

## HOW WE TEACH | *Generalizable Education Research*

# Impact of distance education via interactive videoconferencing on students' course performance and satisfaction

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**Klibanov OM, Dolder C, Anderson K, Kehr HA, Woods JA.** Impact of distance education via interactive videoconferencing on students' course performance and satisfaction. *Adv Physiol Educ* 42: 21–25, 2018; doi:10.1152/advan.00113.2016.—The impact of distance education via interactive videoconferencing on pharmacy students' performance in a course was assessed after implementation of a distance campus. Students filled out a "Student Demographic Survey" and a "Precourse Knowledge Assessment" at the start of the course and a "Postcourse Knowledge Assessment" and a "Postcourse Student Perceptions Survey" at the end of the course. The primary end point, a comparison of course grades (%) between the main and distance campuses, was examined using the two-sample *t*-test. We examined the relationships among demographics, campus location, course grades, grade point average, pre- and postcourse knowledge assessments, and postcourse perceptions as our secondary end points with parametric and nonparametric tests. Data from 93 students were included in the analysis [main campus ( $n = 81$ ); distance campus ( $n = 12$ )]. Students on the main campus achieved a significantly higher final course grade (87 vs. 81%;  $P = 0.02$ ). Scores on the Postcourse Knowledge Assessment were also significantly higher compared with those of students on the distance education campus (77 vs. 68%;  $P = 0.04$ ). Students on both campuses reported self-perceived improvement in their knowledge base regarding various aspects of infectious diseases. Compared with the students on the distance campus, those on the main campus were more likely to subjectively perceive that they had succeeded in the course ( $P = 0.04$ ). Our study suggests that students on the main campus achieved a higher final course grade and were more likely to feel that they had succeeded in the course. Students on both campuses reported improvement in knowledge.

distance campus; distance education; distance learning; interactive videoconferencing

## INTRODUCTION

The advancements of technology have led to many academic institutions offering distance-learning opportunities to students. Distance education can be categorized as either synchronous or asynchronous. Synchronous technology allows for "live" interaction between the instructor and the students (e.g., audioconferencing, videoconferencing, web chats). Asynchronous technology involves significant delays in time between instruction and its receipt (e.g., E-mail, earlier video recording, discussion forums) (4).

Limited data are available regarding the overall success of distance-learning programs within a Doctor of Pharmacy program. Several studies performed at schools of pharmacy in the United States suggest that teaching via interactive videoconferencing (IVC) to students on a satellite campus did not adversely affect students' academic performance (3, 7–10). One study suggested that, although students' performance in the course was not affected, instructors' teaching performance was rated lower by students on the satellite campus (3). Two meta-analyses have evaluated distance learning in nonpharmacy disciplines and have found that student satisfaction and performance are minimally affected by the distance-learning setting (1, 2).

A satellite campus was opened at the Wingate University School of Pharmacy in the Fall of 2011 and is located 140 miles from the main campus. There is a dedicated building for the pharmacy school on the distance campus, with electronics-enabled classrooms, laboratory space, meeting rooms, and faculty offices. In addition to full-time administrative and computer information technology (IT) support staff, the distance campus comprises ~6 full-time faculty members, compared with ~24 full-time faculty members on the main campus. Synchronous technology utilizing IVC is the main method of delivering course content to the satellite campus.

The main purpose of our exploratory study was to evaluate whether distance education via IVC had an impact on pharmacy students' performance in an Infectious Diseases Pharmacotherapy course and to assess students' perceptions and satisfaction with the course.

## MATERIALS AND METHODS

**Experimental design.** Based on previously published recommendations regarding opening a satellite campus (4, 6), faculty implemented changes to their courses to build relationships with the distance students, to promote distance students' engagement during class, and to ensure consistency across sites. Changes included a day-long visit to the distance campus in the middle of the course, directing questions to the distance site and/or specific student at the site (instead of asking a question to the class at large), making all class materials available online to all students 48 h before class, and posting all grades simultaneously to all students enrolled in the course. Technical assistance and training are also instrumental when distance campuses are being developed (1) and were implemented at our program, with an increase in IT staff on the main campus, hiring of IT staff on the distance campus, and faculty development programs on delivering courses via IVC.

Participants in this study were second-year students enrolled in the Infectious Diseases Pharmacotherapy course, as part of their 4-yr

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doctoral degree Pharmacy program. Infectious Diseases Pharmacotherapy at our institution is a 3-semester-hour class and meets 3 times/week (75 min/class period), for 10 consecutive wk in the Spring semester. The course was team-taught by three main campus pharmacy faculty members. The course format was mainly didactic, with patient cases incorporated throughout the lecture to engage students in a discussion and to enhance learning of the material. There were three exams in the course: *exams 1* and *2* carried a weight of 30% of course grade, and the final exam carried a weight of 40% of the final course grade. Course materials used for both campuses were identical, and delivery of material was simultaneous (synchronous) via IVC.

