Pedagogies for Teaching Online

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ABSTRACT
After a total of 13 years experience teaching various courses for various programs online at the university level, the authors discovered that there are unique pedagogical approaches required by different disciplines. Couple this with a constant treadmill requirement of keeping up with the technology. This is further complicated by a constant need to monitor and risk mitigate against what can broadly be described as 'technical difficulties'. The growth of the online teaching market and the tools that have the potential to facilitate this market, on a timeline, differs from traditional academic timelines associated with planning, scheduling, purchasing of software and hardware, deployment to faculty, students, and classrooms, along with training of all humans involved. This paper represents a set of best practices and lessons learned; along with some data representing how non-intuitive online teaching and the experience associated with it has been.

Keywords
D.2.7 [**Interdisciplinary Education**]: Online teaching tools and pedagogies.

1. INTRODUCTION

Pedagogy, simply put, is the science of teaching and the methods associated. As universities either choose to, or are forced to offer distance learning education, it is the responsibility of the educators to figure out how to best deliver the material for getting the knowledge across. In the past, emphasis has often been on how to best recreate the classical and traditional brick-and-mortar classroom [1]. With this movement from the classroom as the center of instruction to the web requires a different approach to instructional design [2][3]. Therefore, there is much interest, and rightfully so in a) the type of knowledge to be taught, b) the current tools available to best exploit knowledge transfer, c) synchronous vs. asynchronous learning, d) testing of knowledge, and e) inherent issues with modern technology and its transfer. On top of all this, there now needs to be special care in anticipating the delivery vehicle and its interfaces, since so many students are now using handheld devices and tablets instead of laptops and desktop computers. These challenges and some solutions are presented here.

2. BACKGROUND

The two authors have collectively been teaching and managing teachers who teach online for over a decade. Since the subject areas are computer information systems and behavior analysis, there are distinct differences in requirements for delivery of each area because of the topics at hand and the goals of the courses. However, there are also pearls of wisdom, useful guidelines, and lessons learned which are shared by both departments. After realizing both of these major differences and similarities, the authors felt that any patterns that have been discovered, good or bad, constructive or destructive, fixable or non fixable, were worthy of further research and sharing.

In general, the observations and research data used for this paper is based in behavior analysis for one set of classes/students and in the field of computer information systems for the other set of classes/students. Let us call this the BA and CIS groups. The purpose of this work is to communicate and log progress and working pedagogies, while researching fixes for the issues and as a way to address the hot spots, or problem areas.

3. ONLINE TEACHING METHODS

For the CIS group of instructors/students, a wide variety of topics need to be taught for about 20 different courses towards a master's degree. As a minimum the instructors build web-site based courses via a learning management system (LMS) such as Angel or Blackboard. Faculty typically conduct, at least 1 virtual chat per week, augmented by email, discussion forums, and/or PowerPoint slides. On top of this, it is strongly encouraged that faculty includes other materials and/or communication methods which can include any of the following:

- Media included with texts
- Links to shared websites with tutorials
- Locally produced tutorials
- Online labs
- Skype
- Podcasts
- Video capture of lectures
- Handouts
- Research Articles
- Tutorials with interaction (quizzes)
- Document Camera Learning

Note that this list is not necessarily exhaustive; i.e., a faculty member may also elect to communicate by phone or to meet in person when the distance learning (DL) student happens to be locally available.

In academia, as tools become available and are being evaluated for use, the IT staff responsible for purchasing and maintaining these tools for the faculty and students may or may not have clear ideas of the challenges of the instructors. But this is true in general in

education: a Calculus professor will face different challenges than a Biology professor who will face different challenges than say a professor who is trying to teach computer programming. It became quickly apparent that the material being taught may help dictate the choice of delivery media, pedagogies and methods.

There are two ways to classify: one is to list the delivery method and try to define what it is good for, and the other is to look at specific topic areas and try to ascertain the best delivery method. For organizational and structural purposes, for this paper, the first classification method will be described here first. See the list below.

