

Assessment of Student Performance in an Advanced Pharmacokinetics Course Taught by Three Methods of Instructional Delivery

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The objective of this study was to evaluate: (i) student academic performance, and (ii) student evaluation of faculty teaching in a pharmacokinetics course taught by three methods of instructional delivery over a three-year period. Student performance is defined as scores on written examinations and student evaluation of faculty teaching involved completion of a standardized evaluation instrument. General linear model analyses were used to determine if differences occurred in grades for the three exams given in each year of the course and where differences occurred, a Bonferroni procedure was used. No difference in student performance could be detected in grades for Exams 1 and 3 over the study period; however, differences were detected for exam 2 between Years 1 and 2 as well as Years 2 and 3. No statistical difference could be demonstrated over the three-year study period for final course grades or for student evaluation scores of faculty teaching performance. The methods of instructional delivery evaluated in this study did not appear to affect students' academic performance or students' assessment of faculty teaching in this pharmacokinetics course.

INTRODUCTION

Colleges of pharmacy often find it necessary to provide course offerings to students who are physically present at more than one site. This is especially true of institutions with split campuses offering didactic classes to students at both sites. Traditionally, such situations necessitated duplication of efforts by faculty members on both campuses. Obviously this is not effective use of resources, which due to budget constraints, are often limited. One method by which this dilemma may be resolved is via distance learning technology. Distance learning and distance education are broad terms which refer to instructional delivery approaches implemented for the purpose of overcoming the problem of distance between instructors and students(1). Current distance learning typically utilizes electronic media such as interactive video methods and computer technologies(2).

At the time of this study, the College of Pharmacy at the University of Georgia had a split campus situation (separated by 100 miles) for the didactic portion of the Doctor of Pharmacy Program. Students were located on one campus, but faculty from the other campus participated in didactic instruction in the pharmacokinetics/therapeutic drug monitoring course. To circumvent the problem of faculty having to travel to the alternate site for

instructional delivery, interactive video conferencing technology was utilized.

The purpose of this study is to assess for differences in student performance in an advanced level pharmacokinetics/therapeutic drug monitoring course offered by three methods of instructional delivery over a three year period. A search of the pharmacy education literature failed to identify a study evaluating distance learning as a method of instructional delivery in an advanced level pharmacokinetics course.

METHODS

Student performance in this course was determined by three written examinations for each year of the study period. In Year One (1994), the entire course was taught by instructors being present in the classroom for each lecture. In Year Two (1995), one half of the lectures were given by distance learning while the remaining lectures were live with the instructor physically present in the classroom. In the final year of this study (1996), all lectures were given by distance learning (Table I). The same three instructors taught the course over the three year study period and course content (basic pharmacokinetic concepts, aminoglycoside and vancomycin dosing) remained constant during this time. Each instructor taught the same section of

Table I. Average student performance

| Year | Exam # 1 | Exam # 2 | Exam # 3 | Final grade |
|-------------|--------------|--------------|---------------|--------------|
| 1994 (n=43) | 92.47 ± 6.20 | 86.05 ± 9.02 | 83.26 ± 10.85 | 88.35 ± 7.26 |
| 1995 (n=37) | 94.32 ± 5.41 | 93.11 ± 5.24 | 82.73 ± 12.63 | 90.82 ± 6.59 |
| 1996 (n=45) | 92.53 ± 3.36 | 86.67 ± 8.06 | 84.76 ± 10.56 | 89.16 ± 5.05 |

