Fall 10-3-2004

A Case Study Of Teaching A Quantitative Course Using Archived Streaming Video

Paul Savory
University of Nebraska at Lincoln, psavory2@gmail.com

A CASE STUDY OF TEACHING A QUANTITATIVE COURSE USING ARCHIVED STEAMING VIDEO

Paul Savory, Ph.D.

Department of Industrial and Management Systems Engineering
University of Nebraska - Lincoln
Lincoln, Nebraska 68588-0518

Abstract

This case study highlights some of the issues and difficulties experienced in teaching a quantitative course using three methods of delivery: in-class to an audience of students, television broadcast over a satellite system to distance students, and archived streaming video accessible by students. The discussion is applicable to administrators and faculty exploring the option of teaching a course using multiple delivery approaches.

An Introduction

The College of Engineering and Technology at the University of Nebraska has a successful tradition of teaching courses to an audience of students and having the broadcast sent over a satellite to learners at distance education locations. In the summer of 2000, I was asked to participate in the college's first attempt at teaching an internet-based steaming video course. The plan was to embellish our approach to distance education by adding in a third delivery mechanism – archived streaming video accessible over the internet. As discussed in Johnson et al. (2001), integrating distance learning into a traditional education program creates new complexities. This was certainly true in our case. Our goal for the streaming video broadcast was to mirror a traditional classroom (and television) experience for a student versus the more common internet course strategy of having no video lecture or discussion and using directed readings, projects, and a message board for posting comments and questions. The course I used for this project, Principles of Operations Research, is a quantitative course that teaches approaches for optimizing mathematical models of systems. Given I had previously taught this course seven times (four of which had been over a television broadcast system), it was thought that it would be a good example for judging how adding a streaming video component would impact preparation time.

The Technology

The layout of our television classroom has the faculty member in the front of the class with access to a classroom computer. For students, there is a large screen television at the front of the room and additional monitors mounted around the room. Adjoining the classroom is a room where a television technician monitors the broadcast equipment and the production.

As part of our internet plan, we wanted to create a stand-alone video presentation that could be viewed with the Real Player video software (http://www.real.com/). Viewers of the streaming video would see a picture of me in the left hand side of their screen and a larger Microsoft PowerPoint (http://www.microsoft.com/) presentation on the right. Figure 1 is a screen shot of a video broadcast. To develop the steaming video presentation, we used the Real Presenter software (http://www.real.com/). This software takes a PowerPoint presentation and creates a static graphic image file (a .jpg file) of each of the slides (and transitions) in the presentation. It then allows one to create a time index for displaying the sequence of image files to accompany a video presentation. As a result, for a viewer of the internet broadcast, while the video feed of me is playing on the left of their screen, the PowerPoint slides will automatically transition on the right of their screen.

Figure 1: A screenshot of the steaming video presentation. On the right is the PowerPoint presentation slide image that is time indexed to the video presentation. In the black screen on the left is where the video feed of me talking would be displayed.

Each day that I arrived to class, I would give the television technician a copy of my PowerPoint presentation. He would load it on his computer and run it through the Real Presenter software program to create the stand-alone image files. I would next take the disk and load it on the computer in the classroom. During class as I am stepping through my presentation on the classroom computer, the technician would mirror my slide transitions on his computer so as to create the time index codes for linking the PowerPoint images/slides. Once class was complete, the technician would transfer all the files over the internet to a post-processing technician who the next morning would adjust hyperlinks and make the broadcast available on a computer server.

Why develop a steaming video broadcast?

Yeung (2002) highlights many of the reasons for adding a web-based delivery mechanism to a curriculum. Additional rational for the time and expense of our creating a steaming video archive course include:

(1) Uses new technology and builds upon our successful satellite broadcast model.
(2) Good publicity for the college and university – administrators like to say that we offer multiple approaches for reaching distance education students.
(3) Distance students can theoretically access the streaming video from anywhere in the world at their convenience.
(4) In-class students can review the video broadcast to have material re-explained to them and/or they can access the broadcast for class sessions that they have missed.
(5) An instructor can reuse the developed PowerPoint presentations in subsequent semesters in which the course is taught. Thus, future course preparation time is potentially reduced.

Observations, Difficulties, Problems, and Frustrations

During the course of the semester, many difficulties and problems resulted. McAlister et al. (2001) highlights key questions that should be addressed before developing and offering web-based courses. The following list of issues expands on many of their points:

Issue 1: Student access is limited.
Students need a fast internet connection to be able to view the streaming video (it will not work with a 56K modem) along with a computer equipped with speakers and the latest version of the Real Player software. As such, a student needs a cable or DSL computer connection at home or access to an internet-connected computer at work or school.

