RESEARCH ARTICLES

Academic Performance in a Pharmacotherapeutics Course Sequence Taught Synchronously on Two Campuses Using Distance Education Technology

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Objective. To compare the academic performance of campus-based students in a pharmacotherapeutics course with that of students at a distant campus taught via synchronous teleconferencing.

Methods. Examination scores and final course grades for campus-based and distant students completing the case-based pharmacotherapeutics course sequence over a 5-year period were collected and analyzed.

Results. The mean examination scores and final course grades were not significantly different between students on the 2 campuses.

Conclusions. The use of synchronous distance education technology to teach students does not affect students' academic performance when used in an active-learning, case-based pharmacotherapeutics course.

Keywords: doctor of pharmacy degree, distance education, pharmacotherapeutics, student assessment

INTRODUCTION

The evolution of technology has played a significant role in altering the delivery of classroom-based pharmacy curriculum, with the use of computer-generated digital slide shows, digitally recorded archives of classes, and online courses and lecture materials.¹ Distance education programs delivered to satellite campuses have been implemented in pharmacy colleges and schools to train more pharmacists without significantly increasing the number of faculty members, space, or other resources required.^{2,3}

The Worcester and Manchester campuses of the Massachusetts College of Pharmacy and Health Sciences offer a 34-month accelerated PharmD degree program.⁴ This program represents the final 3 years of the 6-year program offered at other colleges and schools of pharmacy. Most students matriculating to the Massachusetts College of Pharmacy and Health Sciences have earned a bachelor's degree, and all have completed nonpharmacy prerequisite coursework. PharmD students attend classes throughout the year, including during the summer. The accelerated nature of the program offers a challenging and fast-paced opportunity for students who desire to complete their formal education and begin their careers as competent pharmacists in a shorter period of time than if they were to transfer to a 6-year program.

The college's 2 campuses are linked using telecommunications equipment that allows for the synchronous sharing of audio and visual information during classes. During the first 24 months of the program, all core courses for the PharmD program except for laboratory courses are delivered via real-time distance education technology between campuses. Advanced pharmacy practice experiences (APPEs) comprise the final 10 months of the program. For approximately 85% of the classroom-based portion of the PharmD program, instructors at the Worcester campus teach a class of approximately 200 students while their image, voice, and digital slides are transmitted to approximately 55 students seated in a classroom on the Manchester campus. Students at the Manchester campus view the instructor and slides on a large flat screen color monitor and listen and communicate with the other campus via a state-of-the-art sound system. The other 15% of the classroom-based portion of the PharmD program is taught synchronously from the Manchester campus to the Worcester campus using the same technology.

The use of telecommunications for distance education at the college level has been used for many years in pharmacy and other health professions education programs. While there are limited data validating the equity of grades of pharmacy students enrolled in programs taught on multiple campuses,⁵⁻⁹ none exists for students enrolled in an accelerated PharmD program or in a course taught using student-centered, case-based active learning. The purpose of this study was to determine whether use

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of telecommunications equipment to teach this pharmacotherapeutics course in a distance education format created an unequal educational environment as measured by examination and course grades for students learning face-to-face from an instructor versus students on a distant campus viewing the class on a video screen. Pharmacotherapeutics was chosen for assessment because the challenging nature of the course provided an opportunity to assess the functional level of students after completing much of the classroom-based portion of the PharmD program and prior to beginning their APPEs.

METHODS

The Pharmacotherapeutics course sequence was taught over 3 semesters (fall, spring, and summer) of the program's second year. The course used a student-centered, case-based, active-learning approach to educate students on the pharmacotherapeutic management of common disease states. Approximately 20 to 25 instructors participated in the teaching of the course, with most lectures originating from the Worcester campus. The team-taught approach was used to take advantage of the clinical experience of full-time faculty instructors who also maintained clinical practice sites. Students were provided study materials prior to each class and expected to prepare for classroom-based discussion led by the instructors; there was only a minimum amount of traditional lecture provided.

