Comparison
of Web-Based and Classroom Instruction
Within a Pharm.D. Therapeutics Course

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ABSTRACT. The objective of this study was to compare student performance and satisfaction between an interactive, Web-based instruction and usual classroom instruction in a Pharm.D. pharmacotherapeutics class session. Twenty-one students in a post-B.S. Pharm.D. program participated. Twelve students selected Web-based instruction, nine selected classroom instruction. The primary outcome (examination scores) did not differ between the Web-based and classroom instruction groups (90.3 ± 8.3 vs. 94.1 ± 5.6, respectively; $p = 0.25$). Overall, student evaluations of opportunities for and timeliness of interactions with the instructor were positive with Web-based instruction. Since student learning, as assessed by exam performance, was comparable, interactive Web-based instruction may be a viable alternative for Pharm.D. therapeutics coursework. The preference for classroom instruction may be explained by the lack of previous instructor and student experience with Web-based instruction. *[Article copies available for a fee from The Haworth Document Delivery Service: 1-800-342-9678. E-mail address: getinfo@haworthpressinc.com]*

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INTRODUCTION

While appropriate drug therapy is safer and more cost-effective than other medical alternatives, there is no question that the personal and economic consequences of inappropriate drug therapy are enormous (1). Pharmacy, by delivering pharmaceutical care, can fulfill the societal need for professionals to assure the safe and effective use of drugs. Meeting this societal need will require that pharmacists assume greater responsibility for the management of drug therapies in patients who are under their care (2). In anticipation of this expanded role in patient care, colleges of pharmacy throughout the United States have expanded their curriculums to emphasize patient-care skills necessary for pharmacists to become experts in their area of practice. One mechanism by which this will be accomplished is through a transition to an entry-level Doctor of Pharmacy degree program. The movement toward the Doctor of Pharmacy degree as the sole entry-level degree has caused many pharmacists holding the Bachelor of Science degree, whether long-standing practitioners or recent graduates, to realize that their professional degree may be or eventually become outdated (3).

Changes in health care are occurring so rapidly that advanced training for a large population of pharmacists cannot be accomplished through the use of traditional degree and/or continuing education programs. Conclusions from a recent national study revealed a significant demand for home-study, ''external'' Pharm.D. programs. This national survey confirmed the extent to which bachelor-degree pharmacists are concerned about the potential adverse impact if the Pharm.D. becomes the sole entry-level degree within the next decade. A significant conclusion from this study found that the majority surveyed (80%) would enroll in an external Pharm.D. program if it were offered as a part-time or home-study program (4).

The advent and further development of distance-learning programs is changing the way that future generations will think about education and the university setting. Although distance education is well-established in other countries, it is only with recent advances that distance education programs resulting in a degree have proliferated in the United States. Distance education is defined as any learning which takes place when the teacher and students are separated geographically and/or by time. Today, distance education usually means that an electronic medium is used as the primary source of communication (5). Since the vast majority of pharmacists are employed full-time, a new learning environment which is both accessible and flexible for the nontraditional student would be required. Thus, many colleges of pharmacy have developed or are developing nontraditional Pharm.D. (NTPD) curriculums.

Our program is being developed for delivery to practicing pharmacists through the use of distance-learning technologies. A major component of the courseware, which primarily uses the World Wide Web for delivery of content, has already been developed. The delivery of courses in this nontraditional approach removes time and distance constraints and allows for asynchronous participation by students in diverse locations. It also allows access by a large number of students. Furthermore, there is no geographic limitation to participating in a program delivered via the World Wide Web.

The NTPD courseware is currently undergoing an early stage of evaluation. As part of the ongoing evaluation of these courseware materials, one section of the pathophysiology and therapeutics course was tested. This section of the NTPD courseware was offered in a traditional Pharm.D. advanced pharmacotherapeutics course. We performed a study to compare student performance and satisfaction between an interactive, Web-based instruction and usual classroom instruction of pharmacotherapeutics.

METHODS

Twenty-one students enrolled in our two-year, post-B.S. Pharm.D. program formed the study population. Students were allowed to select participation in either the study group (Web-based instruction) or control group (usual classroom instruction). Several weeks prior to the scheduled class session, the instructor met with the students to discuss this study. All students were provided a handout that summarized the proposal, including important points and requirements of the student. The instructor gave a brief overview of the project and discussed the potential impact of participation in this study. In addition, a four-question survey was distributed to the students for completion. This survey asked if the students were willing to participate in the study group, and whether they had experience using e-mail and a Web browser.