Issue 2: In-class student have little interest in the streaming video.
Of my in-class students, few of them accessed the streaming video to review course material that they did not understand during the traditional lecture. In addition, when a student missed class, I would suggest they watch the internet broadcast. However, only one student followed my suggestion, others simply found it easier and quicker to copy notes from a classroom colleague.

Issue 3: To develop a steaming video course requires an entire team of people.
As noted by Rockwell et al. (2000), the assistance and support offered a faculty member are keys for success. Excluding myself, there were three additional people actively involved in developing the internet streaming video. The key support person was the television technician. Using his computer, he had to mirror my transitioning through the PowerPoint presentation on the classroom computer. While this might sound easy, there were instances in which I had 25 transitions on a single slide (thus, 25 mouse clicks causing something to change on a single slide – a box coming the slide, a discussion point being highlighted). The technician had to mirror every one of these transitions. In several of my 75-minute classes, I had upwards of 400 transitions in 35 or so slides. As a result, he had to carefully monitor me and my PowerPoint presentation, anticipate when I was going to make a transition, and then instantaneously mirror it on his computer. This in addition to his other duties of monitoring the television broadcast equipment.

There was a post-processing technician who confirmed that the material was correctly transferred and adjusted hyperlinks after each class period. Finally, there was a troubleshooter who quickly responded and remedied problems. Overall, this was a huge investment of time, people, and effort for delivering a single course.

In looking towards the future, a PC Support/Technician perhaps is needed to help students configure their computer and diagnose connection problems. Given the problems that I experienced (and I understand the technology and know how to configure a computer), I cannot even fathom the huge number of connection issues for a class with a significant number of internet students with varying levels of computer experience and computer equipment.

Issue 4: Hosting server is unavailable for certain time periods.
The server storing the steaming video broadcasts was unavailable for numerous days throughout the semester. Such periods of unavailability are unacceptable and certainly minimize the advantage of students being able to access the internet broadcast at their convenience. There was nothing more frustrating for a student than to plan the time to view the steaming video broadcast and then not have it available.

Issue 5: The software and hardware technology is unreliable.
Excluding examinations and holidays, I lectured for twenty-three class sessions. For two of these classes, a failure occurred somewhere in the creation process and a streaming video was not created.

For a third class, a streaming video was developed, but if a student were to pause and/or fast-forward the presentation while watching it on their computer, the entire presentation would freeze and become unstable. In a fourth instance, an error occurred towards the beginning of a class session when the television technician's computer locked up. I ended up having to stop class for his computer to be rebooted and then had to restart my presentation. Understandably this was a pilot project and errors were to be expected. Though my experience demonstrates that the reliability of the software and hardware (*e.g.*, the server where the presentations are stored) must be improved before this delivery mechanism is viable.

Issue 6: There is no recovery when a failure occurs.

As outlined in Issue 5, there were several class sessions in which a "problem" occurred with the creation of the internet presentation. When any problem occurs, an internet streaming video is not available. Unfortunately, we had no success in trying to diagnose why a particular video broadcast failed. Hence, when it fails, it fails, and we do not know why. This is certainly not good for trying to prevent future problems. Luckily this course was a hybrid course and a videotape of the broadcast was available and was immediately mailed to my internet students for the days in which a streaming video presentation failed. Such a solution would not be possible with a larger class of internet students or one in which a videotape was not available.

Issue 7: Time delay in the streaming video being made available.

The post-processing technician made a great effort to make the internet streaming video available by noon on the day following my class. While this was adequate, the delay did impact distance education students meeting due dates and exam schedules. Such a time delay is common in a videotape delivery course, but was new for us since we have no such delays in our current satellite delivery system.

Issue 8: Classroom presentation is impacted.

Given our plan of using the Real Presenter software, one cannot vary from using a PowerPoint presentation as the primarily presentation tool. As such, an instructor has to be very organized and have all their teaching materials developed ahead of time. Unfortunately, many of my colleagues would fail to meet this requirement and would have difficulties.

Another issue impacting the presentation was that one cannot edit the PowerPoint slides during class since changes have to occur on both the classroom computer and the technician's computer. As such, errors on the slides (*e.g.*, doing a calculation wrong) become part of the video stream. Post-processing the error(s) and correcting the slides would not be appropriate since the audio stream in which I would be saying there is an error on a slide would not be consistent with the corrected slide image. In addition, such a post-processing step would delay the availability of the broadcast.

