in the field of advertisement. That's true. But still – generally speaking – monitoring module is not a high priority feature.

3. GAMES VS. MUVES "AS SUCH"

In 2008 American Psychological Association published a study [A] where we can read that: "*certain types of video games can have beneficial effects, improving gamers' dexterity as well as their ability to problem-solve*".

Just a few month later report done by Pew Research Center [P] concludes that „*all American teens play computer, console, or cell phone games and … gaming experience is rich and varied, with a significant amount of social interaction…*". In more details 97% of 12- to 17-year-old respondents play games, 31% of them every day. And in February 2010 game designer and game researcher Jane McGonigal stated that "*we spend three billion hours a week playing online games*" [MC].

The problem is that even if there is evidence that games are not only evil, teens are often heavy players and time spent gamming worldwide is quite significant, there are hardly any methods and tools used to assess and evaluate processes inside them.

In a previous chapter there are just two examples of simple environments and problems we can face when we try to use build-in functionalities for monitoring. The question is what kind of problems appear when we start to investigate games in a same way. In a fact, games are much more complex, mostly 3D, gamers can interact with each other and create temporary or stable groups, cooperate and sometime even trigger kind of "script" (or pre-programmed set of actions) that manipulates avatar automatically.

Picture 1 – Screenshot from 3D MMORPG (massively-multiplayer online role-playing game) called "The Lord of the Rings Online" (September 2009)

In a most cases evaluation is done only based on questionnaires or other indirect methods of gathering data about (and from) participants. Virtual environments – means games itself – are not data-mined and in-game surveillance tools are rarely used for monitoring.

The question is why. Five years ago, in 2005, Sande Chen and David Michael published an article "Proof of learning: assessment in serious games" [C] where they defined three main types of assessment used in serious games:

- *Completion Assessment - Did the player complete the lesson or pass the test?*
- *In-Process Assessment - How did the player choose his or her actions? Did he or she change their mind? If so, at what point? And so on.*
- *Teacher Evaluation - Based on observations of the student, does the teacher think the student now knows/understands the material?*

They also explain that "*Teacher evaluation is a combination of both completion assessment and in-process assessment. … Teacher evaluation can also include observation of the student in action.*" [C]

Even if Chen and Michael focused mainly on serious games and game developers' point of view above mentioned definitions are far more complex. Completion aspect is almost the same as in a case of VLE or wiki. System needs to be able to set and afterwards monitor completion of goals – in games called f.e. "quests". But there are basically two possible ways how to give a teacher (or "evaluator") possibility to "be in the process":

- Real-time experience – Become a member of group, play together with students and even lead them.
- Simulated (re)experience – Be able to fully reconstruct the whole environment and replay every single activity. Become an "invisible observer" during process of replaying.[1]

In a second above mentioned case logged data-sets are not used only for completion assessment. Even if these data-sets still provide information about activities gathered from environment, they become much more important. They are memory-records, kind of video-tapes than can be repeatedly played using appropriate tool (software and hardware combination). Therefore logged data cannot be limited to human-readable screen outputs as we can see at Table 3 below.

Table 3 – Example of human-readable data logged automatically from chat window of MMORPG called "The Lord of the Rings Online".

You accept the offer to join a Fellowship.
The loot rule has changed to Round Robin with Roll/Pass.
The loot quality has changed to Uncommon.
Gilgalthir has acquired [Khazâd-iron Ingot].
You have joined the chat room for your Fellowship, Fellowship chat is now available.
You have joined a Fellowship.
[To Fellowship] hi
[Fellowship] Gilgalthir: welcome
Gilgalthir has acquired [3 Khazâd-iron Ingots].
Edheldin slaps Jiversallmighty on the cheek.
Nonesuch waves to Banion.

Due to the fact that at least online games use "client-server" architecture and fully digitalized real-time exchange of data via Internet network to synchronize gamers all around the world, these kinds of "instructional" data-sets exists.

The problem is that we do not have an access to them, we have no right to save and archive them and – last but not least – we are not able to replicate them back into the virtual world.

And there is another issue – most MUVEs do not provide special access to data logs of other users; means teachers have the same access as other users have. What's more, quite often every user/gamer can choose what kind of personal data s/he is going to make public and share. For others such a user is therefore represented only via activities of avatar. Assess and afterwards evaluate a knowledge transfer in MUVEs where we have no role of supervisor is therefore very complicated and sometimes almost impossible. Gathering only publicly available data in 3D MUVEs is generally speaking not enough and there is a need to combine all available sources of data (f.e. data-logs from more users with audio and video records) to be able to make any conclusions.

[1] Actually, these "reply functions" are already incorporated into some – mostly racing – games. Gamers can replay their race, evaluate it and learn from the mistakes.

Nevertheless, opened and fully scalable MUVEs exist. One example is SecondLife.com. As an owner of piece of land inside the Second Life you have a right to create and script interactive object of any kind, even with the ability to trigger HTTP request and receive such a request from the Internet which is useful for storing and retrieving data from databases. Objects that monitor avatars (f.e. storing visited places, names of avatars you met and activities in general) are quite common and are often worn attached to the "HUD" (head-up display) as you can see at the Picture 2 in a right bottom corner of the screen. You can also manipulate an avatar using pre-programmed scripts or use so called "bots", fully automated avatars that can look like other regular users. In such an environment idea of simulated (re)experience can be put into life.