Table II. Average scores for faculty evaluation of teaching by year

| Question | 1994 (N = 30) | 1995 (N = 27) | 1996 (N = 29) |
|---|---------------|---------------|---------------|
| 1. The instructor was well organized and prepared for class | 4.37 ± 0.72 | 4.43 ± 0.49 | 4.79 ± 0.49 |
| 2. The instructor presented course material in an understandable manner | 4.21 ± 0.82 | 4.29 ± 0.63 | 4.74 ± 0.54 |
| 3. I learned a lot from this class | 4.33 ± 0.68 | 4.48 ± 0.66 | 4.79 ± 0.39 |
| 4. The instructor motivated me to do my best | 4.53 ± 0.59 | 4.20 ± 0.68 | 4.56 ± 0.55 |
| 5. The instructor treated students with respect | 4.67 ± 0.49 | 4.75 ± 0.54 | 4.73 ± 0.49 |
| 6. Grades were assigned fairly and impartially | 4.80 ± 0.32 | 4.35 ± 0.96 | 4.32 ± 0.77 |

the course all three years using the same teaching and testing format. Each instructor did not teach in each segment of the course and therefore did not have material on each of the examinations. All class sessions were interactive between students and instructors in that students were asked to provide feedback to questions from the instructors, and instructors addressed questions raised by the students. Each instructor periodically paused during class sessions for the purpose of soliciting questions from students.

Examinations were administered during regularly scheduled class periods over a two-hour time interval. Questions on Examination 1 required students to mathematically derive selected equations commonly used in pharmacokinetic calculations. Questions on Examinations 2 and 3 were case-based and required students to apply equations learned in the first section of the class to mathematically solve pharmacokinetic problems. Although the exact examinations were not given yearly, goals and objectives as well as examination questions and content for each portion of the course were remarkably similar for each year of the study. Instructors personally graded their portion of each examination. This course provided three-quarter hours of credit and was taught over a 10-week time interval.

The interactive videoconferencing equipment used by the University of Georgia College of Pharmacy is the CLI Radiance System Model. This equipment was available prior to the start of this study and is maintained by the office of the Vice President for Academic Affairs for the University of Georgia. Little to no instructions were provided to the faculty prior to initiating interactive videoconferencing. Both campuses provide technical support personnel to operate the equipment during classes.

General Linear Model one-way analysis of variance was used to compare differences in individual examination scores and the final course grades by year. Bonferroni procedure was used to detect where differences occurred. Faculty teaching evaluations were assessed by students anonymously completing a six-item questionnaire using a five-point Likert scale (1 equals "almost never" to 5 equals "almost always") which can be seen in Table II. This questionnaire is the standard University of Georgia evaluation instrument and was completed by the students

at the end of the course. Students are not required, but are strongly encouraged to complete these evaluations. Scores from these evaluations were provided to the investigators as average scores plus standard deviations for each of the six items assessed. These scores were then averaged by year for study purposes. SAS version 6.10 (Cary, North Carolina) was used for making all statistical calculations. An alpha level of $P < 0.05$ was chosen for significance. Power analysis was performed using the method described by Cohen(3).

RESULTS

Results of the statistical analyses of student performance on exams and the final course averages can be found in Table I. No difference in student performance could be detected in grades for Exam 1 over the three-year study period. For the second exam, no difference could be detected in student performance for Year One and Year Three; however, statistical differences were demonstrated between Years One and Two as well as Years Two and Three. No statistical differences were demonstrated on examination performance for Exam 3. In regard to final course grades, no statistical difference could be demonstrated over the three-year study period.

Table II lists average faculty scores calculated from student evaluation of teaching forms during this time. No statistical difference could be demonstrated in these scores. Differences in the values for n between Table I and Table II occurred as a result of students not being required to complete faculty evaluation forms. Participation in this evaluation process is on a voluntary basis.

Costs associated with providing lectures in this course via distance learning is quite minimal to the College of Pharmacy. Since the equipment was purchased and is maintained by the University, no costs are incurred regarding equipment. Telephone line charges are approximately \$16 per hour and therefore total course costs for this item was \$480. The only additional costs include that of support personnel, which was calculated as approximately \$384 for the entire course. On the other hand, costs associated with faculty traveling to the distant campus were considerably higher. Due to the 100 mile distance, an average of four hours of faculty travel time were committed

ted three times a week. At a rate of \$25 per hour plus 28 percent for benefits, this calculates to \$3,840 for the course. To this value, travel re-imbusement must be added which would total \$150 per week. Even if the instructor made a single trip once a week and covered all three hours of class for the week in one day, the total costs associated with distance learning lectures would be less than that incurred with live lectures.

