THE DEVELOPMENT OF A CS0 COURSE FOR DISTANCE DELIVERY

Kenrick Mock
University of Alaska Anchorage
Anchorage, AK 99508
kenrick@acm.org

ABSTRACT

At the University of Alaska Anchorage significant effort has been expended in the development of distance-delivered courses as a means to enhance educational opportunities to both local and remote communities. In the fall of 2002 we developed and delivered a web-based CS0 course. This paper describes the design of the course and the efficacy of the actual delivery based on feedback from students and the instructor. We found it extremely challenging to design the course in a fashion to ensure compatibility with the wide variety of computing platforms available to the students. The problem is further exacerbated by the gap in available communications bandwidth (modem dialup to cable modems). Ultimately we settled on a compromise in technology: distribution of materials both online and via CD, server-side processing, and the use of online collaboration tools. The results are mixed, with success in student satisfaction but failure in the large number of students that dropped out of the class. We hope that the successes and pitfalls that we encountered will assist others wishing to develop distance-based CS0 courses.

1. OVERVIEW OF CS0

Our CS0 class is a survey course that introduces broad concepts in computer science using the Schneider and Gersting text [6]. This course is intended for students that require additional preparation before taking the CS1 course or for non-majors that want to explore whether or not computer science is the right major for them. Additionally, a number of associate degree programs allow this course to be taken as an elective. The types of students that enroll are primarily traditional students that have completed beginning or intermediate algebra. The non-traditional students are primarily adult learners with a full-time job.

Topics covered by the course include an introduction to algorithmic problem solving, data representation, computer architecture, networking, operating systems, software engineering, ethics, and programming. We cover enough Java programming to write simple programs (data types, if-statements, while loop, introduction to methods).

2. COURSE GOALS

In addition to standard pedagogical goals for the course, a new goal specific to distance delivery was to provide as much content online as would normally be available during an actual lecture. The online content included:

1. Electronic video of lecture
2. Interactive online tools (online chat, message forums)
3. Access to the instructor (online chat, instant messaging, email)
4. Static materials (PDF documents, lecture notes, other files and links)

The course was delivered using the Blackboard system, which provides online tools for items 2-4. Assignments required students to post materials on the discussion forum to stimulate student-to-student interaction [4]. The instructor also utilized instant messaging programs such as AIM, MSN, and ICQ to provide online availability. One of the goals was to provide numerous mechanisms for feedback and interaction based upon studies by Carnevale that suggest increased faculty participation and communication increases student retention [1].

3. COURSE DESIGN

A significant amount of time was spent designing the course to meet the goals of section 2 within the following technological constraints. Distance Education Services at our university require the following minimum requirements to enroll in a web-based course:

- 233 MHz or higher PC
- 32 MB RAM
- CD-ROM
- Speakers
- 800 x 600 monitor
- 56Kbps Modem

The wide variety of platforms that students may own forced us to design the course toward the minimum requirements rather than take advantage of features available only on more powerful machines. For example, many IDE's require a 400 MHz machine or higher and significantly more RAM. These minimum requirements forced us to think carefully about how to deliver the programming assignments and the video lectures.

3.1 Programming Environment

This course requires the construction of a number of simple Java programs. Based on previous courses we have discovered that many students have difficulties simply installing Java on their home computer. These difficulties include:

- Installation differences on different platforms (OS/X,Windows 98/XP, etc.)
- Setting the classpath
- Installing and using an IDE

As a result of these potential problems, we decided to revert to a server-based method for programming. Students logged into a UNIX server, edited their programs using a text editor (pico), and then compiled and executed their programs on the server. This approach had the following benefits:

- We could control the server environment
- Installation of a SSH client for the student is easy
- The instructor has easy access to student source code to help debug problems
- Students still have exposure to GUI elements via applets available through the web server

As a potential downside, students did not have easy access to an IDE and were forced to go online and learn some UNIX commands to complete their assignments.

3.2 Online Video

In order to provide an experience as close to the traditional classroom as possible, we expended significant effort researching technologies that delivers video together with content developed in PowerPoint.