Picture 2 – Screenshot from MUVE called "Second Life" (January 2010)

CONLUSIONS

Monitoring activities and gathering data from MUVEs is challenging task. Even simple environments like VLEs and wikis do not properly store all available data about behavior of users and/or changes of content. In a most cases analyzing these data-sets can provide enough information for completion assessment (means answer to the question whether user completed the task, pass the test etc.) but cannot be used for modeling simulated (re)experience. The most promising are MUVEs where we have full access to both data-sets and tools that can be used for "re-playing" past activities.

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To Establish an International Virtual Vocational (Technical) University in Pakistan

by

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Introduction:

In September, 2007, an International Conference was held at National Institute of Science and Technical Education (NISTE), Islamabad Pakistan. The topic was Entrepreneurship and Poverty Reduction. In the closing remarks, the chief guest, the then Educational Minister of the Pakistan, Mr. Javed Ashraf Qazi told us an awakening story. He said and I quote: "Couples of years back, I went to Dubai and met with their labor minister. I praised the development and the pace of development in that country and he was very thankful. I enquired from him as to why they were not employing Pakistanis for this phase of there development." He replied, "Mr. Minister, few years back we were building road, we were digging wells and we were moving sand from the deserts, we needed muscle power and you could see Pakistanis working every where. Today we are busy in building state of the art stuff, we need skilled people and unfortunately you don't have any."

The idea of establishing a virtual vocational university was conceived in that conference. This paper will throw light on how is it possible, who will benefit from it, what will be the modalities, who will finance and what will be the ultimate goal to achieve.

Background:

Pakistan is a country which is rich in human capital. The workforce percentage of total population of 170 millions is much higher as compared to the developed world. The population that goes for college education is nearly 30 percent of the lot. Of the total budget amount, only 2 to 3 percent of it is spent on education. There are only a few vocational institutes in the country and those which are there do not have adequate tools to produce real professionals. Due to lack of knowledge and skills, the country has 'jacks of all and masters of none.' Current crisis of 'war on terror' has further forced the country on the back foot. More is spent on defense than on education and human development. Higher education is available but it is limited and unaffordable to the millions. Pakistan has far too long remained in low-level skills trap and if it was a move into the knowledge economy then it must break out of this trap (Amjad, 2005). The situation is bleak and needs immediate attention.

Pakistan's workforce is characterized as having low skills and poorly prepared to compete in today's globalized world. Rapid technological changes now require individuals to learn and relearn skills throughout their working lives by ensuring its relevance and effectiveness (Kazmi 2007).

The situation has worsened due to the rapid change in the international scenario. Globalization and emergence of huge economic hubs across the borders in China and India has further deteriorated the economic situation of the country. The roaring energy prices and opening of

borders for the foreign products has further increased trade deficit. Foreign reserves are going down and assistance is being sought from IMF and World Bank to bring economy back on track.

Unhealthy political situation in the country and inefficient governance has further put pressure on the economic situation in the country. After having some good years from the start of this century, the poverty level is again on the rise. Joint family system has sustained some pressure but it has become difficult to provide all facilities that are necessary for the daily life. In Pakistan, skills development has been most neglected area. The country has neither been able to improve vocational and job skills nor could inculcate the creative and cognitive skills. The lack of focus on interpersonal and social skills has resulted in loss of output, exports and employment and slow growth of living standards (Kazmi, 2007).

A few examples can be quoted here. Pakistan had a very sound handicraft export business few years ago. It is diminishing every year. The reason is that people continue to work on the tools and techniques of their ancestors when more advanced machinery is available. The industry is being hit badly because customers need more refined products rather than the ones being offered.

A more recent example is about mobile phones. Pakistan is a country that has 95 million active mobile phone users. There may be a few millions mobile phones on the shops for sale. But of the 100 million mobile phones that are in use, not a single one is made in Pakistan. If we put an average price of $100/mobile phone then nearly US$10 billion has flown out of a country that is desperately short of foreign exchange.

Japan was a country, most devastated in the Second World War. The major industrial cities were raised to ground by the atomic bombs but that country emerged stronger than before. Its technical skill is second to none in the entire world. Reason: The country had three engineers out of every ten people that lived in that land. Economically speaking, today Japan is one of the top three nations of the world.

Technical and Vocational Education Available in the Country

Countries that have grown and attained higher rate of development spend more money on human resource development. Countries like Taiwan, Thailand, Singapore, Malaysia and Singapore and many more that achieved prudence in global workplace and in economic gains, invested heavily in human resource development in the initial stages of development (Khan, 2005).

Elementary education must impart usable technical knowledge Vocational education can be used effectively to combat dropouts (Grubb, 1985). Vocation education is effective answer to reduce unemployment and migration to urban centers (Lillis and Hogan, 1983). These issues have been very carefully studied and addressed in my work. Technical and vocational education can be looked at from two angles. One for those who are already on job and need training to enhance their skills and two the ones that have little knowledge but established their business after being in training at a substandard workshop. Then there are people who have little or no knowledge, are jobless and are prepared to do any

odd job for their living. Our project works around those who are running their own business and wish to improve upon their skills and those who have no skills and are jobless. The purpose is to create people who are capable, focused and more professional to cater for the needs of global business workforce. In doing so, we can also effectively reduce unemployment and poverty in the country.

Pakistan is a country that has four provinces. Two of which, Punjab and Sindh have well established educational system while NWFP has recently suffered from the insurgents and many of the girls schools were destroyed to limit education to the boys only. This deprives the 50% population from formal education. Baluchistan is the biggest province area wise. The population is scanty and thus does not have the resources to provide adequate infrastructure to its masses. Then there is feudalism which does not permit the poor to get educated. Baluchistan is the province that is rich in mineral resources. Ironically, it is the most backward of the four provinces. This has created a sense of deprivation. People react by blowing up the gas pipelines and railroads to record their agitation. This causes a massive security and law and order situation in the region. This has also increased the maintenance cost of the facilities that are available in that land.

