Adaptation of a Hypertext Pharmaceutics Course for Videoconference-Based Distance Education

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A hypertext pharmaceutics course was adapted for a videoconference-based long distance pharmacy education program. In the long distance program, live lectures given to one group of students were simultaneously broadcast to a remote group at a site 60 miles away. The pharmaceutics course consisted of a hyperlinked lecture series on dosage forms and routes of drug administration, along with relevant compounding labs. This manuscript describes the long distance program, how the pharmaceutics course was adapted to meet the needs of remote-site students, and the effect of the student location on exam question performance. A statistical analysis revealed that, for this course, the performance of students at broadcast sites did not significantly differ from the performance of students at remote sites.

INTRODUCTION

Beginning in August of 2000, Nova Southeastern University embarked on a mission to expand pharmacy educational opportunities by opening a videoconference-based, long-distance entry-level Doctor of Pharmacy degree program in West Palm Beach (WPB), Florida. In this program, live lectures given to 115 first year students in Fort Lauderdale (FL) were simultaneously broadcast to 35 students in WPB in a two-way interactive format using compressed video technology. Students in WPB watched a projection of the lecture on an 8 x 10 foot screen, and were able to communicate with the instructors in FL using ceiling-mounted microphones and speakers situated throughout the classroom. This manuscript discusses how a hypertext pharmaceutics lecture series was adapted to teach students in the second semester of the long-distance program. Although, nearly all other lectures in the program originated from FL, this pharmaceutics course was unique in that half of the lectures originated from FL and half from WPB. Thus, both sets of students were remote-site (distant) students for an equal number of lectures in the course. In addition to describing the hypertext pharmaceutics lecture series, the manuscript describes the basic elements of the long-distance learning environment, and it compares the exam performance of the WPB and FL students, as well as the performance of distant and live students.

ELEMENTS OF THE LONG DISTANCE LEARNING ENVIRONMENT

The remote site facility at WPB was designed to have faculty offices, a compounding laboratory, a drug information and resource center, study rooms, and a long distance learning classroom. In addition, the lecture hall at the originating site in FL was converted into a long-distance classroom. Among the goals for setting up the long distance learning classrooms at the two sites were to have equivalent broadcast technology at each site and to have live interactive audiovisual communication between the sites. Equivalent broadcast technology at each site was important so that faculty could lecture from either site if needed, a fact that proved critical since the author lectured an equal number of times from FL and from WPB.

To achieve live interactive audiovisual communication in the classrooms, videoconferencing capacity was enabled using compressed digital video transmitted between the sites through three Integrated Services Digital Network (ISDN) lines. At the lecture podiums, the instructor had several tools for lecture presentation including a computer, a document camera, a digital white board, a VCR, and a digital versatile disk (DVD) player. Video images from this equipment are projected onto a large screen at the originating (broadcast) site and transmitted for projection onto a large screen at the remote site. Also at each site, there were two video cameras, one trained on the group of students and projected on a video monitor in front of the instructor's lecture podium, and one trained on the instructor. Ceiling microphones situated throughout the lecture halls enabled audio communication between remote students and the instructor. A control panel at the podium enabled the instructor to control the cameras, the microphones, and the lectures tools described above. An important element missing from the long distance classrooms is that students at the remote site typically could not see both the projected lecture material and the instructor at the same time. This will be addressed later.

Besides the instructor, key personnel involved with lecture delivery were a computer technician at each site as well as a course facilitator at the remote site. The computer technician helped set up the communication and assisted the instructors with use of the technology. The facilitators were professors whose primary roles in the first year of the program were to facilitate communication between remote-site students and the instructor, as well as to deliver class materials, proctor exams, and to help with the technical aspects of videoconferencing.
DESCRIPTION OF THE PHARMACEUTICS COURSE

The pharmaceutics course was the second course of a two-semester series given to first-year Doctor of Pharmacy students. The primary course topics were pharmaceutical compounding, drug dosage forms, and routes of drug administration. The weekly course schedule included two lecture hours, one recitation hour, and one three-hour compounding lab session. The recitation hour was mainly used to discuss the following week's compound prescriptions. Key personnel for the compounding laboratories for the two sites were a lab instructor and a lab helper at the FL site (for 115 students divided into five lab sessions) and the course professor at the remote site (for 35 students divided into two lab sessions).

ORIGINAL DESIGN OF THE HYPERTEXT PHARMACEUTICS LECTURE SERIES

The hypertext pharmaceutics lecture series was designed and implemented five years ago elsewhere for entry-level Doctor of Pharmacy students. The lectures center around frame-based hyperlinked lecture material, wherein the lecture handout in one frame is linked during lecture, to related material in two other frames (Figure 1). One frame mostly contained hyperlinked lecture notes for students to record during lecture, and the other frame contained a hyperlinked glossary and related hyperlinked pharmaceutics notes. Other material that was hyperlinked to the lecture handout included audiovisual demonstrations and Internet sites.