PowerPoint includes a feature to create online, streaming broadcasts. This feature creates a small "talking head" video stream together with the PowerPoint data converted to HTML. Figure 1 depicts a sample of this format. While this appears to be a useful format for certain types of lectures, in our trials for the CS0 content we found the "talking head" to be a distraction that primarily consumed bandwidth. Instead, the instructor found the most useful cues taken from the video are the actual gestures and pointing used for emphasis or directing attention to a particular item on the slide. For example, in narrating additional details on a slide, the instructor liked to point at various equations and annotate, through gesture, how data is transformed from one form to another. The instructor often performed these gestures by pointing the mouse at various items during the presentation and sometimes used the Pen Drawing tool. Since the HTML broadcast has no way to include such gestural data, this feature was not used.

An evaluation of several other packages, such as Real Presenter, suffered from the same problem.

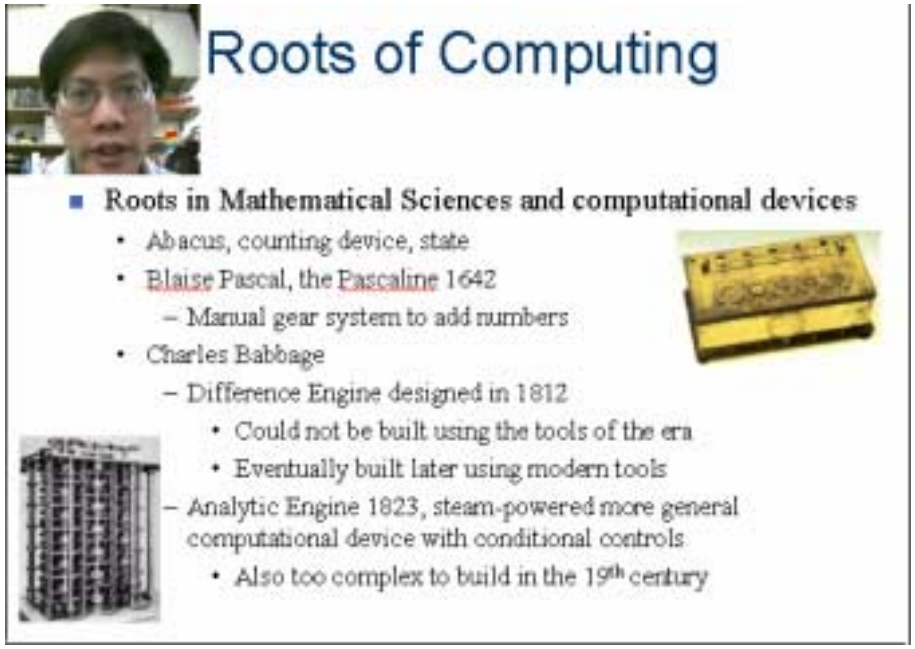

Figure 1. "Talking head" video annotation of PowerPoint

Another option that we considered was to use PowerPoint's slide animation feature in place of gestures during the presentation. By crafting the PowerPoint slide using animation, attention could be drawn to specific components on the slide. While extremely time-consuming to animate, we experimented with PowerPoint's audio

narration feature to capture live audio in combination with the animations. This would not capture live video but does capture audio and animations, which we considered most important to the lecture. This technique proved effective for short presentations, but for long presentations over approximately 30 minutes, we encountered synchronization problems between the audio and the animation timing on the slides. Eventually the audio would become mismatched with the slides, causing confusion. For this reason we abandoned this approach. (Upon conclusion of the course, we noted that the error appears to be corrected in PowerPoint 2002).

Our next approach was to use the Windows Media Encoder to capture frames of the entire desktop, where the desktop consisted of the PowerPoint slide show coupled with audio narration, and encode the entire session as a MPEG file. The resulting file was then viewable on multiple operating systems. This approach did not suffer from the synchronization problem and had the added benefit that it could be used for more than just PowerPoint. Since the process captures the entire desktop, it proved to be a valuable method to show how to use other programs such as the SSH client, how to log in to the Unix server, how to compile and run Java programs, add files to the public_html folder, etc. This process also captured all of the mouse motions used by the instructor for emphasis. A sample session is shown in Figure 2.