Student learning was assessed using multiple-choice and written examinations, each covering material from 6 to 8 lectures. All examination grades were out of a total of 100% and students on both campuses were given the same examinations. Course grades during the study period were based solely upon the examinations; there were no other assignments contributing to the students' final grades. A passing grade in the course was required for students to progress in the program and all students had to pass the course to earn their degree.

Examination and course grades for all PharmD students taking part in sequential semesters of Pharmacotherapeutics I, II, and III on the Worcester and Manchester campuses from fall 2005 through summer 2010 were entered into a database for analysis. No student grades were excluded from the analysis. Mean values were calculated and compared using 2-tailed *t* tests, assuming unequal variances. This study was conducted with approval from the college's investigational review board.

RESULTS

Grades on 71 examinations administered over 15 semesters were compared. A mean of 37 students per semester completed the examinations on the Manchester

campus (median, 35; range, 21-54) and 143 students per semester completed the examinations on the Worcester campus (median 147; range, 122-163) (Table 1). The variation in class size on each campus was attributable to an increase in matriculation over the time period studied and fluctuations related to attrition and students repeating the courses due to previous failures. Forty-four of the 2705 (1.6%) grades included in the study were earned by students who repeated 1 of the 15 semesters evaluated (Worcester, 41/2152 [1.9%]; Manchester, 3/553 [0.5%]). The mean examination scores for the 2 campuses were Manchester, 77.7% $\pm$ 0.7% and Worcester, 77.6% $\pm$ 0.7% ($P = 0.96$) (Table 2; Figure 1). Worcester students scored higher on 38 (53.5%) of the 71 examinations administered, while Manchester students scored higher on 33 (46.5%) of the examinations. The mean test scores on 17 (23.9%) of the examinations were significantly different between the 2 campuses (ie, $P < 0.05$). Students on the Worcester campus scored significantly higher on 7 of these 17 examinations, while students on the Manchester campus scored significantly higher on 10 of the 17 examinations. Mean scores on the remaining 54 (76.0%) examinations were not significantly different between the 2 campuses (Figure 1).

There was no significant difference between final course grades earned by students on the Worcester campus (mean = 77.6%) and those earned by students on the Manchester campus (mean = 77.6%; $P = 0.99$). Of all course grades earned over the 15 semesters, students on the Worcester campus had higher mean course grades for 10 (66.7%) semesters, while Manchester students had higher mean course grades for 5 (33.3%) semesters. Only

Table 1. Comparison of Examination Grades in a Pharmacotherapeutics Course Sequence Taught Synchronously on Two Campuses Using Distance Education Technology, Fall 2005 - Summer 2010

	Worcester Campus	Manchester Campus
Number of examinations	71	71
Number of students who completed each examination:		
Mean	143.2	37.1
Median	147	35
Range	122-163	21-54
Examination grade, %:		
Mean ^a	77.6	77.7
Median	77.1	77.7
Mode	72	71, 79

^a $P = 0.96$

Table 2. Comparison of Course Grades (%) by Semester for a Pharmacotherapeutics Course Sequence Taught Synchronously on Two Campuses Using Distance Education Technology