Currently, there are only a few vocational institutes in the country. The ones that are working are more focused on capacity building and the one qualifying from such institutes can work around to support the family. As per the figures provided by ADB 2005, the total capacity of training people from 546 polytechnic and vocational institutes is 204,670.

Table-1: Vocational and Technical training institutes in Pakistan (2004)

Province	Institute	Number	Capacity
Punjab	Technical and Vocational	402	83,000
Punjab Training Council	Vocational	60	15,000
DMT Sindh	Vocational	33	3,740
TE & VT NWFP	Technical and Vocation	35	3,300
DMT Baluchistan	Vocational	12	1,730
Skill Development	Contractual Basis		25,000
Federal	Ministry of Labor	2	1,500
Federal	Ministry of Education	2	1,400
Private Apprentices			70,000
Total		546	204,670

DMT: Directorate of Manpower and Training
TE & VT: Techinical education and vocational education Source ADB (2005)

For a population of 170 millions, this number is 'insignificant.' All these institutes are in place from a number of years. Their tools and equipment is either obsolete or not there in number. In majority of the cases, the technical staff is not qualified or totally skilled. As can be seen some of the institutes are being run by the federal and provincial governments, thus the opportunity is available to only those where the government is focused. There are some prerequisites to enter these institutes and many would have no chance as they would not be qualified. According to (Kazmi, 2007), the government must invest properly according to requirement of these institutes. The technical education and vocational training authority needs substantial improvement. However, the current situation in the

country is not supportive of government efforts.

Like in many developing countries, there is a great difference in what is on the paper and how it is being implemented. With the ups and downs of political situation in the country, most of the plans do not get to their logical end. So as to support my plan on this vocational university, here is a table that can give us the capability and effectiveness of the existing technical and vocational institutes. The quality of students and the skills produced by these institutes can be reviewed from the following table:

Table 2: Abilities Developed during Training of Polytechnic/Vocational Institutes

Aspects of Evaluation	Polytechnic Programs			Vocational Program		
	poor	Fair	Good	Poor	Fair	Good
Technical Concept	46	41	13	28	60	12
Practical Skills	55	33	12	27	54	19
Repair Maint.	55	37	8	27	58	15
Comm. Skills	63	29	8	44	48	8
Safety Conscious	46	40	14	31	54	15
Quality Mindedness	43	43	14	28	60	12
Others	33	67	-	-	100	-

Source: ADB (2005)

Methodology

The purpose of this university will be to select, register and educate students in a few disciplines at the start and then will expand to cater for more disciplines gradually. The education will be implemented through a television channel/ recorded video media that will be available through the university website. Practical education will be mandatory for some of the disciplines. Labs and workshops will be set up across the country. Raw material, tools and reading material would also be made available through these workshops. Initially some of the training will be outsourced to the places where infrastructure is in place and qualified professional could accommodate and educate students to required standards. Later on, such training activities could take place in the institutes that are established by this university.

The reason why I call it an International university is that the instructors will be hired from the countries where a) massive development is taking place in that field of production and b) where there is a big demand for qualified workers. Qualified foreign professionals will be hired and their lectures will be records for onwards delivery to the students. Lectures will be translated in the local languages to make the students comprehend. Theses instructors will also be responsible to prepare the final examination process. Only students declared passed by them will qualify for the certificate from this university. This will eliminate the biasness from the system. The students that qualify from this university will thus be able to establish a setup of their own in the country. They will also be able to get employments in the countries where the need of such technicians exists. Qualified technicians would not only be able to boost the growth of the country but would also qualify to fill in the skilled jobs that are available internationally and thus earn the much needed foreign exchange for the country.

Another purpose of this university is to educate everybody in the country who has the potential and wishes to know more to improve upon his personal skills.

He may not wish to be a student of the university but would certainly be able to benefit from the education imparted through electronic media. Only the ones that are registered and have obtained vocational education will go through the final examination. All the others will get the awareness and would be able to apply this knowledge when stuck in a situation for which they currently need a technician.

Initially, any person who has obtained a matriculation certificate and attained the age of 16 years will be qualified to appear for registration.. Unlike many other universities, there will be no upper age limit. The desired education level of matriculation can be ignored initially to enable uneducated jobless people to make the best use of it. Gradually, the admission standard can be improved once the university is well established and it has attained a desired value. All the male and female population in the country is eligible to take benefit from this free on air service to improve upon their personal skills which may be handy in an emergency when help is not around the corner.

The university will have a website that will provide all the information about the subjects on which training is being provided. It will also highlight the new programs in the pipeline. It would cater for downloading of forms for registration, submission of online payments, and list of successful students, course outlines, course material, and instructor's profile. Qualified university students will also get auto-generated mails for any job that may be available in any part of the world. This website will be dynamic and change as per the needs and requirements.

Like any other university, this university will also have a physical office. The office will comprise of administrative block that would scrutinize applicants, collect fee, do the registration online, notify, dispatch necessary information and be available for all correspondence work. There will be a 0800 number and a UAN number that would be available for any inquiry at any point in time. Then there will be an educational block that would have professional people who are well aware of the international markets. These professionals can be hired from different universities and compensated on meeting basis. These professionals will help set the direction of the university program. They will also be responsible to select and hire virtual instructors worldwide. Another important section of this university will be dealing with the procurement, storage and dispatch of stuff to the students. The workshop selection, scheduling and student allocation will be a part of this department. This department will also be responsible in acquiring the necessary tools that may be important part of the training and practical working. Business to business and business to customer services can also be acquired to facilitate students.