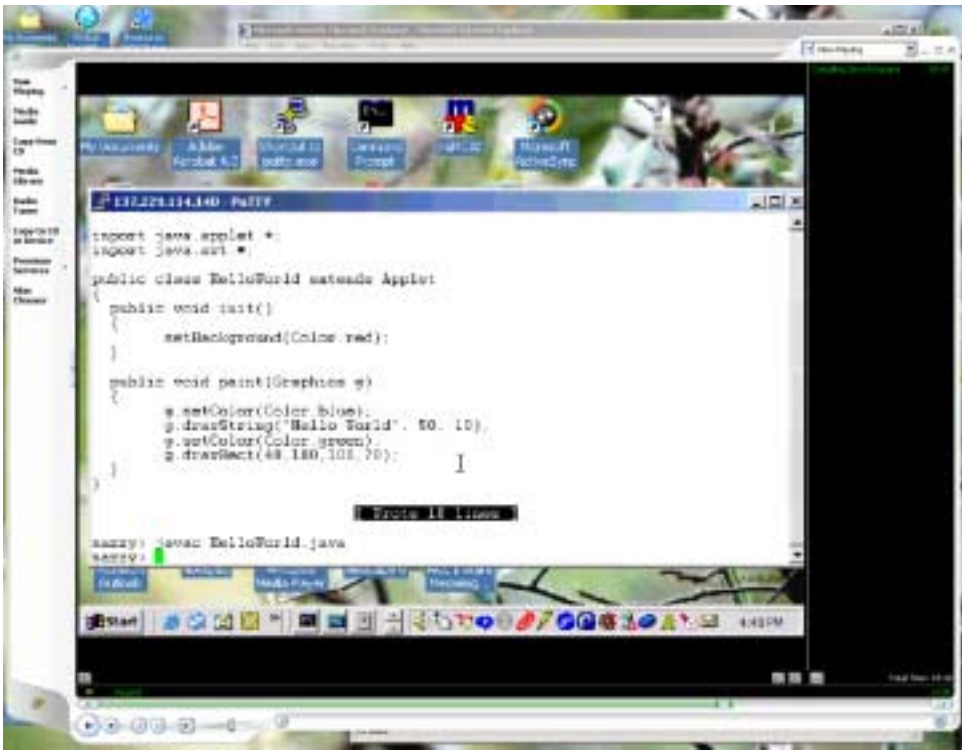

Figure 2. Media encoded video file of how to compile a Java Applet.

The drawback of this approach is the large size of the MPEG file. Even using a screen resolution of 640x480 and a frame rate as low as 2 frames per second, a 30 minute presentation occupied approximately 60 Mb. Such a file size is acceptable to users with high-speed Internet access, but too large for streaming on 56Kbps modems. Despite these drawbacks, we were quite pleased with the capabilities of the Media Encoder approach. Some processes are much easier to show rather than describe in words, and the Media Encoder allowed us to do this. This takes on additional

significance for a purely distance-based course since there is no opportunity for a student to come into the office and show him or her how to perform a particular task.

Since we desired the features offered by the Media Encoder approach but could not expect all students to have high-speed Internet access we decided to offer the video files both online and on a CD-ROM. The CD-ROM was mailed out to all students prior to the beginning of class by Distance Education Services together with an information packet describing how to log on to the course website, where to go to take exams, ask for help, etc.

4. COURSE DELIVERY

We spent the summer of 2002 developing electronic handouts, online video, assignments, solutions, and other web-based materials prior to the actual delivery of the course in fall 2002. This development period comprised the largest amount of time devoted to the class. Despite the up-front work, the actual delivery of the course also occupied a large portion of time. Most of this time was spent answering questions posed by students either via email, instant messenger, or discussion forum. Only minor technical difficulties were reported regarding the online nature of the course and students had little difficulty adapting to the UNIX environment.