Year (Semester ^a)	Worcester Campus		Manchester Campus		P
	n	Course Grades, Mean (SE)	n	Course Grades, Mean (SE)	
2005 (1)	147	78.5 (0.6)	21	77.3 (1.6)	0.48
2005 (2)	148	79.1 (0.01)	21	78.5 (0.02)	0.71
2005 (3)	147	80.3 (0.5)	21	81.0 (1.4)	0.64
2006 (1)	132	71.0 (0.6)	35	69.9 (1.3)	0.47
2006 (2)	125	77.1 (0.5)	33	75.2 (1.2)	0.14
2006 (3)	122	80.3 (0.5)	33	77.6 (0.9)	.007
2007 (1)	149	77.2 (0.6)	46	80.8 (0.9)	.001
2007 (2)	138	73.7 (0.01)	40	77.2 (0.01)	.002
2007 (3)	123	80.2 (0.01)	39	79.8 (0.01)	0.62
2008 (1)	150	75.1 (0.01)	35	76.2 (0.01)	0.37
2008 (2)	163	77.4 (0.7)	35	78.9 (1.1)	0.24
2008 (3)	147	78.0 (0.5)	35	77.2 (1.2)	0.53
2009 (1)	153	77.4 (0.6)	54	77.1 (1.0)	0.84
2009 (2)	156	77.9 (0.01)	53	76.8 (0.01)	0.30
2009 (3)	150	80.4 (0.01)	52	80.1 (0.01)	0.82

^a Semester 1 (fall) = Therapeutics I; semester 2 (winter) - Therapeutics II; semester 3 (summer) - Therapeutics III.

in 3 of the semesters were the mean course grades significantly different ($P < 0.05$) between the 2 campuses (mean course grades were significantly higher on the Worcester campus in 2 semesters and on the Manchester campus in 1 semester.)

DISCUSSION

While reading textbooks, participating in Socratic discussions, and completing practical experiences are all methods used in pharmacy education, classroom lectures remain the primary means of conveying information to students. What has changed is the medium by which lectures are delivered. Although technology such as the Internet and telecommunications equipment are used in some pharmacy programs, the effectiveness of these

methods of information delivery compared to the traditional method of an instructor standing in front of a classroom of students is still questioned. Previous studies show that learning outcomes do not differ between students who received information face-to-face and those who received the same information delivered synchronously at a distant location.^{8,9}

The results of our study are consistent with these studies and suggest that students are not negatively impacted by distance technology and score the same on examinations. These results represent the academic flexibility of students to be able to learn in a novel arena and adapt to this nontraditional manner of conducting classroom activities. It also gives credence to the faculty members who must acknowledge the presence of students

Figure 1. Comparison of Mean (%) examination grades (^a $P < 0.05$).

miles away who deserve the same attention as those students sitting in front of them. The lack of a significant difference in the grades that students earned over the course years studied is further punctuated by the case-based, active-learning nature of the Pharmacotherapeutics courses, which used only a minimal amount of traditional lecture and relied instead on ongoing discussion between students and instructor. Despite the use of distance education technology, the students on the distant end were able to learn from the lectures and achieve the same degree of examination success as their counterparts in the base classroom. As technology continues to advance, additional methods will be devised to provide pharmacy students with the classroom educational experiences that help create the foundations for their careers. As this study does, additional validation of the effectiveness of those new delivery forms should be made available to address the concerns of those on either side of the teaching podium.

One potential limitation to the results of this study is the inclusion of grades for students who were required to repeat the course. The authors opted to include these grades because to exclude them would have been an incorrect omission of data that contributed to the outcomes we observed. The data could have been excluded due to the presumed impact recycled learning has on the grade outcomes of students, but this impact is abstract and immeasurable and may not even exist. This course was not the first time the students participated in distance education as it is used throughout the program, so to argue that repeat students had an experiential advantage would not be correct. The number of student grades representing repeat students was <1.6 % of the entire data pool, thus representing a small fraction of the full cohort. Therefore, the data from repeating students has been included in our analysis in order to gain the full consequences of our use of distance education technology.

CONCLUSION

No significant difference in grade outcomes was found between pharmacy students who attended a student-centered, active-learning, case-based pharmacotherapeutics course in a traditional classroom setting and those who attended the same course via synchronous teleconferencing at a distant campus, suggesting that PharmD students on both campuses received an equivalent curricular experience. Although these conclusions should propagate confidence among the pharmacy education community that novel media are equal in effect to traditional methods of teaching, continued assessment should occur as additional creative adjustments are attempted.

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