Distance Learning: A Discussion of the Implementation of a Graduate Course of Study Using Various On-Line Technologies

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ABSTRACT

This past fall the Center for Imaging Science initiated a distance learning option for its Masters Degree in Imaging Science. This program is identical to the local version of the degree except for the fact that students take the course at a distance. Initially, the program offered a specialization track in Color Imaging but now the program includes Remote Sensing and Digital Image Processing tracks. My course, Vision & Psychophysics, was one of the first courses to go online. The model we have used for this endeavor is an asynchronous one; students may take the courses anywhere and learn on their own schedule. Judging by the experience of the instructors and the feedback from our students, we feel that this endeavor has been a success. In this paper I will describe my experience in designing, implementing, and teaching a distance-learning course. The goal is to facilitate others who may be considering teaching in this way by sharing my limited experience.

1. INTRODUCTION

In the fall of 1990 the Chester F. Carlson Center for Imaging Science at the Rochester Institute of Technology initiated a distance-learning version of its Masters Degree in Imaging Science. This program enables students anywhere in the world to earn a Masters Degree in Imaging Science without having to physically attend classes at RIT. The initiation of this program presented a number of challenges to the faculty. These challenges included convincing faculty to join in on this endeavor, identifying the infrastructure for course delivery, designing the courses, and finally teaching.

The distance-learning MS program was designed to have the same courses and requirements as the local version as our project/paper (non-thesis) MS option. As such, we decided that to begin with, the instructors would teach the distance sections of the course concurrently with the local versions. We realized from the start that teaching an additional section of a course in this new format would be equivalent to adding a new course to one’s teaching load. Because of this increase in teaching load, we decided that the program would be implemented gradually so that beginning students would be able to take one or two courses per quarter, as they were implemented, so that they could complete the degree within three years. This meant implementing the core courses within the first two years. The faculty in the Munsell Color Science Laboratory agreed to begin the program by implementing the courses in the Color Imaging specialty track first. Although there were times when it looked unlikely that we could match overburdened instructors with new course sections, the faculty worked together to ensure instructors were committed to teaching the courses required for a complete degree. One benefit of this exercise was that different faculty would now become familiar with courses that they do not usually teach producing more flexibility in future teaching assignments.

2. CREATING A COURSE

We met with staff from RIT’s Online Learning Office to learn about distance learning and what methods and technology are available for teaching at a distance. Although RIT has been ranked as the third largest distance learning degree and program provider in the US, we were surprised that there was very little concrete advice they could offer on how to deliver a course. Instead we learned more about the philosophy of distance learning, for example, make the course modular so that different pieces could be updated and used elsewhere easily. Fortunately, the technical staff would be

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able to provide us with assistance, which turned out to be very valuable when it came to the nuts and bolts of the courses. We did determine, though, that our goal was to create a program that was primarily asynchronous teaching. That is, students anywhere in the world should be able to go online and learn the course material at anytime as opposed to using live conferencing.

Our main concern was how to teach technical material online. This concern was greatest for the faculty teaching very math intensive courses. Faculty in the math department have been offering distance-learning courses for a number of years so I met with a couple of faculty to find out how they did it. To my surprise, their main method was to send videotapes of their lectures to their distance students! This was not an option for us. We did not have enough time to produce the videos and we did not think this was the best way to utilize the resources available especially the internet. (Personally, I was not that confident of my lecturing skills to have my lectures turned into permanent records. I was unwilling to turn my classroom into a performance stage. In addition I would hope that my time in the classroom would be described more as a conversation than a lecture, per se.) Basically, we were on our own. The instructors going first would have to decide how to teach their courses and pass what they learned on to the others.

With all of that as an introduction, I will now focus on the decisions I made for creating my course, Vision & Psychophysics. This course is a ten-week course in which the first half of the quarter is an introduction to psychophysical methods useful in color and imaging science applications and the second half of the course is an overview of the visual system. Although this course is not as technical and math intensive as say, Linear Mathematics for Imaging, there were still challenges in deciding how to teach the material.

The main differences between the local and distance version of the course is obviously the lack of lectures for the distance-learning students, the inability for the students to interact with me face-to-face, and the inability for the students to take advantage of the lab resources such as computers and software, color-vision tests, and other lab apparatus that may be used in homework assignments. In addition, distance students would have much limited access to reference materials available at a university library for researching their homework assignments and term papers.