How will the program work:

The program will work in three stages. In stage-1, the basic knowledge about the components and tools is provided. This will enable the student to know the importance of each component and its function in the product. The second stage is focused on the assembly of the components and making the final product. Once students get the experience of manufacturing a complete product, they would be able to make suggestions and improvements that could help in

developing a new product altogether. The third stage will focus on quality. Quality tools like; Six Sigma, the ISO 9000s, the role of audit and inspection and final rolling out of the product will be emphasized. Thus the culture of acceptance and rejection and their implications will be made known to the students.

Financing:

Financing is the backbone of any business. Irrespective of its nature, funds are needed to put a step forward in any direction. Universities are not built to make money rather their job is to provide the much needed knowledge that could improve the image of a person in particular and the country on the whole. The purpose of this university is to promote the image of the country and enable people to live a better life. It is assumed that all those industries that are short of real technical people and who are in need of improved workmanship will finance. Government of Pakistan should be there to support; after all, this mission is to improve the image of the country. Higher Education Commission (HEC), an organization that promotes education in the country would be very keen to closely monitor and support as this would add a new dimension to their portfolio.

Conclusion

As the saying goes "Rome was not built in a day." Our program will also not produce something dynamic overnight. With appropriate marketing, we are confident to attract many people who are currently unemployed and find it difficult to sustain their basic needs. The other groups of people that would be interested are the ones who produce substandard stuff that has lost its market and want to change into something more productive. We are also targeting students who would like to learn skills and be able to grab a job in the local and international markets. The effect of this program will generate an entrepreneurial environment that will produce new products and adequately support the local demands and reduce dependency on foreign goods.

Due to globalization, the countries are busy in obtaining competitive advantage and marketing their products in all parts of the world. Those countries that are not in the race are being left far behind. Our program will provide a competitive advantage for the individuals and the organizations that would enhance productivity and thus reduce dependency on foreign products and saving much needed foreign exchange. Once the program produces skilled people and they make a place in the society, we are confident that many sponsors and companies in the country will step forward, join hands and expand this program country wide and benefit the entire nation.

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The Digital Divide Between Students and Lecturers: A Case Study of the Access and Attitudes Towards Information and Communication Technology (ICT) in Selected Nigerian Universities

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ABSTRACT

The study of inequality in access to and use of ICT among and within countries has over the years attracted significant attention of researchers, policy makers and the world community at large. This is for the fact that ICT has become the most important vehicle that has made the emergence of the global/information society possible and individuals or group that lack access to or unable to effectively use ICT are shut out from meaningful participation in the global society. However, little attention seems given to the emergence of inequality in the use of ICT between students and teachers especially in a developing country like Nigeria and the implications for the teaching-learning process and for the authority of the teacher as a professional that ought to lead knowledge in the school environment. The study was intended to make contribution towards empirically verifying the existence of a digital divide between students and lecturers in three Nigerian universities and to ascertain whether or not attitudes played a role in creating the divide. The findings of the study showed that both students and lecturers had access to ICT but the students were predisposed to its use than the lecturers. The study in examining the attitudes using Student's t-test statistic discovered that both students and lecturers perceived ICT as being very important and with the lecturers' perception even being superior to that of students. However, students demonstrated more interest in the use of ICT and this could be explained by the fact that the factors that encouraged the use of ICT were more favourable to the students. The factors included availability of free time; the need for social networking through use of ICT; the various ordinary level and university entry examinations undertaken by students over the years which have become mandatorily online, etc.

Keywords: Digital Divide, Access/Use, Attitudes, Students, Lecturers, University and Nigeria.

1. INTRODUCTION

The world has turned into an information society where the rate of development is dictated primarily by the quantity and quality of information that are available to the people. The single largest force propelling the information society is the Information and Communication Technology (ICT).

Today there is so much talk about the need to be a digital citizen, which means an individual that is able to relate to others using ICT- computers, mobile phones, internet, and other electronic devices. With this comes equally the concern about knowledge divide - the gap in career advancement and life chances between those who can access and utilize information and those who cannot. A universal feature of advanced and advancing countries currently is the concept of information society, that information has become a most critical and strategic factor of production and that acquisition, management and deployment is the primary occupation or factor of production of the nations.

The United Nations in Geneva 2003 and Tunis 2005 World Summits on the Information Society (WSIS) have raised so much attention on the need for bridging digital divide in all its ramifications. This is clearly expressed in its Commitments and Action Plans. In particular, the Geneva Summit expressed the desire "to build a people-centred, inclusive and development-oriented Information Society, where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life, premised on the purposes and principles of the Charter of the United Nations and respecting fully and upholding the Universal Declaration of Human Rights." [1]

In Nigeria, interest by students and lecturers on the use of ICT tools seem to differ. The students, from the primary to the university levels, are being made to register and at times write their examinations mandatorily online and this is giving them greater opportunity/motivation to appreciate, learn, perfect and continuously improve their ICT knowledge skills than the lecturers who do not seem to come under such compelling/motivating conditions. Coupled with this advantage for the students are their youthful attributes such as inquisitiveness, great interest in entertainment and games, very strong urge to belong to the youth culture and to connect with other youths across boundaries, all of which are readily facilitated by existing as well as emerging ICT tools.

