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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