The main purposes of hyperlinking from the handout to related material was to help keep students engaged during lecture and to enrich the lecture by elaborating upon concepts and principles introduced in the handout. For example, the hyperlinked lecture notes served as focal points to guide the student's study for exams. Students were responsible recording these notes during the lecture, and because of their importance for exams, students became particularly attentive when these notes were accessed. The hyperlinked glossary was used to help clarify concepts and to stress to the students their responsibility for understanding the meaning of words used in their handouts. Hyperlinks to other pharmaceutics lectures within the lecture series were used to help the students integrate closely related concepts. For example, Figure 2 shows a relationship between ophthalmic and nasal routes of administration. Hyperlinked audiovisual materials, created by the author, were used primarily to demonstrate certain pharmaceutical phenomena. For example, the students were shown computer microscope-recorded videos of tablet disintegration and drug release from osmotic controlled-release tablets. Hyperlinked Internet sites contained information ranging from product information to pertinent physiological information. For example, in a lecture on spacers for oral inhalers, an Internet site (www.kidsmeds.com) was accessed to demonstrate their proper usage (Figure 3). Most often, students were advised to independently explore these Internet sites after lecture.

The hypertext pharmaceutics lectures (with all hyperlinks active) were posted to the Internet after the lectures for student review. This was to enable students to explore the hyperlinked lectures as a study aid. However, Internet access of the lectures was usually delayed until about a week before exams in order to encourage student classroom attendance, thus helping to enforce the mandatory attendance policy for the college.

ADAPTATION OF THE COURSE FOR LONG-DISTANCE PHARMACY EDUCATION

The hyperlinked pharmaceutics lectures were readily adaptable for long distance education, both for the synchronous mode of live interactive lectures and the asynchronous mode of independent exploration over the Internet. Modifications that were made to adapt the course further for long distance education,
included using a video camera for showing the instructor during lecture, developing audiovisual demonstrations of compounding techniques, developing on-line e-mail forms for submitting compounding lab reports, and increasing the use of e-mail for communication between the instructor and students.

The main goals in modifying the course for long distance education were to keep students actively engaged during lecture, and to develop and maintain instructor-student relationships with remote site students(1,2). A common finding with videoconference-based lectures is that students at remote sites can become easily disengaged from the lecture, potentially leading to a sustained sense of isolation and potentially hindering the development of a high quality student-instructor relationship(3,4). There are many factors involved in student disengagement, including student attitude and learning style, student interest in the subject matter, instructor interest in remote-site students, student ability to see and communicate with the instructor during the lecture, and distractions from technological difficulties. Having observed student disengagement while facilitating courses, it was important for the author to pursue alternatives to keeping the distant student engaged. Providing hyperlinks to mandatory and sometimes more attention-grabbing material was the first step. The next step was to develop a means to maintain a visual contact between instructor and student during lecture.

To maintain visual contact between students and the instructor, the author employed a computer-connected video camera. This was necessary, because the video-conferencing technology did not allow for a simultaneous transmission of the instructor's image and the lecture material. Either the technician or the instructor could change projected images between the lecture material and the instructor, but the transitions were usually awkward and often distracted from the subject matter at hand. To minimize this source of distractions and to maintain visual communication between students and instructor, the author used a video camera (Logitech QuickCam Pro) during lecture to project the his image (using Microsoft Netmeeting) into one of the frames of the presentation. This enabled students to continuously perceive conscious and subconscious elements of nonverbal communication (e.g., facial expression and hand gestures). In addition, it was important for the author to give the students the impression of eye-to-eye contact in order to help prevent feelings of isolation by remote-site students. The foregoing is not to say that nonverbal communication is necessary for effective learning, as some students can learn effectively without the need for seeing the instructor(5). The purpose of employing the video camera to maintain visual contact with the students was for the psychological purpose of keeping the students engaged, which indirectly may have a cognitive benefit.

Electronic mail (e-mail) was used extensively to facilitate communication between the student and teacher. Since the instructor was based in WPB, it was difficult for the instructor to develop strong relationships with FL students. E-mail was an important tool for communicating with these students, thus it was indispensable for developing and maintaining good relationships. Using e-mail, remote students were able to articulate cogent questions and concerns any time the need arose, and without the intimidation or technological constraints of the classroom setting. For the e-mail communication to be effective, timely and respectful responses by the instructor were vital.