This study about the digital gap between students and lecturers therefore:

(a) Investigated whether or not there is a student-lecturer digital divide in terms of access to and use of ICT tools;
(b) Compared the perception of the students and lecturers regarding the importance of ICT.
(c) Rated the level of interest of the students and lecturers in the use of ICT.
(d) Ascertained the factors that motivated or disposed students and lecturers towards the use ICT.

2. DEFINITION OF TERMS

Information and Communication Technology (ICT): UNESCO defined ICT as "the combination of informatics technology with other related technologies, specifically communication technology." [2] It stated that informatics (or Computing Science) is "the science dealing with the design, realization, evaluation, use and maintenance of information processing systems, including hardware, software, organisational and human aspects, and the industrial, commercial, governmental and political implications of these" and informatics technology is "the technological applications (artifacts) of informatics in society."

The word "***digital***", derives from the Latin word, *digitus* (finger) and which connotes the conversion of information to binary numeric system or data technologies that deal with discrete (discontinuous) values. [3] It is used in this study to refer to all aspects of ICT available for use by individuals in their personal and professional or work situations. The word, "divide", points to the gap or inequality between students and lecturers in the mastery and use of ICT.

Attitudes: There is a plethora of literature defining attitudes as a key concept of social psychology and spanning over the decades. One of the earliest and classical definitions of attitude was given by Allport who stated that it is a "mental or neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all object and situations with which it is related." [4] Shaw and Wright saw attitudes as "relatively enduring system of affective evaluating concepts or beliefs which have been learned" about persons, places and objects with whom an individual is associated while Ajzen and Fishbein defined it as "A learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object." [5,6] The basic sense in these and other definitions is that attitudes are products of experience that have pre-condition individuals to act either in a favourable or unfavourable manner to persons, things and issues that they are associated with.

3. LITERATURE REVIEW

3.1 The Role of Attitudes towards Use of ICT (or e-Participation)

Siragusa and Dixon of the School of Education, Curtin University, Melbourne, carried out a pilot experiment with a small number of undergraduates in a higher institution setting to see how interaction in an ICT activity was affected by their "planned behaviour." [7] The study probed into their intentions to use ICT, their attitudes towards participation in the ICT activity, "their perceived social pressure to interact with ICT, their perceived control over their capacity to interact with ICT, their beliefs about the likely consequences of interacting with ICT, their beliefs about the expectations of others regarding the interaction and their beliefs about the various factors that potentially would either help or hinder their interaction with ICT." The study found out that the students participation was greatly motivated by attitude or planned behaviour. There was high level of participation by the undergraduates and they basically described the ICT activity as pleasant, helpful and easy, though some experienced feelings of anxiety and intimidation in the course of the ICT interaction.

Kaba, N'Da and Mbarika observed that many studies that explain the adoption and use of mobile phones in developing countries especially in Sub-Saharan Africa had focused more on macro factors while ignoring micro factors such as perception, motivation and other social variables. [8] Therefore, they investigated the influence of micro factors that directly influenced the real motivations of the phone users. They surveyed 463 mobile phone users and tested several hypotheses and found a link between "attitude toward and use of cellular phones" and mobility, group characteristics (familiarity), social influence (social pressure and social image), and the possession of resources.

3.2 Attitudes towards e-Participation in the Context of a Motivation Theory

This study of the digital gap between students and lecturers in Nigerian universities focused on the influence that motivation had on attitudes. Motivation in the human context looks at goal-orientated behaviours; actions and preferences that are based on perceived benefits and conducive environment which seem to naturally encourage the performance of an act without external force or pressure. It is possible that differences in the levels of motivation of students and lecturers result in differing levels of e-participation of the two groups.

Therefore, this study looked at the theories of motivation because such theories explain how attitudes and behaviour are formed based on the ability of action to satisfy needs. Some of the popular motivation theories are the Theory of Hierarchy of Needs by Maslow (1943), Herzberg's Two-Factor Theory and McGregor's Theory X and Y. [9-10] However, Vroom's Expectancy Theory seemed better in explaining the digital gap between the students and lecturers. [11]

Vroom sees motivation as a process that governs the choices that an individual makes among alternative forms of voluntary activities and which is under the individual's control. To make the choices, the individual carefully estimates how commensurate the expected result of the action could be compared to his or her desire or need. Consequently, motivation is a product of an individual's expectancy that a certain effort will lead to the intended performance, the instrumentality of this performance to achieving a certain result, and the desirability of this result for the individual, known as valence. [12] The three key concepts involved in Vroom's theory therefore are: (a) Valence - Strength of an individual's preference for a given outcome; (b) Instrumentality – The likelihood of the action serving as a means of attaining a goal; and (c) Expectancy - Probability that an action will lead to a desired result. [13-14]

3.3 The Reality of Digital Divides

The digital divide is known to exist not only among nations but also within nations. With the nations there are divides in terms of gender, rural-urban, educational, economic and other bases. For instance, Obi in his capacity as the President of the Computer Professionals Registration Council of Nigeria cautioned against ignoring the digital divides within the country. [15] He asserted that "Digital divide should not just be looked at from the perspective of Nigeria's position to other countries, but also from the divide that exists within the country."

The National Information Technology Development Agency (NITDA) in its baseline survey of Nigeria came to the

conclusion that relatively, increasing number of persons are owning and using computers; the teledensity is 30 lines per 1000 persons out of which mobile teledensity is 25 per 1000 persons. [16] However, the survey revealed the following inequalities: That 71% of the men own computers as against 29% of the females; 76% of the computers are in offices as against 24% in the homes; more than half (i.e. 55%) of the persons that used computers are the very young persons of the 21-30 years age bracket; the next age group that used computers are those 31-40 years of age and they constituted 20% of the persons surveyed. This implied that 75% of those that used computers are within the ages of 21-40. Though shortly after the NITDA survey Nigeria witnessed an unprecedented growth in the use of ICT, it is unlikely that the digital gap revealed by the survey had reduced – the rapid growth of ICT might even have aggravated gap.