On the first day of class, all students enrolled in the course were asked to complete a "Student Demographic Survey" and a "Precourse Knowledge Assessment." The Student Demographic Survey was composed of six questions regarding the students' demographics, prior education level, work experience in the field of pharmacy, and five Likert-scale questions regarding their self-perceived baseline comfort level with microbiology and antibiotics. The Precourse Knowledge Assessment consisted of 20 multiple choice questions that evaluated the students' basic knowledge of microbiology. The students' performance on this assessment did not factor into the overall course grade.

On the last day of class, the students were asked to complete another survey and an assessment. The "Postcourse Student Perceptions Survey" included six questions regarding their satisfaction with the course, their self-perceived performance, and change in knowledge base. The "Postcourse Knowledge Assessment" had 40 multiple choice questions, which included the same 20 questions from the first day of class assessment and 20 new questions on topics taught in the course. The students' performance on this assessment did not factor into the overall course grade.

Completion of surveys and assessments were voluntary. Results of the surveys, assessments, as well as overall course grades were recorded, separated by campus, and blinded to the researchers before analysis. All procedures were approved by the institutional review board.

**Statistical analysis.** The primary endpoint of this study was to assess whether distance education via IVC had an impact on final Infectious Diseases Pharmacotherapy course grades. Secondary endpoints were to assess whether distance education via IVC had an impact on the students' grade point average (GPA) at the end of their second year of pharmacy school, the Postcourse Knowledge Assess-

ment scores, and perceived improvement in knowledge and course satisfaction (assessed with the Postcourse Student Perceptions Survey).

Baseline characteristics between the two campuses were evaluated using the two-sample *t*-test for continuous variables (i.e., age) and  $\chi^2$  analysis for nominal data (i.e., sex, prior educational background, prior microbiology background, practical antibiotic experience). Fisher's exact test was used for comparisons of nominal data with small cell sizes. The primary outcome was examined using the two-sample *t*-test.

Secondary outcomes investigating the relationships among demographics, educational and practical background, pre- and postclass surveys, course grades, test scores, end-of-semester GPA, and campus location were assessed via a variety of statistical tests, as appropriate. Pre- and Postcourse Knowledge Assessment scores between campuses were analyzed via two-sample *t*-tests. GPA data between campuses were also examined using two-sample *t*-tests. Investigating possible relationships between demographic variables and academic performance was undertaken using Pearson correlation and ANOVA (with Tukey's post hoc tests as necessary). The Kruskal-Wallis test was used when comparing the campuses on items from the Student Perceptions surveys, and the Wilcoxon-signed rank test was employed when examining Student Perceptions surveys within a campus location. Due to the difference in sample size between the two campuses, separate variance tests were used for all analyses involving *t*-tests. For all inferential statistics, significance was set at  $<0.05$ .

## RESULTS

A total of 108 students were enrolled in the Spring 2014 course: 92 on the main campus and 16 on the distance campus. Only data from the students who completed the surveys and assessments from the first and last day of class were included in the analysis (81/92 (88%) students on the main campus; 12/16 (75%) of students on the distance campus).

Student baseline demographics were similar between the two groups, with the majority of students being female and having 4 yr or more of college education (Table 1). Our results showed that students on the distance campus had significantly lower overall course grades compared with students on the main campus (81.5 vs. 86.9%;  $P = 0.02$ ) (Table 2). Despite

Table 1. Student baseline demographics

Variable	Main Campus	Distance Campus	<i>P</i> Value
<i>n</i>	81	12	
Age, mean (SD), yr	25 (2)	28 (5)	0.12
Sex, <i>n</i> (%)			0.52
Women	46 (57)	8 (67)	
Men	35 (43)	4 (33)	
Education level before pharmacy school, <i>n</i> (%)			1.00
2 yr of undergraduate coursework	23 (28)	5 (42)	
4 yr of undergraduate coursework	43 (53)	6 (50)	
Graduate degree	3 (4)	1 (8)	
Other	12 (15)	0	
Prior background in microbiology, infectious diseases, antimicrobials, <i>n</i> (%)			1.00
No background	1 (1)	0	
1 College-level course	65 (80)	12 (100)	
$\geq 1$ College-level course	15 (19)	0	
Other	1 (1)	0	
Practical experience in preparing/dispensing antibiotics, <i>n</i> (%)			0.89
None	30 (37)	5 (42)	
<1 yr	27 (33)	5 (42)	
1–2 yr	17 (21)	1 (8)	
>2 yr	8 (9)	1 (8)	

Values are means (SD) or *n* (%); *n*, no. of students. Note: percentage numbers are rounded to the nearest whole number.

Table 2. Course grades, Pre- and Postcourse Knowledge Assessment scores, and GPAs

End Point	Main Campus (n = 81)	Distance Campus (n = 12)	Mean Difference (95% CI)	P Value
<i>Primary end point</i>				
Course grade, %	86.9 (7.1)	81.5 (9.5)	-5.4 (-10.0 to -0.8)	0.02
<i>Secondary end points</i>				
Precourse Knowledge Assessment score, %	65 (10)	60 (13)	-4.3 (-10.9 to 2.2)	0.19
Postcourse Knowledge Assessment score, %	76.7 (9.7)	68.3 (12.1)	-8.4 (-16.3 to -0.5)	0.04
Pharmacy school GPA, end of second year	3.4 (0.4)	3.2 (0.4)	-0.2 (-0.47 to 0.00)	0.05

Values are means (SD); n, no. of students. CI, confidence interval.

having similar assessment scores regarding basic microbiology on the first day of class, students on the distance campus had significantly lower Postcourse Knowledge Assessment scores on the last day of class, as well as lower pharmacy school GPA at the end of the semester, although the GPA difference did not reach statistical significance (Table 2).