Finally, one cannot easily write materials by hand in class. This is especially difficult in a quantitative class where working through a homework problem in response to a student question often results in the best learning. The alternative offered to me was to provide any handwritten pages to the television technician. The pages would be passed along to the post-processing technician who would scan them into the computer as graphic files and would then include them in the steaming video presentation during a post-processing step (she would add them into the sequence of PowerPoint images). While this is possible, the key trade-off is that it will increase the delay in the time needed for the presentation to be made available on the internet. In addition, we had no procedure for how the television technician was to provide the handwritten pages to the post-processing technician (they were on opposite sides of campus). Do they go by campus mail or by fax? How is the post-processing technician supposed to know where to put them in the presentation? Due to these unanswered questions and the potential problems it would have required me to explain/solve, I chose not to write anything during class. I believe that this impacted my ability to answer certain student questions.

Issue 9: Software incompatibilities exist.

A PowerPoint presentation created on my office computer does not necessarily appear the same on the classroom computer or on the television technician's computer. The reason for this is that each computer may have different fonts loaded onto it. For example, I might develop the PowerPoint presentation on my office computer using the "Tahoma" font. If the classroom computer or the technician's computer does not have this specific font, PowerPoint will automatically replace it. This impacts the viewers of the streaming video when the technician's computer is used to generate the static image (.jpg) files of the PowerPoint presentation. If his computer does not have a font, it is automatically replaced in the generated image files that will be used to create the time-indexed presentation. A similar substitution will occur when using the classroom computer to present to the in-class students and the television broadcast. Hence, for one to be certain of how a presentation will look, one needs to be sure that the same fonts are available on all three computers.

In addition, one has to be sure that all three computers have the same Microsoft Office (http://www.microsoft.com/) tools/modules installed. For example, I included numerous equations in my slides. Yet on the classroom computer and the technician's computer, they did not appear correctly. This was due to the fact that neither of these computers initially had the equation editor tool installed on them (the equation editor is not loaded by default when one installs Microsoft Office). Once diagnosed, the issue was resolved by adding the equation editor tool to both computers.

Issue 10: The classroom PowerPoint presentation is impacted by going through the television system.

There were dozens of instances in which horizontal lines and negative signs disappeared when the signal was piped from the classroom computer to the large screen television in the classroom. That

is, the presentation would look perfect on the classroom computer monitor, the technician's computer, and my office computer, but would have missing lines and negative signs on the big-screen television in the classroom. This was due to the television having less resolution than the lowest computer setting. As a result, the television would receive the signal for a line, decide that it was insignificant, and then not allocate any on-screen pixels for displaying it.

This is highly inconvenient when one is presenting mathematical formulas and equations. Figure 2 is how a set of equations would correctly appear on the computer monitor. Figure 3 is what would appear on the big screen television. In Figure 3, the bar over the "t", the division line, and the negative/subtraction signs have disappeared

$$W = \bar{t} + \frac{\lambda(\bar{t}^2 + \sigma_t^2)}{2(1-\lambda\bar{t})}$$
$$= 14 + \frac{.0667(14^2 + 12)}{2(1-.0667(14))} = 118$$

Figure 2: Example of mathematical equations as correctly viewed on a computer monitor.

$$W = t + \frac{\lambda(t^2 + \sigma_t^2)}{2(1\ \lambda t)}$$
$$= 14 + \frac{.0667(14^2 + 12)}{2(1\quad .0667(14))} = 118$$

Figure 3: Example of mathematical equations as viewed on the large screen television.

One solution to this problem is to purchase a line/resolution doubler for the large screen television. Since this was not an alternative, I ended up using the drawing tool in Microsoft PowerPoint to draw "thicker" lines on top of every line in my equations. For example, in Figure 2, I would draw a 3-point line over each of the bars over the t's, I would draw a new division bar, and I would draw new negative signs on top of the existing ones. Such an approach worked (since the lines were thicker, the television would allocate on-screen pixels for displaying them), but was very time consuming and was not perfect since I would occasionally miss drawing a line.

Issue 11: Teaching an entire course using PowerPoint is difficult.

Given my course was primarily a mathematics course; I had a lot of diagrams, pictures, calculations, and equations. Having the presentation solely limited to PowerPoint slides was very restricting. I had to become a PowerPoint expert to even make the material presentable. Since the course material cannot simply be presented as definitions or bullet lists of discussion points, I had to use numerous

PowerPoint transitions (objects moving onto a slide). There were several instances in which I had upwards of 25 transitions on a slide (e.g., stepping though a mathematical calculation). Developing such a presentation was not only time consuming but is prone to development errors. Additionally, the television technician was easily confused when trying to mirror my stepping through the PowerPoint presentation.