Prior to the scheduled classroom session, the instructor conducted an introductory tutorial on accessing the Internet using a Web browser for those students forming the study group. The intent of this review was to prevent the lack of student familiarity with the Internet from deterring participation in the study group. The instructor also assisted students with any difficulties related to e-mail access. A listserve dedicated to this study was established for use by students in the study group.

The learning module developed for the study group consisted of learning objectives, a detailed handout, a list of required readings, and patient cases. The handout was developed to guide the student through the reading materials. It highlighted key points and provided additional information where necessary. The handout was primarily text in an outline format with several tables or figures included. These materials, except for the patient cases, were

distributed to the students ten days prior to the examination and four days prior to the control group classroom session. The topic for this particular class session was "hemodynamic support in shock states." The instructor for the classroom session also developed the learning module for the study group. The instructor had no previous experience in Web-based instruction. The content covered was the same for both groups. All aspects of this class session, including development of course materials and facilitation of discussion or answering of questions, were performed by one instructor.

The students were instructed to complete the required readings and handout prior to the patient cases. The two patient cases utilized in this study were converted to hypertext mark-up language (HTML) format and uploaded to our server for use by the study group. HTML is the file format used by the World Wide Web. These cases were accessed by the students using a Web browser. The patient cases consisted of a patient review and several questions. The students completed the case studies by typing a response to each question in the text box provided and submitting their answers to the instructor via e-mail. This was accomplished by embedding a CGI script (a command embedded within a graphic) to direct their responses via e-mail to the author within a "submit" button at the bottom of the page. Upon receipt of student responses, the instructor would review the responses and provide feedback to students via e-mail. The intent of this process was to provide students with additional information that would be addressed in the control group during their classroom case study exercises. Explicit instructions were given to students in the study group that all communication with the instructor would occur using e-mail or the listserve. Also, students in the control group did not have access to the Web-based instructional materials.

The control group participated in the usual classroom session for this topic. This consisted of a two-hour lecture/discussion that concluded with the same two patient cases utilized in the study group. The lecture portion of this session clarified the reading materials and provided additional information not included in the readings. These materials were representative of the materials included in the handout for the study group. The instructor addressed issues during the case study exercises that were being addressed via e-mail with the study group. Both groups of students took identical exams over the material; all students took the exam at the same time. The exam was administered to both the control and study group in a formal classroom setting. On-line testing was not utilized because of current limitations with Web-based testing. Limitations include the inability to control time allotted for test or to guarantee that students completed the test independently.

Background information including age, gender, number of years since completion of their B.S. in Pharmacy degree, cumulative grade-point average from undergraduate program, and cumulative grade-point average for the

Pharm.D. program prior to this study was collected. Analysis of this data, in addition to the primary study endpoint (examination score), was done with an Excel spreadsheet (Microsoft). Students' t-test was utilized to compare these data for statistical significance between groups. Statistical significance was defined as a *p* value of less than 0.05.

RESULTS

Of the 21 students, 12 students chose to participate in the Web-based instruction group (study group); the other 9 selected usual classroom instruction. Demographic data are listed in Table 1. There was no statistical difference between the groups with respect to these parameters. The primary outcome for this study (examination score for this class section) did not differ between the study and control groups, $90.3 \pm 8.3\%$ and $94.1 \pm 5.6\%$, respectively ($p = 0.25$).

Responses compiled from student course evaluation are listed in Tables 2 and 3. The most common reason for electing to participate in Web-based instruction was the flexibility of this type of instruction (6 students). Other less common reasons included not having to attend class and familiarity with or interest in the Internet. The predominant reason for students choosing usual classroom instruction was their preference for the direct instructor-student interaction that occurs in the classroom.