According to Akdogan, the "youth is the biggest group to use new ICT and especially mobile technology in the (developing) world. [17] It is relatively easier to engage them politically and make them participate with attractive online and/or mobile applications…" He discussed further that "the knowledge youth have of new ICT, their innovative use of these new technologies – that also make them connect globally to youth all around the world, their dynamism, fresh ideas and perspectives are of immeasurable value in policy making processes."

The evidence or probability of teachers being unable to take full advantages of ICT may not be peculiar to Nigeria. Altun in the study of ICT integration in Education in Turkey, Germany, Japan, United Kingdom, and United States of America quotes the report by Willis and Mehlinger (1996) that "although the possibilities for using ICT as a tool for teaching and learning in schools had increased in recent years, much empirical research evidence demonstrate that those possibilities were not being exploited by teachers." [18]

3.4 Criteria for Evaluation of Citizen's e-Participation

UNESCO's ICT Curriculum and other sources provide good evidence of the variables or factors to look for in assessing a learner' or teacher's participation in the digital society. [2] Also, Akdogan, and Wright and Street reported efforts by several international bodies to assess local e-governance models across the world. [17, 19] Specific reference was made to the 2008 "Digital Governance in Municipalities Worldwide Reports" of the United Nations Public Administration Network (UNPAN) and American Society of Public Administration (ASPA). The Reports covered selected 100 municipalities worldwide and listed five categories of factors which formed the bases of the evaluation. Among the categories were services (transactional services such as purchase or register, interaction between citizens, businesses and government) and citizenship participation (online civic engagement/policy, deliberation, citizen based performance and measurement).

In the study of e-participation in Istanbul, Akdogan made a case for the addition of other criteria for the assessment of citizens' involvement in electronic governance. For instance, he advocated the inclusion of the use of mobile technology; the availability and use of social media (blogs, vlogs, miniblogs, and social network sites on municipalities' websites which promote web-based social interaction among citizens); and customization of website tools to avoid information overload and to help "receive/access information in a meaningful way".

The questionnaire employed by Siragusa and Dixon in their study of attitude towards ICT interactions among undergraduates focused on the (a) Intentions, attitudes, subjective norms and perceived behavioural control towards ICT; (b) Behavioural beliefs: expected outcomes and desirability of engagement with ICT; and (c) Their value systems such as whether or not they considered engagement with ICT to enhance learning, promote good education, facilitate responsibilities at workplace, and related factors. [7]

4. METHODOLOGY

4.1 Research Subjects

The universities chosen are located in the metropolitan cities of Nigeria with relatively very high availability of ICT tools and services. The findings in such metropolitan areas could help to reveal the likely highest level of ICT compliance or e-participation for the Nigerian universities, since those in the more remote areas may not have better access or use of ICT due to lack of infrastructure and facilities. The study focused on students and lecturers at the university level (which corresponds to UNESCO's International Standard Classification of Education Level 6). [20] This Level is the second and highest stage of tertiary education according to the Classification.

4.2 Research Instruments

A structured questionnaire was used in this study. It had four sections, namely, (1) personal data (6 items); (2) access to ICT tools (2 items); (3) use of ICT tools (9 items); and (4) opinions about ICT (30 items). The section on opinions was particularly framed as a Likert Scale and further subdivided into three as follows: (a) Perception about importance of ICT (9 items); (b) Interest towards use of ICT (11 items); and (c) Factors that determined engagement with ICT (10 items). [21]

4.3 Sampling

200 questionnaires were distributed to students of three universities in Nigeria – the University of Abuja, Benin and Jos and 100 questionnaires also were given out to lecturers in these three institutions. The sample was randomly selected and excluded students and lecturers in the Computer Science/computer related studies, who by nature of their specialization are already fully engaged with ICT. However the number of questionnaires successfully completed and returned to the researcher was 156 for students and 64 for lecturers.

4.4 Validity of Instrument

The research items were drawn from a universe of items received from ICT experts, very senior academic colleagues, and literature. [2,7,8,17,19] The instrument was thereafter pilot-tested to ensure that both the students and lecturers had no difficult in understanding the precise meaning of the constructs and grammar used.

4.5 Reliability of the Instrument

Adequate attention was given to the reliability of the instrument to ensure that repeated administration on the same samples will elicit same response. The Likert items, in particular, were subjected to statistical verification using Conbach's alpha index of reliability to ensure that each item in the sections on "perception", "interest" and "determining factors" appropriately measured the respective underlying constructs. [22]

Table 1: Internal consistency index of the Likert items using Cronbach's Alpha

Construct	No. of Items	Alpha
Perception	9	.816
Interest	11	.775
Factors	10	.804

Overall reliability of instrument = .798

4.6 Application of Likert Items, Likert Scale and Student's t-test to the Research

Questionnaire with Likert items (named after Resis Likert (1932) who developed a most popular instrument for the measurement of attitudes) was used to conduct the survey. The Likert items enabled respondents to agree or disagree with statements. The Scale also involved the summation of figures obtained by an individual in an entire section of the questionnaire so as to arrive at the total figure of the individual for that section. The Likert Scale assumes that all items of a given section are measuring aspects of the same variable. Therefore summation of items (in a section or even the entire questionnaire) yields a figure that is much more valid than one obtained from a single Likert item. This approach was very necessary because the Student's t-test was applied in the verification of hypotheses. The t-test determines the statistical significance of the difference in the means of two groups (in this case, students and lecturers) and the means were determined by computing figures of every respondent with respect to each section of the questionnaire. In other words, Student's t-test deals with only values obtained at a minimum of the interval level of measurement. Therefore, the use of Likert item and Likert Scale adequately satisfied this requirement.