Issue 12: Faculty preparation time is greatly increased.

My participation in this project was funded through a summer stipend. On reflection, my preference would be to have a reduced teaching load during the semester in which I had taught the course. The problem with summer support is that I did not learn what works and does not work in presenting materials (*e.g.*, slide colors, how much material to put on slides, the level of detail to go into, how to use transitions within slides to present material, how to troubleshoot problems, technology problems) until after the semester had begun. Interestingly enough, my previous experience of teaching on a television-only system was of little help. During the semester, I ended up completely redoing all the PowerPoint presentations that I had prepared over the summer months.

As a measure of the amount of work required in creating the PowerPoint slides, I developed over 750 slides for the course and spent approximately 90 hours on creating and editing them. This large development time is directly related to the course being a quantitative and requiring me to use transitions on each slide to highlight and step through equations, calculations, and formulas. This was time simply creating the slides and does not account for my time in developing/writing the material that appears on the slides. Unfortunately, creating the slides is not work that can be easily assigned to a teaching assistant or student helper due to the specific details and content that has to go on each slide.

Issue 13: Instructor time must be used to solve problems.

Combining all the previous issues along with the difficulties in getting students access to the internet broadcast, teaching students how to use the Real Player software, adjusting due dates for distance students due to "technology problems", I easily spent an hour every day for the first four weeks of the semester solving streaming video issues and problems. Thankfully as the semester went along, my efforts in monitoring the steaming video and solving problems were reduced, but not eliminated.

Issue 14: Streaming video presentation is asynchronous.

Given the streaming video presentation is asynchronous (one-way), other than its supposedly easy accessibility to students, it is in no way superior or more cost effective at reaching our non-satellite distance students than a simple videotape-based program.

Lessons Learned

This was a pilot program and a learning experience for everyone that was involved. Due to technical problems with several of the internet streaming video broadcasts, my internet students were provided videotapes of several of the class sessions. At the end of the semester, I asked each of them the following question: "*Given you have had the opportunity to view the class using streaming video and using a videotape, which do you prefer?"* The consensus was overwhelmingly in favor of the videotape presentation. Issues the students highlighted included: (1) the videotape has a better image quality, (2) the videotape has more emphasis on the PowerPoint slides (whereas in the internet feed, the slides do not occupy the whole screen), (3) the video of me in the internet broadcast is jarring and distracting – especially with my hand movements (this is directly related to the speed of their internet connection – the slower the connection, the more impact on the video quality), (4) the videotape allows students to watch the broadcast at home or work, rather than only at the location where they had a fast internet connection, (5) with a videotape, students do not have to worry about the broadcast not being available when they wanted to watch it, and (6) students prefer watching the videotape on a larger screen television versus the internet broadcast on a smaller computer monitor.

The unreliable technology and the required number of resources, people, and time have resulted in my course being the only archived steaming video course developed in our pilot program. MacDonald (2001) reports similar problems and experiences. On a positive note, in the past two years, our college has continued our successful satellite broadcast delivery system and are exploring developing stand-alone internet courses with no streaming video component.

References

Johnson, J., DeSpain, B. C. (2001). Policies and Practices in the Utilization of Interactive Television and Web-Based Delivery Models in Public Universities. *Online Journal of Distance Learning Administration*, 4 (2). Available: http://www.westga.edu/~distance/ojdla/summer42/johnson42.html

MacDonald (2001). Banking on Potential: Providing streamed video of class lectures via the Internet is no small feat. *Wall Street Journal* (March 12, 2001).

McAlister, M. K., Rivera, J. C., Hallam, S. F. (2001). Twelve Important Questions to Answer Before You Offer a Web Based Curriculum. *Online Journal of Distance Learning Administration*, 4 (2). Available: http://www.westga.edu/~distance/ojdla/summer42/mcalister42.html

Rockwell, S. K., Schauer, J., Fritz, S. M., and Marx, D. B. (2000). Faculty Education, Assistance and Support Needed to Deliver Education via Distance. *Online Journal of Distance Learning Administration*, 3 (2). Available: http://www.westga.edu/~distance/rockwell32.html

Yeung, D. (2002).Toward and Effective Quality Assurance Model of Web-Based Learning: The Perspective of Academic Staff. *Online Journal of Distance Learning Administration*, 5 (2). Available: http://www.westga.edu/~distance/ojdla/summer52/yeung52.htm