4. DELIVERY METHODS, POSITIVE ASPECTS

Delivery methods are often called synchronous or asynchronous (aka, in real-time and non-real-time) [2] and there often is a blur or omission of the line between development/preparation and actual delivery. Professors in the DL arena tend to be in one of the following classifications:

- Course facilitators – these are faculty who present canned materials developed by another faculty member, group, or organization. Their role may include as an augmentation to the material presented by the media and their role is secondary.

- Faculty developers – these are faculty or others (in instructional technology or IT or graduate students for instance) who develop tutorials, videos, podcasts, scripts, content, or other materials. These stakeholders also represent the expert domain.

- Full participant faculty – these are defined here as faculty who develop and administer all aspects of the DL course. Although they may have graduate student assistants (GSAs) to assist them with grading and administration, especially with videotaping, they are the primary producers and deliverers of course materials for the course.

Regardless of the role of the faculty, any faculty member, DL or not, can benefit from a variety of media, pedagogies and methods that can currently be produced with what is available (most at a price) today. Here is a list that represents most of the teaching media styles used or needed for CIS. The examples are in no way a complete list but are meant to better describe how the tool/method can be used.

1. Document Camera Learning

Definition: A document camera is a device which allows a professor to write on a tablet or similar device and the handwriting itself is captured either as snapshots or video.

Best for: math problems and showing students how to do something or problem solving traditionally taught on the chalk board.

Examples: Solving roots of equations, writing a program, graphing (i.e. creating graphs).

Conclusion: This method is really well suited for math problems since a video with a professor just speaking or lecturing about math can lack depth of understanding or be lost to a certain subset of students, cognitively. Additionally, it has been found that PowerPoint is too dry or sterile a presentation method for complex mathematical derivations or problem solving.

Tools: As an example document cameras integrate well with Adobe© Connect™. Adobe© Connect™ is an interactive eLearning platform that enables instructors to present material live or to record material for future viewing by students. The document camera interfaces with Adobe© Connect™ to allow the instructor to walk through examples step by step. It also allows the instructor to show items to the students.

2. The Video Captured Lecture

Definition: A video camera is either put in a classroom where a lecturer is holding a lecture to a number of students, or a lecturer speaks or reads from scripted material in a studio. Lecturers may use all scripted material, no scripted material, or both.

Best for: Opining on a topic that one is an expert in or otherwise delivering with the goal of recreating the traditional university lecture. Note that interaction from students, if carefully filmed can be captured, but this is not always practical or easy.

Examples: History of Florida before the Civil War, Lessons learned in the administration of the chemistry lab, President Nixon and the Watergate Scandal, My experiences as an Astronaut, what I did on my summer vacation.

Conclusion: The lecture has been the cornerstone of traditional university teaching in the brick and mortar environment. However, instructors in the CIS field are realizing that there is a limited amount of material inherent in this field which can adequately be communicated or delivered via a video-taped lecture. It is best used for the colorful lecturer, speaker, or teacher who is able to infuse meaningful 'war stories', humor, or visual aids best transmitted by streaming video.

Tools: Adobe© Connect™, Tegrity®, Panopto, Brainshark™™

3. Interactive Discussion with two-way Audio

Definition: This needs to be defined abstractly and then more technically. The abstract definition is used when it is required to have the entire class or a subset of the class talk to each other in real time (synchronously), with audio. Technically, this means that a tool is needed to accomplish transmitting high speed streaming audio, synchronously to each student and faculty member, and every participant will need a microphone as well. A secondary requirement typically is to also capture this interaction so it is available to everyone (or not as determined by the faculty involved).

Best For: Open discussions, brainstorming, group projects, project management, case studies, and debates.

Examples: Creating a Requirements Document for a particular software product, discussing pros and cons of a particular software design method, group project presentations, how to build the next best mousetrap.

Conclusion: This is a challenging delivery method and pedagogy for several reasons. There can be technology issues that are considered *high risk* since all parties must have high speed internet access, audio, microphones, cameras, and given this long list of technological requirements that must all be synchronized it can be disastrous if several participants (or even one: the faculty member) have technical difficulties. The most (initially) non-obvious and difficult to get resource to make this method work is: there needs to be technical staff on call for these synchronized events, and oftentimes (i.e. for CIS, all of the time) this staff will need to be on call after regular business hours. It is tantamount to the lecture hall door being locked for some and open for others..

