The Promise and Challenges

of Integrating Interactive Technologies into University Pedagogy

Randy Jackson, Ph.D. University of Washington, Seattle

INTRODUCTION

At the University of Washington (UW), Seattle one of the key factors driving AV purchases these days is the quest to create *added value* in our existing learning environments. In the past this simply meant installing data projectors, Ethernet, and AV control systems. It was largely a capital projects effort with little or no thought being put into the precise pedagogical demands that we were meeting by doing so. This was something that almost everyone wanted regardless of their personal approach to instruction and we happily met that demand. Life was easy.

Now that many of our rooms have reached a certain standard of computer-based multimedia display sophistication we are turning to pedagogical-based analyses of the roles technology plays in our classrooms. This process is impacting how we look at basic room configuration and design but, more importantly, it is leading us to consider technology offerings that might better support desirable pedagogical outcomes. After all, we now have over 100 years of dramatic growth in learning theory, learning science, and technological aids to guide us. Yet, with countless hours of practical experience invested in investigating these tools it seems remarkable that up to 80% of our campus instruction still comes in the form of tried-and-true sage-on-the-stage lecturing, albeit enhanced by digital bullet points, clipart, and sound bites.

Surely there is value to be found in traditional lecture formats, but what added value might we harvest from large lecture environments where significant interaction is seriously lacking and only a handful of students dominate any attempt at spontaneous interaction? How might we improve a fifty-minute lecture period where questions from the audience comprise less than five minutes of class time and only 19% of students will ask a teacher for advice after class? And how might we improve things if we know that only one-third of all students leaving a typical lecture will have most of the key lecture points recorded? What are the barriers that prevent our smart classrooms from being used by our very smart faculty in the smartest of ways?

Questions like these have led us to investigate the promise and challenge of integrating technologies that support interactive experiences into our learning environments. Many theories of learning suggest that instruction will be most effective when it leverages both active and interactive learning experiences. That is, learners must respond in some way to the learning material they encounter. Passive listening, viewing, or reading cannot yield the same benefit. With this in mind we set about to identify technologies that would support some degree of interactive learning believing that the true value of modern educational technologies is only fully realized when they allow us to do things interactively. We sought to find ways to engage students using technology, to provide formative feedback along the way, and to allow for novel ways of interacting with instructional content.

INTERACTION

Using educational technologies in interactive ways is challenging because it demands better curriculum design and course production. Significant time and effort must be invested in mastering the technology and in converting existing courses into interactive experiences. There may be substantial initial instructor effort required and almost certainly additional efforts required of learners, but the promise and payoff comes in the form of a much better overall learning experience for all stakeholders. Technology managers are tasked with offsetting as much of that effort as possible by implementing well-designed technology programs, selecting appropriate technologies, and providing a variety of avenues for end-user support. The first step towards accomplishing this is to gain an understanding of the relationship between interactive educational experiences and educational technology.

An interactive experience might be defined simply as allowing a user to make a change in the state of a system. However, from an educational technology perspective an interactive experience would be employed to promote change in the state of the user's mind. This is an important distinction and the fact that the state of the system changed may be irrelevant. Educational Technology can be broadly defined as *knowledge applied systematically to instruction* and can be viewed as both physical technology (i.e. assorted classroom tools, books, computers, software, computer networks) and communications media (i.e. lectures, writing, drama, instructional design, symbol systems).

Educational technology, therefore, allows for two basic types of interactive activities: technology based (Human-Machine) and media based (Human-Human). Human-Machine Interaction might involve interactive whiteboards, tablet-and-pen display interfaces, document cameras, and other hardware-based tools (i.e. keyboards and mice) and allows instructors or students access to learning materials, in potentially novel ways, by using a technology interface. Human-Human interaction can occur in three distinct ways: 1. Interaction between the learner and the originator of the teaching material, 2. Interaction between the learner and an instructor who mediates between the original material and the learner by providing guidance and assessment, and 3. Interaction between the learner and other learners. It is commonplace to use technology to mediate human-human interaction. There are also many applications, such as in educational virtual environments, where both of the above types of interaction are employed simultaneously.

Interactive educational technologies might provide simple transparent access to a variety of instructional content, serve to remove distance or time constraints by providing a channel of communication for learners, be employed in ways that directly challenge a students' existing knowledge or abilities, or be used to push personalized content to learners just when they need it most. There are many potential approaches to using interaction in education and educational technologies will vary widely in both how they encourage interaction and provide an educational benefit. Successfully generating added value by integrating interactive technologies into university pedagogy turns out to involve a highly sophisticated set of considerations.

