

## Implementation and Evaluation of a Distance Learning Introductory Course in Medical Informatics

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### Abstract

*Context:* There is a growing interest in and need for continuing education in medical informatics delivered by distance learning.

*Objectives:* Implement and evaluate a distance learning introductory course in medical informatics.

*Methods:* A Web-based version of our on-campus "Introduction to Medical Informatics" course was implemented using streaming audio lectures, threaded discussion boards, and several other teaching modalities. Evaluation was performed using an adaptation of our on-campus course evaluation instrument.

*Results:* The course was implemented with no major technological or pedagogical problems. Student satisfaction with teaching modalities and other course modalities was high.

*Conclusions:* The learning technologies used in this course were implemented successfully and a Graduate Certificate Program is planned to further meet educational needs in medical informatics.

### Keywords:

Medical informatics education, distance learning

### Introduction

Professionals in health care are lifelong learners. Whether physicians, other clinical practitioners, administrators, or librarians, they must keep up with new information and knowledge to perform their jobs effectively and obtain advancement or promotion. Medical informatics is an increasingly important area for most health care professionals to gain and maintain knowledge in, since the impact of information technology is becoming so prevalent. The interest in continuing education in medical informatics became apparent to us when we received increasing numbers of queries as to whether the courses and/or the entire program in our Master of Science (MS) in Medical Informatics degree [1] could be taken via distance learning. This interest led us to develop and evaluate a distance learning course as described in this paper.

Distance learning is usually defined as education that takes place when distance and/or technology separate the teacher and learner. [2, 3] There are a growing number of programs in health care fields, as evidenced by a catalog of distance learning programs. [4] Nursing is the area of health care with the greatest number of programs, as 65 institutions offer degrees at the bachelor's, master, and doctorate levels. A smaller number of public health, dental technology, and mental health offer programs as well.

This paper describes the process we used to develop, implement, and evaluate our distance learning program. We began with evaluation and selection of available technologies for course and content delivery. Next we implemented the courses and adapted our on-campus evaluation instrument to assess their effectiveness. Finally, we evaluated our course and planned for developing more courses in the future.

### Technology and Content Planning

Discussion with potential students indicated to us that there was definite interest in medical informatics distance education that was Web-based but accessible via modem, led to some sort of certification, and paralleled the curriculum of our on-campus MS program. Our next step was to evaluate technology for course implementation and delivery.

### Technology Evaluation

The first decision in this process was to determine whether to use a distance learning hosting company (e.g., eCollege, www.ecollege.com) or manage our own server and course materials. Because we had the expertise to develop content and manage a server, we chose the latter option. A Sun (www.sun.com) Enterprise 250 server with one-half gigabyte of RAM, dual processors, and 30 gigabytes of hard disk space was acquired for initial testing and later implementation. The system was installed on the campus network with 100 megabit per second bandwidth.

We looked at a variety of course delivery shells. One option was a locally developed system that had already

Table 1 - Syllabus for MINF 510

Week	Topic	Textbook chapter
1	Acquisition, storage, and use of medical data	1, 2
2	Medical computing	4, 5
3	Medical decision-making and evidence-based medicine	3 (sections 1-5)
4	The electronic medical record	9, 10
5	Standards, security and confidentiality	6, Handout
6	Information retrieval and digital libraries	15
7	Imaging and telemedicine	14, Handouts
8	Artificial intelligence and decision support	16
9	Computer networks and the Internet; Ethics of medical informatics	7
10	Nursing, public health, and consumer health informatics	11, 12
11	Final Examination	

been used effectively. [5] This system was created when commercial course delivery shells were in their infancy. By the time we undertook this process (summer, 1999), the commercial systems had long surpassed the local system in functionality. Our major evaluative decision was the choice between WebCT ([www.webct.com](http://www.webct.com)) and Blackboard CourseInfo ([www.blackboard.com](http://www.blackboard.com)). Sample materials were produced for all the teaching modalities (described below), mounted on both systems, and presented to the seven faculty and four students participating in the evaluation process. The near-unanimous sentiment was that while WebCT provided more “bells and whistles,” Blackboard CourseInfo presented a much simpler and consistent user interface, especially for the teaching modalities we planned to use.