We discovered a serious glitch when students added the course late or immediately prior to the start of the semester. Distance Education Services mailed out the CD and information packet a week prior to the beginning of class. Therefore, the late additions did not receive a CD or information packet until approximately a week after the start of the course. Some students did not even realize that they had signed up for a distance-based class (even though this was clearly indicated in the course schedule), as the instructor received several emails inquiring where the class was meeting. We suspect some students may not have received the CD or information packet at all, as a number of students submitted no coursework whatsoever. These issues must be addressed to make the course run more smoothly in the future and may have been major contributors to the high dropout rate.

5. COURSE ANALYSIS

An analysis of the course in terms of the dropout rate and a survey of student satisfaction were conducted at the end of the class. However, the low number of responses makes it difficult to draw firm conclusions.

5.1 Dropout Rate

For this study, a dropout is considered to be a student that submitted some work, either in the form of homework or an exam, and then either withdrew from the course or failed to take the final exam. This definition was used to capture the students that actually attempted the coursework but failed to complete the material. Note that students that enrolled in the course but never submitted any homework or exams are not considered dropouts since there was no indication that they attempted any of the work at all. These students are classified as “Non-attendance” instead of dropouts. Students that completed the final exam of the course are classified as “Finishers” (i.e., Total Students – Dropouts – Non-Attendance).

The dropout rates, non-attendance numbers, and average GPA of the Finishers for the distance education course is shown in Figure 3. For comparison purposes, the same class taught by the same instructor as a traditional course is also shown:

Fall 2002 - Distance	
Total Enrollment	31
Dropouts	13
Dropout Rate	0.42
Non-Attendance	9
Ave GPA of Finishers	3.33
Fall 2001 - Traditional	
Total Enrollment	34
Dropouts	3
Dropout Rate	0.12
Non-Attendance	9
Ave GPA of Finishers	2.9
Fall 2000 - Traditional	
Total Enrollment	45
Dropouts	11
Dropout Rate	0.26
Non-Attendance	3
Ave GPA of Finishers	2.93

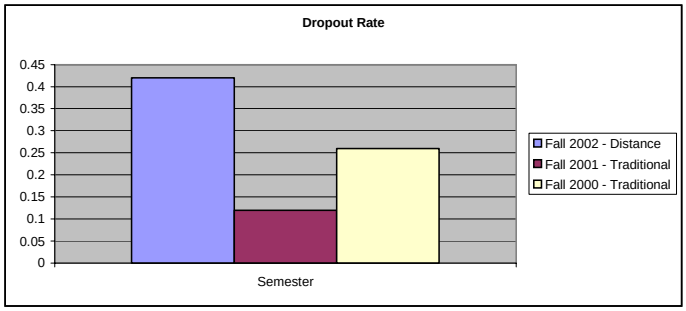

Figure 3. Dropout rates and GPA

The dropout rate for the distance course is 42%, much higher than the 12% and 26% for the same class in prior years taught by the same instructor. This number is also larger than the often-reported 32% dropout rate for distance courses [3].

The average GPA of the finishers is an indicator of how well the students understood the course material. As reported by Neuhauser, there appears to be little difference in student performance in distance vs. face-to-face courses, as the distance students actually received a higher average GPA (3.3 vs. 2.9) [5]. This variation may also be due to the high attrition in the distance course, leaving only the more motivated and qualified students. However, we cannot assume that students that prefer a distance environment will perform better than students that do not prefer a distance environment. Neuhauser's studies indicate that a student's learning preference or style also has a low correlation to actual performance.

5.2 Student Satisfaction

An online survey was conducted at the end of the class soliciting input regarding student satisfaction in how the course was conducted. Students answered questions on a scale from 1-5. The total number of responses given for each scale value is shown in Figure 4. For example, on the question of whether the distance course was as effective as a traditional course, two students somewhat disagreed, three students somewhat agreed, and two students strongly agreed.