I decided that I would replace the lectures with a web site. I wanted to put in the web site the parts of the course that one could not get from the textbook and readings. The web site should therefore complement the readings, focus on the relevant points, present my personal experience and philosophy, provide useful examples from the lab, and stimulate thought and discussion in an open ended way. As such, I wanted to take advantage of multimedia to make the course more interactive. I wanted to make the web site as complete and comprehensive as possible so that the course would be fully asynchronous. I tried to make the site reflect my personality by writing in the first person using a colloquial voice and asking open-ended questions with the suggestion that they be discussed on the bulletin boards. I also wanted the web site to be low-bandwidth so that the students would not spend too much time watching pages load. (RIT subscribed to a service provided by Blackboard Inc. called blackboard.com. This site allows an instructor to post course material and interact with students by e-mail, bulletin boards, and interactive chats.)

It was necessary to become bit of a web-master to make my site. Fortunately, there are a variety of software applications that make this possible at reasonable expense with academic discounts. This allowed me to make more eye-catching and interactive graphics and include demonstrations. The downside was that the more web-savvy I wanted to be, the more time I needed to spend on learning software and producing web material at the expense of actual creating learning material. In the end, there was more actual text than interactive material I had envisioned, but with time I can change and add to the web site.

There are a variety of products by different vendors that do similar things. I will briefly describe some of the software I used. I was very pleased with these products but I am describing them not as an endorsement but rather to describe what I did to create my course web site.

Macromedia Dreamweaver: Dreamweaver is a web site/page creation program that allows one to create a site with very little knowledge of html. One can put in graphics, movies, tables, interactive behaviors, links, etc. in a WYSIWYG user interface. One can also instantaneously test the site by previewing it in a browser.
Dreamweaver is also integrated with other Macromedia products so that the import of graphics and Flash movies is very easy.

Macromedia Fireworks: Fireworks can be used to create, edit, and animate web graphics as well as optimize images for presentation on the web. I found it extremely useful for optimizing scanned images for inclusion in my web site. It allows you to interactively preview images as you change the size of the image and amount of compression so that your pictures will not take forever to load over a modem.

Macromedia Flash: Flash movies are great for animation and interactive demonstrations. They use vector graphics and are extremely compact in their use of memory. Flash movies are viewed using a free and readily available plugin in your browser. For simple graphics and movies, it is quite easy to use, however one can easily devote a lifetime to its extended interactive capabilities.

Adobe Acrobat: The free reader makes pdf files universally available across platforms. Acrobat will allow you to create viewable documents from almost any application. If your students submit assignments as pdf's, you can "red-pen" their papers and return them electronically. I used pdf's to make my PowerPoint lecture notes available to the distance class and to make homework assignments and other handouts that were not part of the course web site.

Blackboard.com: I uploaded my course web site to the Blackboard web site. The student would click on a link in the course documents section to access the web site. There were a number of technical issues that made this method less than optimal. Blackboard has many capabilities, including announcements, document folders, digital drop boxes for students to send documents, and discussion boards that I found to be adequate. My colleagues who tried the interactive chat features found it to be lacking. There are a number of other features such as administrative features for recording grades and creating groups for projects that I never used.

In the classroom, going through quantitative examples can be tedious and time consuming. One would much rather get to more substantive topics than stand out the board writing equations and columns of numbers to add up. A benefit of the web is that one can add several worked out examples enumerating the steps of the problems that students can work out on their own time. The online course was made available to the local students to review the course web site, go through the examples, and participate in the discussion boards.

Homework assignments needed to be modified for the distance students. For example, one homework assignment required the administration of the Farnsworth Munsell 100-Hue Test and the Ishihara Pseudoisochromatic Plates. For the distance learners I provided the raw data for the 100-Hue test to score with additional information on the design and administration of the test and a scanned pdf version of the Ishihara Plates. Another assignment consisted of a program called "Gabori Attack," (http://vsoc.berkeley.edu/vsoc/index.html) which is a cross-platform program that is used to psychophysically measure one's contrast sensitivity function in the form of a video game. Although not used under calibrated and controlled conditions, it was possible for the distance students to get a "hands-on" feel for the assignment.

To quantify the experience, I would say that creating an online version of the course was at least twice as much work as originally creating the local version when I first started teaching it:

\[ \varepsilon_{\text{online}} \geq 2 \varepsilon_{\text{local}} \]  

where \( \varepsilon_{\text{online}} \) is the amount of work to prepare the online course and \( \varepsilon_{\text{local}} \) was the amount of work needed to first prepare the local version.

A sample of the course can be found at http://www.cis.rit.edu/people/faculty/montag/sample.
3. TEACHING THE COURSE

There were five students in the course from across the country employed by a variety of companies. To some extent each student had interest in color science and psychophysics and took the course for professional development. Students were required to have access to a scanner, fax machine, and the usual suite of internet tools. In addition they needed some type of programming and statistical software for assignments.