### Teaching Modalities

In selecting teaching modalities, we adhered to two guiding principles:

- We wanted to provide parallel experiences to all aspects of on-campus learning, from lectures describing the content verbally to high-quality readings and interaction among students and faculty
- We needed the modalities to be deliverable over a modem connection, which ruled out high-bandwidth content such as video

The first course to be implemented would be MINF 510, *Introduction to Medical Informatics*. As our university is on an academic quarter system, this course would span 11 weeks. This introductory survey course is offered annually on campus in the fall quarter. It is taken by entering medical informatics MS students as well as those in Public Health, Graduate Nursing, and other programs. Like most courses in the MS curriculum, it is a three-credit course that meets three hours per week. In addition to weekly lectures, in which interaction is encouraged by the instructor, the course also includes weekly readings, weekly homework assignments that attempt to demonstrate application of the course content, a term paper which allows the student to

explore a specific area of interest in greater detail, and a final examination.

The first on-line version of the course was implemented in parallel with the on-campus course in the fall of 1999. This minimized the amount of additional curricular development that would be necessary. The syllabus for both the on-campus and on-line versions of MINF 510 is shown in Table 1.

### Implementation

As noted above, the first course was offered in the fall quarter of 1999. Based on the interest generated by the needs assessment as well as information on our program Web site, over 100 individuals had expressed an interest in taking the course. Because it was our first offering, we limited enrollment to 15 people. A computer experience survey was distributed to all who were interested, and we chose a group with adequate experience in using the Web and browser plug-ins. Those not selected were assured they would be accommodated in subsequent terms. A second offering of MINF 510 was made in the winter quarter of 2000. Continued interest led us to offer the course again in the spring and summer quarters of 2000.

For the course, the instructor prepared each week the following materials:

- Learning objectives - aiming to describe the most important topics to be learned
- Reading assignments - for a textbook we used pre-prints of the forthcoming second edition of *Medical Informatics: Computer Applications in Health Care* [6]
- Lectures - developed in Powerpoint (Microsoft Corp. [www.microsoft.com](http://www.microsoft.com)) and played using RealPlayer (RealNetworks Corp., [www.real.com](http://www.real.com))
- Discussion questions - aiming to encourage discussion on the most important issues surrounding the topic
- Homework assignments - aiming to require application of the concepts taught in the week's materials

The on-line lectures were produced using the Record Narration feature of Powerpoint that captures WAV sound files and slide timings. A Powerpoint add-in, RealPresenter (www.real.com), was used to convert the file into a RealPlayer presentation that could be delivered by streaming over the Web. RealPresenter compressed the images and audio to minimize bandwidth usage. The resulting streaming file, which had a very low frame-rate for the video (since the content was relatively static Powerpoint slides), gave acceptable performance even over a modem connection.

In the first offering, the weekly homework assignments were the same short-answer and matching problems given to on-campus students. However, it was found that these were difficult to grade, since they were submitted as Microsoft Word files and the attempt by the TAs to provide grading and explanations in red font proved to be very time-consuming. As such, assignments in future courses were converted to multiple choice format so they could be graded automatically by the software.

All of the above weekly materials were posted every Wednesday, with students given one week to complete the homework assignments. Once posted, all material was kept on the server for the duration of the term, enabling students to review prior material. Discussions began the week the material was posted but typically continued into the following week or two. As noted above, a term paper due on the second-to-last Wednesday was required, at which time the "take home" final examination was posted, to be completed in another week's time.

The instructor (WRH) was aided by one or two teaching assistants (KG, MM, or PT) per term who maintained the server, provided technical support, and moderated the discussion boards. Technical support was provided by both phone and email, with the promise that all messages would have a response by the following working day. In reality, support was provided on a seven-day-per-week basis.

Students were also given access to all of the on-line resources of the OHSU Library. This included the library card catalog (with which they could check out books) and licensed bibliographic and full-text databases (MEDLINE and several other bibliographic databases plus full-text journals). Additional reading assignments beyond those in the textbook were made only if they were freely available on the Web.

## Evaluation

The evaluation of each course was performed by expanding the instrument used to evaluate on-campus courses. Questions were added to elicit feedback about specific aspects of the on-line learning environment. In the first term, we also documented technical support contacts. For the spring and summer terms, we added additional questions to the instrument about how and when the

students accessed the materials as well as the acceptability of server and software performance.

## Instrument data

Table 2 shows the number of students who started, completed, and filled out the evaluation form for each course. A total of 59 students took MINF 510 during the course of the year, 52 of whom completed it. The most common occupations of students were physician (36), nurse (6), and medical librarian (3). Among the other occupations were a library science student, a computer science student, and a medical researcher.

Table 3 shows Leikert-scale evaluations for the various teaching modalities. Students felt the slide plus audio (as opposed to just audio) lectures were valuable. They generally enjoyed the discussion boards, although a minority felt they spent too much time reading messages. There was general satisfaction with the textbooks, and most but not all students had access to adequate library resources. All students felt the support staff was prompt and helpful or said they had no basis to judge, i.e., they never needed technical support. Virtually all students they had adequate preparation for the technical aspects as well as the content of the course.