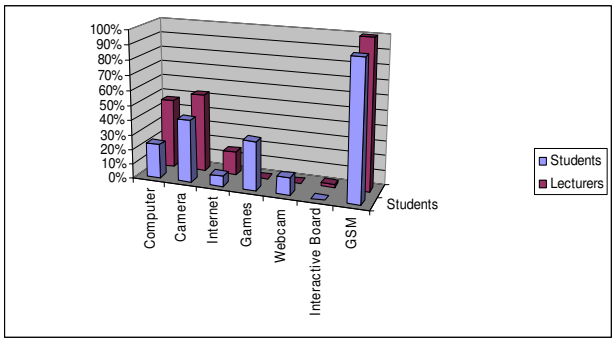
The completion of the questionnaire was made relatively easy as respondents were requested to simply tick the correct answer that applied to them. A 7-point scale was used. Though the common Likert Scales utilize 5-piont scale, some studies have found the 7-9 point scales as being quite valid. [23] The seven points or responses of each Likert item were presented in form of a visual analog scale with equal spacing of response levels which strongly suggested that the measurement was at the interval level.

5. PRESENTATION OF FINDINGS

5.1 Access to ICT Tools

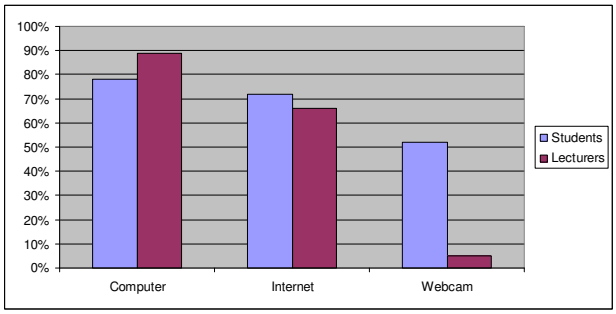
The first item in this section gave a list of ICT tools and required respondents to indicate those that they owned. The following were the percentages of students and lecturers, respectively, that owned the tools: Computer desktop or laptop: 36(23%) students as against 30(47%) lecturers; Digital camera: 66(42%) students and 34(53%) lecturers ; Internet connectivity (plug and play device, etc): 11(7%) students and 10(16%) lecturers; Electronic games: 51(33%) students and nil for lecturers; Webcam: 19 (12%) students and nil for lecturers; Interactive whiteboard: nil for students and 1 (2%) for lecturers; GSM handset or line: 145(93%) students and 64(100%) lecturers. In summary, all the lecturers had mobile telephone while 93% of the students had as well. Also, more lecturers had digital camera, computer and internet connectivity than students. However, while 33% of the students had ICT tools for games, none of the lecturers had any.

Figure 1: ICT tools owned by students compared with Lecturers



The questionnaire also requested the students and lecturers to indicate whether or not they had access to computer (desk top or laptop), internet connectivity and webcam – be it at their home, public places, cafés, school or offices. For computer, 122 (78%) students and 57 (89%) had access; in terms of internet, 112 (72%) students and 42 (66%) lecturers had access; and for webcam, 81 (52%) students and 3 (5%) lecturers had access.

Fig. 2: ICT tools accessible to the students and lecturers



5.2 Use of ICT

Table 2. Use of ICT by respondents

Use	Number and percentage that engaged in ICT over 5 times in one year	
	Students	Lecturers
Word processing	129 (83%)	36 (56%)
Email messages	144 (92%)	39 (61%)
Internet browsing	151 (97%)	42 (66%)
e-transactions	129 (83%)	22 (34%)
Online chat/facebook	112 (72%)	3 (5%)
GSM multimedia	90 (58%)	12 (19%)
e-learning/teaching	76 (49%)	4 (7%)
Academic multimedia	51 (33%)	26 (42%)
Internet search engines	142 (91%)	33 (52%)

Table 2 shows the responses of students and lecturers regarding the use of ICT. The students consistently maintained a clear lead in the use of ICT tools except the multimedia (audio and visual discs and other materials) which were used by a slightly greater percentage of lecturers than students.

5.3 Perception about Importance of ICT

The items in this section of the questionnaire attempted to know how respondents would rate issues such as the indispensability of ICT in society and in development; importance of ICT in getting organisational results and academic performance; the importance of the internet compared to other inventions in the

past century; comparison of manual and online transactions; estimation of the positive and negative consequences of ICT; the role of ICT in teaching and learning; among others.

***Null Hypothesis*:** There is no significant difference between the *mean* of students and lecturers in the perception of the importance of ICT.
Alternate Hypothesis: The *mean* of the lecturers is significantly higher than that of the students.

The 156 students recorded a mean figure of 73.955 and standard deviation of 11.1212; while the 64 lecturers had a mean of 82.797 and standard deviation of 10.5923. The Student's t-test of the differences between the two means revealed as follows:

Observed difference (lecturers-students) = 8.842;
Standard deviation of the difference = 1.5956.
Degree of freedom: 122
95% confidence interval for the difference = 5.6834, 12.0006.
T-Value = 5.5415
Students =/ lecturers: P-Value = <.00001
Students > lecturers :P-Value =>.9999
Students < lecturers: P-Value =<.00001

Based on the statistical evidence above, the null hypothesis was rejected while the alternate was accepted. The implication of this finding is that the lecturers attached more importance to ICT than the students.