Seven of the nine finishers completed the survey. A majority of the finishers enjoyed the distance format, although a few preferred a traditional classroom setting. We were pleased to find that all of the students found the videos and online materials useful in learning the course material. We also received useful feedback; the distance aspect they liked most was the ability to work at one's own pace and that the students desired more student-to-student interaction.

It is important to note that the survey was only completed by the finishers, which itself is a small number. Significantly more negative feedback and different comments would likely be gathered if we were able to survey students that dropped out of the class.

	Strongly Disagree 1	Somewhat Disagree 2	Neither Agree nor Disagree 3	Somewhat Agree 4	Strongly Agree 5
I think that this distance-delivered course was as effective as a traditional, classroom/lecture-based course.		2		3	2
If I was taking another Computer Science course, I would be willing to take it as a distance-education course	1	1		1	4
I found the videos useful in understanding the course material.			1		6
I found the online "lecture" notes useful in understanding the course material.					7
I found the online chat in the 'Virtual Classroom' to be useful in interacting with the instructor and/or other students for the class.			1	5	1
I found chatting using an Instant Messaging client to be useful in interacting with the instructor and/or other students for the class.			3	2	2
I found email to be useful in interacting with the instructor and/or other students for the class.				2	5
I found the online discussion forum 'bulletin board' to be useful in interacting with the instructor and/or other students for the class.			3	4	

Comments:

Interaction between students lacking
Emjoyed working at own pace
The interaction and on-line availability of the professor had a lot to do with the success.
It may have helped to have scheduled, but not mandatory, online class times to meet in the virtual classroom
The inability to work with others, as it was near impossible to know who your classmates were.

Figure 4. Student Satisfaction Survey.

6. FUTURE WORK

As a result of conducting this course we have learned useful information in offering a future distance-based class. First, we learned that it is possible to conduct the course successfully with student satisfaction in the electronic materials that are developed. Second, we have identified areas of improvement. For example, our method of distributing CD's, syllabus, and other information must be improved for students that enroll late. For example, we may require a voice phone call to each enrolling student to ensure that they have all of the materials to begin the class. Another option might be to offer the course throughout the year, similar to some correspondence courses, instead of tying the course dates to a normal semester. Additionally, we should investigate methods of increasing student-to-student interaction and continue to provide as much faculty-to-student interaction as possible.

We would also like to investigate ways to reduce the dropout rate. Increased motivation may be one method to reduce the dropout rate [2]. The next study must also interview the dropouts, not only the students that remain in the course. On the technical side, we would also like to evaluate additional streaming video packages.

Software such as Impatica, Presedia, Microsoft Producer, and a host of other PowerPoint streaming/delivery packages exists that may suit our needs much better than the Media Encoder approach. In particular, some of these products advertise solutions that capture audio and gesture information coupled with PowerPoint even over 56Kbps lines. Finally, we would like to investigate modularizing our content into Learning Objects that can be used in other courses or seminars.

REFERENCES

[1] Carnevale, Dan. (1999). "Instructor Cuts Dropout Rate by Giving Extra Attention to On-Line Students." Chronicle of Higher Education, Thursday Dec. 16, 1999

[2] Chyung, S.Y. (2001). "Systematic and Systemic Approaches to Reducing Attrition Rates in Online Higher Education." The American Journal of Distance Education. 2001, Volume 15, Number 3.

[3] Institute for Higher Education Policy. (1999). "What's the Difference? A Review of Contemporary Research on the Effectiveness of Distance Learning in Higher Education." Retrieved 3/10/2003 from http://www.ihep.com/Pubs/PDF/Difference.pdf

[4] Mock, K (2001). "The Use of Internet Tools to Supplement Communication in the Classroom." The Journal for Computing in Small Colleges.

[5] Neuhauser, C. (2002). "Learning Style and Effectiveness of Online and Face-to-Face Instruction." The American Journal of Distance Education. 2002, Volume 16, Number 2.

[6] Schneider, G., Gersting, J. (2000). An Invitation to Computer Science - Java Version. Brooks/Cole, 1st Edition.