In the spring and summer terms, a total of 14 students accessed the course via telephone modem, with the remaining five connecting via cable modem from home or Ethernet at work. All but two students had 56 kbps telephone modems. Students were evenly distributed across all North American time zones, with the exception of one student from New Zealand who connected by telephone modem and rarely had access problems. As shown in Table 4, most students rated the response time for all course modalities as usually acceptable.

In general, technical problems were rare. A number of individuals had problems configuring their browsers or RealPlayer plug-in, but once corrected, subsequent problems were minimal. There were occasional reports of temporary inability to access the server, which were most likely due to Internet congestion somewhere between OHSU and the student's Internet Service Provider. The most serious technical problem occurred during finals week of the spring term, when a router failure compromised the OHSU Internet gateway. This caused all Internet traffic in and out of OHSU, including from our courses, to significantly slow. This resulted in considerable distress to students and led us to extend deadline for turning in the final examination by four days. This experience actually highlighted how well server access had been during the rest of the year.

Table 2 - Number of students who started, completed, and evaluated each offering of the course

	Fall 1999	Winter 2000	Spring 2000	Summer 2000	Total
Students who started course	15	15	10	19	59
Students who completed course	14	14	9	15	52
Students who completed evaluation form	13	10	8	11	42

Table 3 - Evaluation of course modalities

	Strongly Agree	Agree	Disagree	Strongly Disagree	No basis for judgement/ Not applicable
The lectures were a valuable addition to the text materials (book and handout)	34	5	2	0	1
I would have preferred access to just the audio portion of the lectures	1	3	12	25	0
I liked using the discussion board	16	21	5	0	0
I spent too much time reading through the discussion board messages to find useful comments	1	9	26	6	0
The content of the textbook was appropriate for this course	23	19	0	0	0
I had adequate access to a library (local or OHSU) and other research resources for completing the course paper	14	14	7	1	2
The support staff provided prompt and valuable assistance with technical issues (the use of Blackboard and the required plugins)	19	10	0	0	13
The support staff provided prompt and valuable assistance with course related issues	27	13	1	0	0
I feel that I had adequate experience and preparation for the technical (computer usage) aspects of this course	30	10	2	0	0
I feel that I had adequate experience and preparation for understanding the content of this course	20	19	3	0	0

Table 4 - Acceptability of responsiveness for course modalities

Response time for	Always acceptable	Usually acceptable	Usually unacceptable	Always unacceptable
Blackboard relative to other Web sites	4	14	1	0
Discussion boards relative to other Web sites	6	13	0	0
RealPlayer lectures relative to other Web sites	4	14	1	0

### Faculty Observations

A number of subjective observations were made by the course faculty. In general, we found the students to be more enthusiastic about learning than their on-campus counterparts. This was no doubt due in part to their demographics; they tended to be older, already accomplished in their fields, and more inclined to learn to advance their careers. No doubt the fact that they devoted considerable time, not to mention tuition money, gave them impetus to want to maximize their learning.

A number observations were made with regards to the discussion boards. The amount of discussion on these boards greatly exceeded the amount of discussion that occurs in the on-campus class. The course faculty, including the senior instructor, learned much new about medical informatics from this accomplished and diverse group of students.

Probably the least popular aspect of the courses were the weekly homework assignments. As noted above, the goal

of these exercises was to apply the weekly content. The multiple choice format precluded rote recitation of facts (which the instructor avoids in his courses anyway). As with many multiple choice questions, there were one or two questions (out of 10) each week that could be interpreted differently than the instructor had intended. These usually generated email discussions, sometimes heated, from students, who were assured that such interpretations would be taken into account when determining their final grade. Each term a number of questions were changed to reflect the problems identified in prior terms.

## Conclusions

Based on the success of our first offering, a second course in information retrieval was added near the end of the year. Further interest has led to the implementation of a Graduate Certificate Program (see [www.ohsu.edu/bicc-informatics/distance](http://www.ohsu.edu/bicc-informatics/distance)).

The successful implementation and acceptance of this course indicates that distance learning can contribute to lifelong learning in medical informatics. Streaming media lectures appear comparable to in-person lectures, while threaded discussion boards provide interaction similar to, or probably greater than, in-person classroom discussions. Distance learning has the potential to revolutionize education in much the same way that other medical informatics applications are fundamentally changing health care.

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