What follows are several case-study descriptions of two interactive technology pilot projects at the University of Washington involving the relatively simple technologies of podcasting and audience response. These are ongoing projects at the University of Washington that in a mere two years have been subjected to continuous technology evolution and a maturing of instructional approaches. Thus, they highlight both the promise and challenges of using interactive technologies and their associated pedagogical strategies. These particular technologies are clearly in their developmental infancies and the months and years ahead are likely to bring many remarkable changes, not only in the technologies themselves but also to the overall roles that interactive technologies play in our everyday learning environments.

<u>PODCASTING</u>

Podcasting refers to the audio recording of classes in the MP3 format for distribution. Today's podcasts may also include a video component and are increasingly being referred to as coursecasts. Setting up a podcast or coursecast capture and distribution system will probably involve a lot more effort and consideration than those with a casual interest may be willing to invest. Therefore, central administration campus technology managers are likely to lead the effort to establish campus-wide coursecasting systems. A growing number of vendors now offer off-the-shelf tools designed to capture both audio and video for coursecasting applications, some costing upwards of $10,000 annually. Apple offers a service called iTunes U to handle the distribution of coursecasts. The features of these systems vary widely, but with some effort institutions can piece together their own coursecasting systems that can capture audio, video, and PowerPoint slide presentations for a fraction of the cost of turnkey systems.

Along with making hardware decisions, coursecasting system administrators must consider policy issues. Access to course materials stored on a server might be restricted or open to the public. Ownership, copyright, intellectual property, and archiving issues must also be carefully considered and many institutions maintain their own Web sites and dedicated servers for coursecasting programs as a measure of insurance against potential problems.

At the University of Washington we have deployed home-brewed IP-based audio encoding devices throughout 24 classrooms using Barix Instreamers. The Instreamer's audio input takes a feed from the classroom PA system and the audio is consequently encoded and delivered through the campus network to a central capture server where it is processed and uploaded to a secure archive on one of the UW's portal Web pages. The portal runs RSS-capable blogging software, which students can use to access the recordings after they are successfully uploaded.

In the fall of 2007 an automated video screen and audio capture system will be deployed in UW classrooms. This enhanced system replicates the automated audio podcasting system already in use, but adds flash video and screen capture frames of presentation materials. Students will now be able to both listen to and view lectures using operating-system agnostic flash media-player software and can skip ahead to pre-defined points in the lecture, which is an improvement over the linear audio podcasting files that must play continuously from beginning to end. With the exception of the flash video player the entire system operates on open source software, including Debian linux running on home-brewed linux servers. A channel guide of a MythTV server is populated with information from the UW's classroom scheduling database so that preset recording times can be programmed. The video input comes from a video camera in the classroom and a frame grabber is used for full motion video and jpeg slides of the presentation. The entire system is scripted to run automatically.

So far podcasting has proven to be a relatively simple behind the scenes interactive technology to implement. The automated podcast recording and distribution system we have developed requires very little effort from faculty who want to podcast their courses and from the outset the podcasting program has provided students easy access to digitally recorded lecture content that can be played back on any MP3 player. In the year and a half since the program's inception we have now logged over 110,000 lecture downloads.

It is important, however, to keep the current success of the podcasting pilot program in perspective. What we have devised is, essentially, a digital replacement for our 20-year-old classroom audio cassette-tape recording program. The old process of producing audiocassette tapes is suddenly viewed as being both inefficient and labor intensive. We can now make those recordings available via an automated IP-based capture and distribution system. Our hope is that this is vastly more convenient and educationally beneficial than having to go to the library to pick up cassette tapes of those same class sessions.

Podcasting might have potential to enable a robust anywhere-anytime interactive learning style, but using our current system students are forced to listen to a simple un-indexed linear recording having no rewind capabilities. Once you start it, you listen to it all the way through or start again from the beginning. A better interface is planned for the new audio/video capture system. Regarding the notion of interactive learning styles, to determine exactly how interactive this medium really is we will need to take a much closer look at how students are actually using the class recordings. For example, if students access these materials primarily from computer-lab computers (not portable MP3 players) for the purpose of cramming for a test or mid-term, then we have not enabled a learn-anywhere-anytime kind of interactive learning. Nevertheless, students report that these recordings help them catch up when they miss class and are a good resource for homework and exams. Students tend to talk about podcasts in terms of being good study aids that help to clarify materials covered in lectures and enhance comprehension of complex concepts. Clearly, this program is filling a need.

AUDIENCE RESPONSE

Audience response systems have been around in one form or another quite some time now but it wasn't until the highly portable, easy to use Radio Frequency systems hit the market a few years ago that the technology suddenly jumped into the mainstream. Audience response systems use infrared or radio frequency technology to transmit and record student responses to questions posed by the instructor. Each individual handheld response device, generically referred to as a clicker, has the potential to be registered to a specific student and generates a unique, identifiable signal. A small receiver, typically a USB dongle plugged into a host computer, collects and records the student responses, which are reported to a software program running on the computer. The software may be a stand-alone product or a PowerPoint plug-in and questions and response results can be readily displayed to the class using a data projector.