DISCUSSION

Other health care professionals have utilized distance learning as a modality of providing instructions at off-campus sites. Nursing schools are utilizing this technology to provide both graduate level courses(2,4,5) as well as specialty training and continuing education(6,7). Distance-learning methods utilized by nursing schools include interactive electronic bulletin boards and two-way interactive videoconferencing. Programs offered by this educational methodology are designed to provide self directed independent study and allow the individual to continue to serve the community in which they reside. Evaluations of such programs demonstrate a high degree of satisfaction with distance learning and no difference across sites in knowledge acquisition.

Medical schools have primarily utilized distance-learning technology for continuing medical education purposes(8-11) as well as for residency training(10). Such methods have been demonstrated to have a substantial impact on the knowledge gained by attendees. Additionally, distance learning has been cited as a more effective means of communicating new knowledge than the more traditional instructional methods of lecture and teaching rounds(10).

Geriatric education centers responsible for training large numbers of faculty and practicing health professionals in geriatrics have utilized distance learning methodologies to accomplish this task(12,13). Satellite interactive teleconferences are the major distance learning method used by these programs. Such programs have been successful in training significant numbers of individuals at multiple sites over an extended time interval.

In 1987, Talbert *et al.* evaluated the effects of live lecture versus interactive televised presentations on senior pharmacy students' performances on written examinations in a disease process and therapeutic management course(14). No difference in performance could be determined in this study, although students preferred live to televised lectures. As previously stated, a similar study evaluating students performance on written examinations in a pharmacokinetics course could not be identified upon reviewing the literature. Therefore, the objective of this study was to evaluate performance in an advanced level pharmacokinetics course taught by three methods of instructional delivery over a three year period. The investigators focused on two issues regarding distance learning: student performance and student evaluation of faculty. Students had previously expressed concerns that this method of instructional delivery would negatively affect their examination performance. Likewise, faculty had conveyed the concern that this method would adversely affect student evaluations of teaching performance. In our institution, teaching evaluations are a component of faculty annual evaluations, salary justification, and promotion

and tenure considerations. The results of this pilot study suggest that these concerns may be unfounded.

Several limitations are readily identified in the current study. The absence of a control group and the relatively small sample which was limited due to class size may have affected the outcomes observed. In our situation, a control group could not be utilized, as all students enrolled in the course for each year were taught by the respective method for that year. A power of 0.47 was demonstrated as a result of the small effect size (0.17) at $\alpha = 0.05$. Examination validation was not undertaken; however, examination format had remained consistent over the three years prior to the study and student's performance on these exams were quite similar to the performance during the course of our study.

Faculty evaluation scores were not available to the investigators as raw data. This is because student evaluations are not provided directly to the faculty, but rather are collected by college administrators. These individuals provide scores to faculty as averages and standard deviations. Raw data is not maintained on file. Clearly the lack of availability of raw data may not account for differences in effectiveness of various faculty in the different teaching situations. Such data may also be useful in identifying characteristics of instructors who are more effective in using distance learning technology. And finally, because fewer students completed faculty teaching evaluations than were enrolled in the course, scores from these evaluations may have been biased.

Therefore, due to these limitations, the results of this study should be viewed as preliminary data and further studies evaluating a larger population need to be conducted.

CONCLUSIONS

Regardless of the method of instructional delivery, students overall performance in the advanced level pharmacokinetics/therapeutic drug monitoring course remained constant over this three year study period. Interactive videoconferencing did not seem to affect students' performances. At the same time, this instructional method did not seem to affect the students assessment of faculty teaching in this course.

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