The first couple of weeks of the course had a few rough spots while the students and I worked out technological issues involved with using the Blackboard technology, getting access to the electronic reserves at the library, and working out e-mail addresses and communication issues. It was important for both me and the students to work out a routine to ensure smooth operation of the course. I needed to make sure to post regular announcements telling the students how far along they should be in the course web site and the readings and when assignments were due. The students needed to learn to set aside study time to keep up with the course. I also needed to constantly promote discussion on the discussion boards and respond to questions and comments to keep the conversation flowing.

Because I designed the course to be asynchronous, I planned on relying on the discussion boards for the majority of the interaction with the students regarding the content of the course such as questions, comments and clarifications. The discussion boards were used less frequently than I had hoped. I would have liked to have seen more lively conversation and debate. The students claimed that they did not need too much more clarification and discussion but in the future I will make it a requirement to participate at some level in the discussions.

The best way to gauge the success of the course is by student performance and their evaluations. The distance students performed as well as if not better than the local student on average even thought the local student had access to the online course material as well as the lectures. There is however a selection bias in that students who either pay for the course or are supported by their companies may put more effort into the course and as a group are older and perhaps more self-motivated. The students commented in a survey that they were satisfied with the amount of work (averaging 10-15 hours a week), the material learned, and the amount of interaction with the instructor. Some students commented that they preferred to print out the material on the course web site and read it off-line. I would hope in the future to make the course more interactive and useable as an online experience.

Because the class was small and the students were mature and hard working, I allowed the closed-book final to be taken on the honor system. However, proctoring of exams may be an issue in the future.

In general, the amount of effort involved in the actual teaching of the class was slightly less than that of the local version. Although the amount of time spent on keeping the distance learning going was equivalent to the time I spent lecturing to the local students, the effort was not as strenuous:

\[
\tau_{\text{online}} \leq \tau_{\text{local}}
\]

where \(\tau_{\text{online}}\) is the effort expended on teaching the distance section of the course and \(\tau_{\text{local}}\) is the effort expended on teaching the local version.

4. OTHER'S EXPERIENCES

As mentioned, other courses have been taught as part of this program. These courses, including Linear Math I and II, Digital Image Processing, and Geometric Optics, have been as successful as mine by the criteria of students performance an their evaluations of the courses.

The philosophy of the instructors of these courses has been different than mine. These courses did not implement a web site to take the place of lectures. Instead, extensive course notes and examples were prepared and disseminated as pdf's on Blackboard. The instructors set aside ample periods of time in which student interact with the instructors and teaching assistants to go over the notes in interactive chats which are archived for other students to read, if they wish.
number of different technologies have been employed to add interactive graphic capabilities (white boards) to the chats. In addition, voice capabilities (with archiving of the sound files) have been added since communicating by typing is in many instances too slow. These courses are less asynchronous than mine and do not take advantage of the multimedia possibilities of the web, but I must stress that these courses have been quite successful. The students are uniformly impressed and happy with the quality of the education.

As another example of teaching style, Dr. Mark Fairchild will be teaching Color Reproduction next winter using interactive Flash modules and discussion boards almost exclusively. Part of the methodology involved in teaching a distance learning course will depend on the material and resources available. For Mark's course, the textbook, Hunt's Color Reproduction, will be put to life and supplemented by the Flash movies. For the math courses mentioned above, no real textbook was used. In all cases however, the learning is guided by an actual instructor involved with the students.

5. CONCLUSIONS

All of us involved in this first round of teaching were pleasantly surprised with the success of our initial efforts in distance teaching. The results were so encouraging that we already have put two more specialty tracks, Digital Image Processing and Remote Sensing, into the program. This will provide more flexibility and choice to our students.

We feel our success is due to the involvement we have with the students. This is clearly not a correspondence course implemented on the internet. As the quarter progresses, we get to know the student even if we do not see their faces. Through our interactions, we can tell which students would be the ones who sit in the back and never ask questions, yet surprise us by acing the exams, and which students are the ones who need a little extra attention to get on track with a new concept.

We do not want the distance-learning program to replace our local efforts. We hope it is a viable alternative for people who do not have the flexibility to come to campus. As mentioned above, this program is equivalent to our MS program with a project/paper option. What these students do miss out on is the opportunity to complete a Master's Thesis working with one of our faculty members. We hope that the addition of this program will not only aid in the professional development of our distance students but will also create a larger audience for our research and teaching on campus.