Clicker systems are popular in part because they allow for interactive participation by all students in a class. They provide immediate feedback from the entire audience to the instructor, which can then be subsequently displayed back to all students. This kind of interaction and feedback is traditionally very difficult to achieve in large lecture environments where class size limits student-instructor interaction. In formative assessment applications, clickers are used to ensure that students understand core concepts before having to take a test on the subject matter. Getting the answer right in a non-test situation is less important than identifying knowledge gaps or misconceptions.

Instructors from every discipline have used clicker systems to help keep students motivated and engaged in what is going on in class, from the largest of classes to small group discussions. Interaction and engagement are critical elements of successful instruction and can be easily facilitated with clickers when the right questions are asked at the right times. The ability to leverage a teachable-moment into a genuine learning experience is lost, however, when poorly structured questions are posed that don't focus on key concepts or contribute meaningfully to the discussion. Since identifying student misconceptions and providing frequent feedback are critical elements of good clicker, there is likely to be an additional burden placed on instructors to create well-considered and well-designed interactive educational experiences. Clickers have been demonstrated to be highly versatile interactive tools that bring added value to learning environments by facilitating activities such as discipline-specific discussions, large group interaction, small group cooperation, and student-student interactions.

In the summer of 2005 we decided to investigate the potential for standardizing audience response system usage at the University of Washington. At that time we had at least 4 varieties of systems, both IR and RF technologies, that were being used across campus and interest in audience response systems was growing rapidly. Students were required to purchase different $30 handheld clickers for use in classes using competing technologies and we were being asked to support the use of multiple brand installations across campus.

That summer we evaluated multiple vendors to see what product best met the needs of users on our campus and in August of 2005 we acquired a site license for using Turning Point software and hardware, manufactured by Turning Technologies. Our intent was to establishing a model for centrally managing audience response technology on a diverse campus of over 40,000 students where we were seeing both heavy departmental use of these systems, particularly in the sciences, and a strong interest from individual faculty and administrators. We believed then, as we do now, that acquiring a site license for this particular interactive technology would provide strong incentive for standardization and bring about a number of associated benefits. For example, independent and creative users could easily get involved and experiment with innovative uses of the technology without having to make major investments of time or money, while large departments could standardize on one keypad and one software product which simplifies the training and distribution process. In addition, our bookstore would have a strong incentive to sell and buy back the clickers and students could anticipate using the same clicker in more than one class.

At the end of our 2006/2007 academic year, the UW now has about 4,000 students actively using Turning Point. The majority of these students are in our Biology and Chemistry undergraduate programs, but the list of audience response users is continually growing and includes students in a number of academic units including the Law School, Linguistics, Urban Design & Planning, Communications, Education, Health Sciences, Physics & Astronomy, and the Program on the Environment. In addition, administrative offices have made use of Turning Point audience response technology for both internal and high profile community outreach presentations and events.

While we initially viewed audience response technologies as a way to generate added value through real-time interaction in large lecture environments we found that having a campus site license has resulted in the audience response system users being used in diverse and sometimes very unique ways which include: 1. Simple on the fly polling of the audience, 2. Awarding bonus points for attendance, 3. Pop quizzes, 4. Focus groups, 5. Course evaluations, 6. Case study analyses, 7. Identification of misconceptions, and 8. group responses and competitions. In fact, we have observed no standard way of using audience response technology at the University of Washington. Use will vary widely according to individual instructor interests and goals and students have used the technology to evaluate both peer presentations and instructor performance. One instructor might casually ask 1 or 2 questions per class to challenge thinking at the start of a presentation while another will use audience polling continuously throughout lectures to generate interaction and keep students on track.

The criteria we used to evaluate and select Turning Point include the following points:

- RF based
- Portability – ease of hardware setup
- Supports large numbers of users (up to 1000)
- Integrates well with current classroom computer setup
- Office-based software – PowerPoint plug-in
- Robust software that can do more than ask simple questions
- Incorporate graphics, import 3rd party questions, run reports, branching, cross-tabulation, etc.
- Scaleable
- Overall ease of use (software & hardware)
- Customer support
- Technical support and training
- Not tied to curriculum or textbook materials
- Competitive total cost of ownership
- Availability of product updates
- In-house database management

Following two years of use, the University of Washington has made Turning Point the campus standard and this is as much for administrative reasons as it is for technology performance reasons. There are many manufacturers of audience response technologies and both the technology and marketing strategies continue to evolve rapidly. Choosing what specific technology to employ and how to manage it remains a significant challenge. In spite of the demands this reality places on a centrally managed approach to audience response systems, our belief that clickers, when used in well thought out interactive learning environments, bring a wealth of added value by enabling a more effective, more efficient, more engaging, and highly interactive pedagogy has made it a very worthwhile effort.