Tools: Adobe© Connect™, ANGEL, Skype, Panopto, Tegrity®

Please note that ANGEL and other LMS's readily make available live chat and conversational features that are synchronous and textual (without audio).

4. Electronic Test Proctoring

Definition: This type of test proctoring uses a camera to attempt to provide a foolproof security monitor of a student during the taking of a quiz, test, or exam. This may include showing of an ID for a student at the onset, the use of software to monitor the desktop during test taking, the use of the camera to monitor the student (only) during administration of the test, and use of 360° tracking cameras for monitoring of the room and student during administration of the test. The requirement may be to be used with a LMS timed test tool or not.

Best For: Oral and written quizzes, tests, and exams.

Examples: Oral and written quizzes, tests, and exams.

Conclusion: This is one of the most problematic and important tasks at hand for the administration of online courses. This is done far less than it should be, and if academic accrediting agencies ever get involved in the policing of proctoring, there will be a mad scramble for many to incorporate quickly.

Tools: Adobe© Connect™, Software Secure Remote Proctor, ProctorCam, Panopto, Tegrity®,

5. Show How Something Works

Definition: This functional requirement of distance learning is similar to or overlaps with some of the previously mentioned methods above. Therefore it might be doable with video capturing and a professor doing whatever on the white board. Another imaginative and effective means of production is using Flash or creative use of PowerPoint. This requires a lot of expertise in Flash and creating animation is time consuming but some of the tutorials are especially effective in showing movement and aspiring to reach different students who may not respond as well to some of the other methods.

Best for: See some examples that have been done for CIS at Florida Institute of Technology.

Examples: Process scheduling and migration of processes within uniprocessor and multiprocessor systems, arithmetic of binary numbers, bit representations of data, computer memory models, programming constructs, and in general ideas, problems, and theories that incorporate *movement*.

Conclusions: This is an exciting area of production since it is the most creative and rewarding when the creations are correct and useable. As with many of these methods a big advantage is the reusability in terms of use from semester to semester and in terms of by the student who can view and re-view as many times as they want. The design, scripting, development, and planning of these sorts of tutorials are time-consuming and if a tutorial has one error in it, it may be rendered unusable. Since topics the developer chooses as content or knowledge to transfer are often the most complex of the class, this makes design and development that much more problematic.

Tools: Brainshark™, Adobe© Flash™, Adobe© Captivate™, Camtasia Studio®

6. Student Presentations

Definition: Student must be able to record themselves with a camera presenting a research topic. This defines student as originator of the artifact, not an instructor. Students can also create podcasts. Podcasts can be either video and audio or audio alone.

Best for: Student presentations, project demonstrations, showcasing of ideas, patents, inventions, etc.

Examples: See "Best for".

Conclusions: There are five significant conclusions here:

- For the student to achieve this, document camera learning, video capturing, pod casting, and interactive discussions; i.e. pretty much all aforementioned methods may be used here. The primary difference is that the student is the one who now is producing content, scripts, video, audio, etc. There really is no limit to the combinations of what a student can come up with here.

- Since there was research that involved thirty years of safety training that found the most effective training involved a high level of engagement [5], it is being realized that assigning or forcing students to create their own multi-media may enhance the learning of the topic significantly by having students create content, they are highly engaged in the learning.

- Additionally, studies have also shown that if a learner does not find the information relevant they will not

necessarily learn the information [7]. Involving the students can help them make the necessary connections.

- Collaboration between the student and instructor during student projects affords the opportunity to discuss and compare ideas which allows for further development and articulation of ideas [8].
- Feedback is critical to learning and human performance [9]. Student presentations allow the instructor to provide valuable feedback to assist the student in the learning process. Feedback also promotes self-regulation researchers have found as well improved quality in student participation [10].

As has been demonstrated above, careful choices must be made in determining the best production and delivery method when attempting to create the knowledge base of media associated with a class. Quite frankly, the authors feel this is just the tip of the iceberg. For the most part, the technical issues have been conveniently ignored up to this point. The next section will address this.