5.4 Interest in the Use of ICT
The issues addressed here included how respondents associated the quality of their work or performance with ICT; the kind of experience they had in using ICT tools; how exciting or boring they felt while browsing or using other tools; whether or not their very close and important friends or relations encouraged them to excel in the use of ICT; how they could rate their ICT ability; if anything could make them lose interest in the use of ICT; willingness to take advanced course in ICT; and whether they had made great friends with the help of ICT.

***Null Hypothesis*:** There is no significant difference between the *mean* of students and lecturers in terms of interest in the use of ICT.
Alternate Hypothesis: The *mean* of students is significantly higher than that of lecturers in terms of interest in the use of ICT.

The students got a mean figure of 76.122 and standard deviation of 10.5564; and the lecturers recorded a mean of 53.594 with standard deviation as 16.1665. The t-test of the difference in means showed as follows:

Observed difference (students-lecturers) = 22.528;
Standard deviation = 2.1904.
Degree of freedom= 85
95% confidence interval for the difference (18.1728,26.8832)
T-Value =10.2849
Lecturers =/students: P-Value = <.00001
Lecturers > students: P-Value =>.9999
Lecturers < students: P-Value =<.00001

The result of the statistical test led to the rejection of the null hypothesis and acceptance of the alternate. This finding means that the students had interest in the use of ICT than the lecturers.

5.5 Factors that Determined Engagement with ICT
The items here attempted to ascertain whether their use of the ICT tools particularly e-mails, face-book, and other blogs and facilities was to make and sustain friends; how much their relationship with family and important friends depended on the use of the ICT tools; if their use of ICT had much to do with examinations taken in the past; whether they engaged in use of e-payment more often than the use of cheques; the availability of time to engage in ICT; their priority for ICT compared with other needs; how much fun or entertainment they derived from ICT; how often the use of ICT helped them to explore ideas about life; how much resources they could devote to ICT compared to other interests; and other similar issues.

***Null Hypothesis*:** There is no significant difference between the *mean* of students and lecturers in terms of factors that determined their engagement with ICT.
Alternate Hypothesis: The *mean* of students is significantly higher than that of lecturers in terms of factors that determined engagement with ICT.

The students' mean figure was 77.058 and standard deviation of 9.2396; and the lecturers' mean was 50.156 with standard deviation of 14.9191. The results of the t-test were:

Observed difference (students-lecturers) = 26.902;
Standard deviation = 2.0063
Degree of freedom= 83
95% confidence interval for the difference (22.9115, 30.8925)
T-Value =13,4088
Lecturers =/students: P-Value = <.00001
Lecturers > students: P-Value =>.9999
Lecturers < students: P-Value =<.00001

With the findings above, the null hypothesis was rejected and the alternate accepted. The finding shows that the students are more associated with the factors that promoted the use of ICT than the lecturers.

6. DISCUSSION OF FINDINGS

6.1 Evidence of the Digital Gap between Students and Lecturers
This study has revealed that there is significant "digital gap" between the students and lecturers. Though the lecturers seem to be better aware of the critical role of ICT, the students show more interest in its use and are favoured by factors that encourage the use of ICT. The study further indicate that there could be equitable access or ownership of ICT tools, but the real difference or digital gap comes with the differences in the ability and interest to use them.

The digital gap between students and lecturers is closing the knowledge gap between the two key players of the education system. On one hand, this is a positive development because it shows that students are becoming more proactive and that the quality of learning by students is accelerating. On the other hand, it poses a danger to the lecturers who are professionally expected to lead knowledge development in their various specializations and particularly in the classroom. The Educational system will find its optimum quality of teaching and learning at the point where both students and lecturers are equally engaged in the race towards e-participation.

6.2 Way Forward

UNESCO presented two models of ICT development for students and teachers which it considers to be a kind of scaffold or framework that could guide the integration of ICT in the education system. [2] One model is seen as *"a continuum of approaches to ICT development"* and the other is referred to as "*stages of teaching and learning with and through ICT."* In the first model, ICT development as a *continuum* runs from the *emerging, applying, infusing to transforming* levels. In the second, ICT development as stages passes through "*discovering ICT tools, learning how to use ICT tools, understanding how and when to use ICT tools for particular purposes, and specializing in the use of ICT tools."* The UNESCO framework has proved to be a very powerful tool or guide that can help in a systematic turn-around of the low level of appreciation and use of ICT in schools especially by teachers. Wokocha and Nwokeocha have reported that the biggest successful attempt to re-orientate teachers in Nigeria towards appreciating and using ICT was accomplished in year 2006 by the Teachers Registration Council of Nigeria, inspired by the UNESCO models. [24]

Altun after extensive review of literature on strategies adopted by selected countries (Japan, Germany, United Kingdom, USA, etc) to reposition ICT in their schools, outlined four major areas that all the countries addressed in order to make significant progress. [18] These are (a) ICT infrastructure and physical resources, (b) curriculum and policy development, (c) training of lecturers, and (d) pedagogical training in ICT. Similarly, Albion and Redmond (2009) asserted that a teachers' ability to use ICT is determined by motivational factors, personal knowledge and experience with ICT tools, confidence in use, access to ICT resources and training, teacher preparedness, and pedagogical and technical support. Therefore, for a successful advancement in teachers' use of ICT, this study advocates for increased access to technology, training of teachers, and favourable policy environment.

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