Of the 11 students in the study group who responded, 7 students would choose a usual classroom instruction over Web-based instruction if given another opportunity to decide between the two. In addition, all 9 students in the control group would choose usual classroom instruction over Web-based instruction if given this choice again. For those students in the Web-based

TABLE 1. Student Demographic and Performance (Mean $\pm$ SD).[a]

	Web-based Instruction	Classroom Instruction
Age (years)	27.9 ± 4.8	26.6 ± 3.8
No. years since B.S. Pharmacy degree awarded	3.8 ± 4.8	3.4 ± 6.7
Admission GPA[b]	3.11 ± 0.43	3.26 ± 0.36
Cumulative GPA[c]	3.55 ± 0.29	3.44 ± 0.28
Cardiovascular section examination score[d]	91.4 ± 11.3	92.3 ± 3.2
Study section examination score	90.3 ± 8.3	94.1 ± 5.6

[a] *p* = not statistically significant for all categories.
[b] GPA from B.S. in Pharmacy program.
[c] Cumulative GPA to date within the Pharm.D. program.
[d] Overall score for the advanced therapeutics cardiovascular section.

TABLE 2. Web-based Instruction Student Evaluation Responses (n = 11).

Question	Response
1. The outline helped clarify the reading assignments and provide appropriate guidance.	Strongly Agree (5) Agree (5) Disagree (1)
2. How many times did you interact with the instructor by sending messages via e-mail or listserve?	2 ± 1.6 (mean $\pm$ SD)
3. Opportunities for communication with the instructor were adequate.	Agree (6) Disagree (2)
4. Response time for feedback to questions asked by the student was:	Adequate (7) Delayed without affecting progress (3) Delayed, affecting progress (1)
5. Response time for feedback to case study answers was:	Adequate (7) Delayed without affecting progress (3) Delayed, affecting progress (1)
6. Would you prefer to have the course outline in hardcopy form or an electronic version on the Web?	Hard copy (10) Web version (1)
7. Did you encounter any significant problems connecting to the Internet?	Yes (8) No (3)

TABLE 3. Advantages and Disadvantages of Web-based Instruction.

Perceived advantages by students
Flexible schedule Can work at own pace Provided self-direction and motivating Removes the need for the student to travel to campus

Perceived disadvantages by students
Took more time Difficult waiting for answers Technical problems with Internet access/computers Using computer lab Impersonal More time needed to understand unclear information Do not get to hear anecdotal information from practice that would occur in classroom Need for computer training

instruction group who chose not to participate in Web-based instruction again, reasons for this response included the following: 1. greater time commitment, 2. dislike independent learning, and 3. technical or typing difficulties. One individual stated he/she was dissatisfied with his/her performance and lack of knowledge attained, and two individuals responded that this method of courseware delivery failed to meet their expectations. The students who would choose Web-based instruction again included the following as reasons for their choice: 1. satisfied with performance and knowledge attained, 2. flexibility, 3. courseware delivery met their expectations, and 4. time commitment was greater for classroom instruction.

Faculty time required for conducting the Web-based instruction was 25.3 ± 14.1 minutes per student (range 10-60) for a total time of 253 minutes. This included only the time spent by the instructor evaluating and responding to patient case-study answers submitted by students. It did not include time required to develop learning materials. Instruction time for the classroom session was 120 minutes (two-hour lecture/discussion session), which also does not include preparation time.

DISCUSSION

Popularity of the Internet and the World Wide Web has grown immensely over the past several years. Not only is it being used for entertainment, but many medical and pharmacy organizations, governmental agencies and universities now use it to disseminate information to interested parties. One clear advantage of the Web over traditional print media is the ability of the information on a Web site to be updated at any time and be made immediately available to the user. With print media or textbooks, there are delays in availability of materials because of the printing and distribution process. This process often makes textbooks out-of-date once they are available for purchase. Web-based materials can be updated to incorporate the latest research. This has obvious advantages for pharmacy and medical education. Students can now have access to learning materials provided by an instructor that can be as current as information that is available the day of instruction. A disadvantage is the time constraints related to continual update of the material.

Because of this popularity, the Internet can offer numerous other resources which students can access while they are completing their instructional materials. As mentioned previously, many medical, pharmacy, and governmental organizations have Web sites that offer education information. Links to these sites can be established within an instructor's course materials allowing students to easily access these resources. Examples of items that can be found on some of these sites include guidelines developed by medical or governmental agencies for management of a certain disease state (*e.g.*, Agency for Health

Care Policy and Research), recommendations for treatment or prevention of certain infectious diseases (Centers for Disease Control), and the availability of population and health-related statistics.