4.1 Issues

4.1.1 Technical Difficulties

Here is a quick summary of some of the technical difficulties CIS and BA faculty have encountered:

- **Single point of failure: no internet access.** Stuff happens sometimes the internet connection is lost.
- **Single point of failure: no power or a device runs out of battery**. In Florida residents are particularly sensitive due to hurricanes and weather; plus newer devices run on batteries.
- **Slow or limited internet access:** Unfortunately, there are still some people (in an environment where one is too many) that have slow access or modems - think third world. Different internet companies have different levels of service depending on the company and the geographic location. There are also **bandwidth limitations.** Multiple users accessing the internet at the same time can cause traffic congestion and reduce the bandwidth availability for other users.
- **Incompatibility issues with different browsers and versions of browsers.** Unless you require that everybody use the same browser and version of that browser (which is not practical).
- **MAC versus PC** Not all tools and software are available for both the MAC and PC.
- **Faulty devices.** Cameras, microphones, handheld devices, etc.—you can file this in the stuff happens category also.
- **Software difficulties**. The idea that there are never problems with cloud and web based software tools is ridiculous. Vendors may promise N% uptime, but unless N = 100, it is only responsible to always have a plan for failure.
- **Time overhead for preparation.** This included the installation of all necessary software including required plug-ins like Flash Player, Quick Time, etc.
- **Not all handheld devices support all tools.** If an institution decides not to allow handheld devices for taking online courses, then this will have to be a policy or compatibility with handheld devices will need to be addressed.
- **Incompatibility due to other software programs, drivers or devices on student's computers.**
- **Forgetting passwords**. Students will have their browser remember the password and then when they use another device or they have to reload their computer they do not know their password. Anybody in today's world surely must be able to appreciate this issue.
- **File Formats.** Not all software can handle all video file formats, image formats, PDFs, etc.

4.1.2 How to Handle Technical Difficulties

It is important to have access to knowledgeable technical support in a timely manner [9]. Delays in accessing support increase the frustration of students, especially students that have not taken online courses before or used the technology. Even the students with technical knowledge may not have authorizations to fix technical problems with synchronous and asynchronous delivery methods, especially when students are taking courses on work computers, where firewalls prevent administrator access.

It is also important to remember that there is a great divide between those that have and use technology and those that do not. There have been great efforts to close this divide but it still does exist, and is sometimes tied to geographic location, field of endeavor, and economic demographics.

In the Behavior Analysis online program, besides having access to the University Technical Support which is open seven days a week, one full time employee and three student workers in the Continuing Education department provide support for students. This is a huge commitment in time, money and resources that must exist from the get-go.

The University Technical Support provides assistance to students with issues related to password resets and assist students with computer related issues such as assistance in downloading and installing needed plug-ins.

The support staff, within the department, assist students with course related difficulties such as difficulty with an exam because of a loss of internet connection during the exam, or problems with downloading videos from iTunes U. There are too many technical difficulties that can happen and this is not an exhaustive list.

The sooner the student can obtain help, the less it will interfere with their studies. A great deal of time is spent at the beginning of courses teaching students how to use their computer and the software involved with the course so that the technology does not get in the way of the learning.

Tutorial videos are presented during the orientation of the course to provide students with information to assist them with common difficulties that they may encounter. This reduces the number of support emails and calls.

Throughout the course emails are sent to students on such topics as how to clear their cache. Clearing the cache for example is important when students are watching a large number of videos as a part of their coursework. It will slow down their computer.

Internet companies promise their customers that they will receive up to a certain level of service. Students are provided information on how to run speed tests on their computers and how to communicate with their internet providers if they are not receiving the level of service they feel they should be receiving.

Offering the same video in different formats assists with reducing technical difficulties. Streaming video works well when the student has a high speed reliable internet connection. Progressive download will download the video to the student's computer. It is important in progressive download to let the video download before viewing it to avoid buffering issues. This format works well for students with slower or unreliable internet connections. It does take longer to view as the student has to wait for the video to download. A third option is iTunes U. In this option the student can download the videos for viewing at a later time. Since it is physically located on their device, once it is downloaded they can view in locations that there is no internet connection.