To enhance the weekly lab recitation, where the following week's prescriptions are discussed, the author used videos to demonstrate compounding techniques. The videos, produced using the web camera and video software (MGI Video Wave II SE Plus), were concise, rehearsed, narrated demonstrations of compounding techniques. Among the techniques described in the video format were geometric dilution, powder-paper folding, and capsule filling (Figure 4). The videos were replayed as often as necessary to get essential points across. As such, they proved valuable in helping to prepare students for subsequent labs.

The most significant modification made for the compounding lab was to employ on-line forms for submission of lab reports. Written compounding lab reports are an important part of the lab experience, as it affords the first year students the opportunity to practice researching drug and ingredient properties, to practice documenting their work, and to be active in preparing themselves for the lab. In the past, the reports would ordinarily be turned in the day of the lab, and graded and returned as quickly as possible. The on-line lab report forms were created in an effort to eliminate the multiple transfers of written reports between FL and WPB. The forms were HTML forms created with MS Front Page 2000 with an added CGI script added for form processing. Completed forms were transmitted to the author as e-mails, graded, then returned to the students as e-mail replies. Information required on the form included the properties and purpose of the compound ingredients, calculations, preliminary procedures, and label information. The students were also asked to choose appropriate auxiliary labels. To help the students look up drug information, the website containing the form had a link to an Internet drug information site (www.rxlist.com). Following submission of the form, the students received a feedback page detailing the information that they entered into the form. The students would bring this feedback page to lab as a guide to compounding the prescriptions.

STUDENT PERFORMANCE
To assess student performance in the course, we tested the effects of student location (FL versus WPB) and student-lecturer proximity (live versus distant) on exam performance. In this pharmaceutics course, students took two exams that were derived solely from lecture material. We employed independent samples t-tests to compare the student performance on 58 of the multiple-choice exam questions where the student-lec-
turer proximities during relevant lectures were clearly identified. Of these questions, 32 were derived from lectures in WPB and 26 from lectures in FL. Overall, the mean score on the 58 questions was 3.37 points higher for FL students (75.13 \( \pm \) 1.9 S.E.M.) than for WPB students (71.76 \( \pm \) 2.04 S.E.M.). However, the difference was not statistically significant \( (P = 0.23) \). Similarly, an analysis of the combined performance of WPB and FL students showed that the mean score on questions where the students were distant from the instructor (73.63 \( \pm \) 1.40 S.E.M.) was not significantly different than the mean score on questions where the students were in live contact with the instructor (73.26 \( \pm \) 1.62 S.E.M.), \( P = 0.89 \).

The exam performance data suggests that, for this videoconferenced hypertext pharmaceutics course, being a remote site student did not have a negative impact on exam performance. It is important to note that of the 58 exam questions analyzed, 26 of them were knowledge level (recall) and 32 of them were comprehension level (understanding and recall) questions. In the future we plan on assessing in detail the effect of this videoconference-based approach on student performance on these and other levels of exam-questions including application, analysis, synthesis, and evaluation levels. This more detailed analysis will give us a more comprehensive view of the affect of this approach for videoconferenced pharmaceutics lectures on remote site student learning and will enable us to make rational modifications as needed.

**FUTURE DIRECTIONS**

The main goals for this videoconference-based hypertext pharmaceutics course were to keep the students engaged and develop a strong student-faculty relationship with remote students. The pursuit of both of these goals was greatly facilitated by lecturing from each site equally. However, this will not be the case in the future, as nearly all lectures in this pharmaceutics course will originate from the author's location in WPB. Furthermore, the program will expand to include another distant site. Thus, the author will lecture simultaneously to about 35 live students in WPB, about 115 students in FL, and up to 35 students at another remote site. In such a scenario, it probably will not be difficult to keep students engaged during lecture, but the goal of creating meaningful faculty-student relationships is formidable. Electronic means of communication and occasional visits to remote sites will help, but will command increasing effort and time from the instructor.

Although strong instructor-student relationships can be rewarding and live interactive lectures can be efficient, neither is absolutely necessary for learning well(5,6). So, in the face of an expanding program, it is likely that the author will shift away from live lectures towards a blend of live-lectures and asynchronous learning methods, and away from pure one-to-one instructor-student relationships towards a blend of instructor-student relationships, and moderated facilitator-student and student-student relationships (e.g., using bulletin boards).

The future goals for this course will be to deliver a high quality learning experience in an environment where there is a sense of a professional pharmacy community among students separated by large distances. For this pharmaceutics course, the live compounding laboratories at each site will help to achieve these goals. For the curriculum as a whole, it will be incumbent upon administrators to provide strong logistical and intellectual support to faculty. Pharmacy faculty have continuously risen to the challenge of providing highly creative and interactive learning environments for their live students, and are now being asked to make considerable pedagogical adjustments to accommodate remote students.

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**References**