The Internet also offers several methods for communication. These can range from e-mail to the more advanced real-time video conferencing. Communication available on the Internet can either be asynchronous (*i.e.*, not in "real-time") such as e-mail, or synchronous (*i.e.*, "real time") such as chat rooms or video conferencing. The Web also has the capability to include graphic presentations within a site. These can range from a simple picture or drawing to animation, video clips, and sound. These different types of media can be incorporated into an instructor's Web site to make it more appealing to students.

Results from this study suggest that Web-based instruction may be a viable instructional format for students who are unable to participate in traditional instruction. The apparent flexibility of this instructional format would benefit the large number of practicing pharmacists with the Bachelor of Science degree who desire to obtain their Doctor of Pharmacy degree. This method of instruction would make it possible for these individuals to maintain their current employment without having to relocate to attend a traditional program. The removal of time constraints associated with traditional instruction allows students to complete their coursework at any time of the day. One additional perceived advantage of Web-based instruction is that it requires active learning on the part of the student. In other words, it is considered "student-centered" learning, with students having some responsibility for the instructional process. In contrast, with traditional instruction or "teacher-centered" learning, the teacher has sole responsibility for instruction, encouraging passive learning (6).

There are limitations to a Web-based method of instruction. Clearly, it requires that students and instructors adapt to a new instructional style. Because education has typically included a traditional classroom setting, students are accustomed to this face-to-face instruction and may not enjoy independent learning. This was evident in the results of this study as students stated this as one of the more common reasons for not wishing to participate in Web-based instruction again. It appears that students felt satisfied with the outcome of their participating in this project but discovered that they prefer more traditional instructional methods. Students also perceived that Web-based instruction required more time. This was also true for the instructor, who required about twice as much to time to conduct an equivalent class session. The increased time requirement of the instructor only included actual instruction time. It did not include time for preparation of learning materials.

This study has some potential limitations. First, prospective randomization of students into the two study groups did not occur. The curriculum adminis-

trators felt that it was inappropriate to force students to participate in an instructional method that was new to them and to the program; therefore, it was decided to only ask for volunteers. The potential result could be that a more highly motivated student was selected out in this process thus somewhat assuring a good examination performance. However, the criteria used to compare the two groups found no differences in the groups with respect to grades or performance in the preceding Pharm.D. curriculum. Secondly, this study only included instruction for a single topic. Use of this method of instruction for an entire class may reveal other problems or difficulties. Thirdly, examination performance does not necessarily measure the ability of the student to apply the knowledge in a clinical or practice scenario. Finally, our sample size was limited to the number of students enrolled in the advanced pharmacotherapeutics course at the time of this evaluation. We prospectively decided that a 10% difference in exam performance would be an important difference. Based on power calculations, this study had a 64% probability of finding a 10% difference in exam performance.

Despite these potential limitations, useful information was obtained from this study. Clearly, students who participated in the Web-based instruction group felt they received adequate instruction and met their expectation of the class even though many stated they would prefer traditional classroom instruction in the future. This is encouraging since, over time, students and instructors will grow accustomed to this new style of instruction making the issue of comfort with current instructional methods of lesser importance. With increased experience, this process of instruction would also presumably become more efficient. Finally, it is possible that by engaging students in "active learning," as is required by this method of instruction, overall learning will improve.

REFERENCES

1. Manasse HR. Medication use in an imperfect world: drug misadventuring as an issue of public policy. Am J Hosp Pharm. 1989 May; 46(2 Pt 1):929-44; Am J Hosp Pharm. 1989 June; 46(2 Pt 2):1141-52.

2. Commission to Implement Change in Pharmaceutical Education. Entry level education in pharmacy: a commitment to change. AACP News. 1991 Nov; 22(10):19.

3. Delfino D. Nontraditional programs help practicing pharmacists earn Pharm.D. degree. Am J Hosp Pharm. 1990 Dec; 47:2606,2609,2612,2614.

4. Kushner D. External Pharm.D. programs sought by many RPhs holding only Bachelors degrees. American Druggist. 1986 August; 194(8):42-4,46,48,51-2,54.

5. Learn CD. Distance learning: issues and applications for nontraditional programs. Am J Pharm Educ. 1994; 58(4):406-10.

6. Relan A, Gillani B. Web-based instruction and the traditional classroom: similarities and differences. In: Khan BH, editor. Web-based instruction. Englewood Cliffs, NJ: Education Technology Publications, Inc.; 1997:41-6.