5. EXPERIMENTS AND ANALYSIS

As more and more students use mobile devices to access online learning environments, the need to design effective mobile learning environments increases in importance. Preliminary evaluation of four popular mobile devices was conducted. The devices evaluated were the iPad, the iTouch, the Samsung Galaxy®, and the Android™ phone.

Each device was evaluated for: process of connecting to the wireless network, accessing the web browser, accessing the learning management system, ease of accessing the course and course material, ability to view the learning artifacts, and the ability to interact with the learning artifacts. For this experiment, a course in the ANGEL learning management system was used.

6. RESULTS

Each device had a different method for setting up the wireless internet access. This causes difficulties for new users of the devices.

Accessing the web browser was available from an icon on each device. Accessing the learning management system had some differences. The smaller devices did have smaller keyboards which could make it more difficult to type for some users. Also, the smaller devices had smaller text. Again, this could present a problem for some of the students. Haptic feedback was available on the Samsung Galaxy®.

It was found that the mobile tablets worked well for reading related assignments. Reading is more difficult on the smaller mobile devices.

The tablets and the smaller mobile devices are convenient for watching videos. The limitation for the iPad and iTouch is that they cannot view flash videos.

In order to view course related material saved in different formats, the user would need to download the software to view these documents on the mobile devices. An example of this is downloading the Adobe© PDF reader to be able to view PDF documents. Students may need technical assistance in how to do this at the beginning of the class to avoid delay in accessing technical support should they have any difficulties.

The online courses were developed on a desktop. One limitation that was discovered was that the more tabs and folders that a student has to navigate to on a mobile device, the longer the delay in accessing the course material. Each time a new tab or folder is selected there is a delay as the page does not load as quickly due to the slower internet connection on mobile devices.

When testing the devices early in the morning, access to material was much quicker. The later in the day, the longer the delay users experience in accessing the course material. This was due to wireless congestion with more users vying for the bandwidth on the wireless network. This can lead to greater frustration when students have assignments that they need to complete by a deadline.

Breaks in internet connection can knock a student out of an exam. This is a security feature within the ANGEL learning management system. On mobile devices, the internet connection can be intermittent causing difficulties for the students taking exams.

7. FUTURE RESEARCH

More research can be done on:

- Mobile device interface and usability in learning environments to include human centered design principles of safety, comfort and efficiency [11].
- Fault tolerance, availability, and mitigating risk during test taking in the environment where multimedia collaboration in a distributed environment needs to be made more robust.
- Learning outcomes based on pedagogy and delivery methods.

8. CONCLUSIONS

In a review of online learning studies conducted by the U.S. Department of Education, it was found that "students in online

conditions performed modestly better, on average, than those learning the same material through traditional face to face instruction [12].” One of the potential reasons for this is students in online learning environments tend to spend more time on task. Technology, the instructional design of the curriculum and the delivery method may all contribute to this.

Technology is evolving at a rapid pace. Instructors also have great demands placed on their schedules. Effective learning environments need to include technologies that are ubiquitous. Technologies and tools are needed that are intuitive to learn how to use them by both the instructor and the student, that do not require a great deal of set-up on the part of the instructor or the student, and that do not have technical difficulties that take away valuable teaching and learning time.

“Modern information technology strongly supports knowledge development and learning,” according to Dr. Guy Boy [13]. Mobile and online learning platforms are information technologies that are available to support knowledge development and learning. Learning is a basic fundamental of all that we do from the time we are born to the time that we die.

We are a mobile society. Many of today’s youth have grown up with mobile technology. When they want information they often look it up on their phones. They are used to being able to access needed information wherever they are and whenever it is needed. The use of mobile devices that today’s youth are currently using can aid in providing the needed training and education. Education, institutions of higher learning and corporations are evolving to embrace the online and mobile technologies for learning.

Once caution is that rather than trying to fit the technology or tool to the learning environment, it is important to look at the needed pedagogy and select the tool that provides the appropriate delivery method to maximize learning.

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