Evaluation of Postcourse Student Perceptions Survey results suggests that students on both campuses felt that they had significant improvements in their knowledge of infectious diseases and antimicrobials on the last day of class compared with the first day of class (Fig. 1). A comparison of perceptions between students on the two campuses showed that students on the main campus felt significantly more confident in their ability to identify the causative organism of an infection and to appropriately counsel a patient on antibiotics (Fig. 1).

Postcourse Student Perceptions Survey results showed some disparities between the different campuses and their satisfaction with the overall course structure. Whereas students on both campuses felt that the number of patient cases and active-learning activities was sufficient to enhance their learn-

ing of the material, students on the main campus were more likely to be satisfied with the amount of credit hours and duration of the course ( $P < 0.001$ ) and were more likely to have an overall feeling of success in the course compared with students on the distance campus ( $P = 0.04$ ).

## DISCUSSION

Distance education is becoming an increasingly popular method of teaching in higher learning institutions, including health education. A satellite campus opened at our school of pharmacy in 2011, but no formal evaluation has been performed to compare the performance of students at the two campuses in the Infectious Diseases Pharmacotherapy course. Our study had three main findings. The overall course grades were statistically significantly lower in the group of students on the distance campus compared with the students on the main campus. Students on both campuses perceived significant improvements in their knowledge of antimicrobial and various infections. Students on both campuses were generally satisfied with the course, although main campus students were more

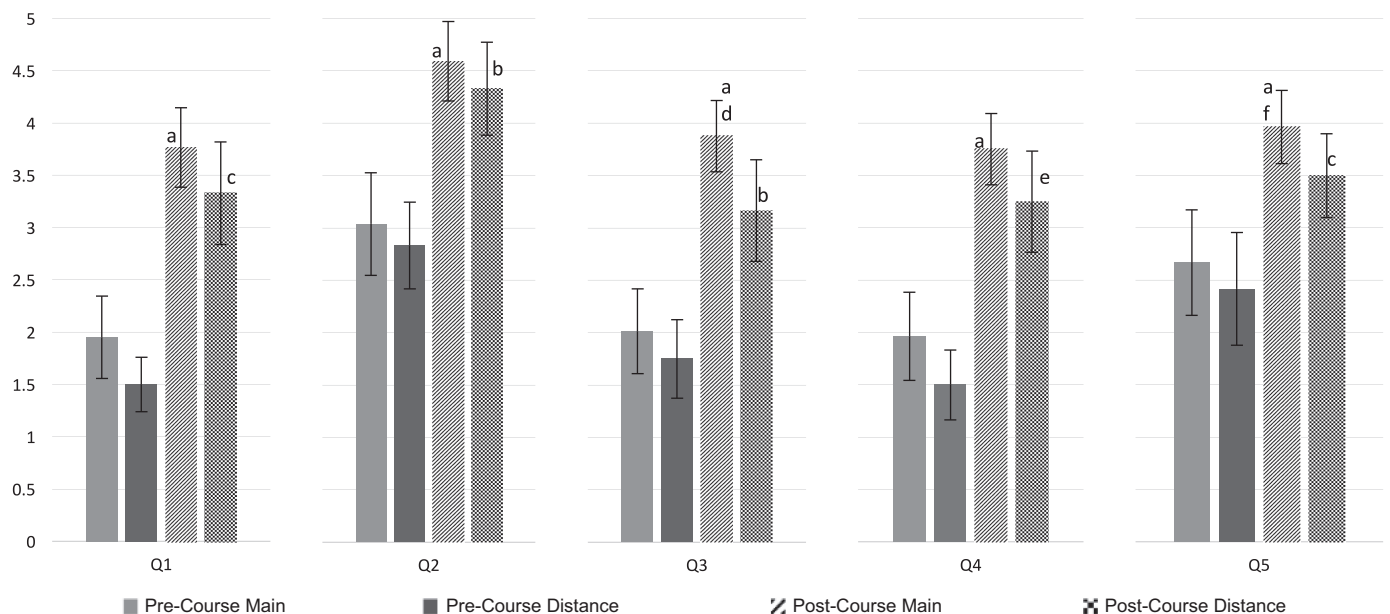


Fig. 1. Pre- and Postcourse Student Perceptions Survey results (scale: 1 = completely disagree; 5 = completely agree). Q1: When given the name of an organism, I can correctly state whether it's a gram-positive, gram-negative, anaerobic, or fungal organism. Q2: When given the name of an antibiotic, I can correctly state which class of antibiotics it belongs to. Q3: When given a name of an infection, I can correctly state which organism is likely causing it. Q4: When given a name of an antibiotic, I can correctly state its spectrum of antimicrobial activity. Q5: When given a name of an antibiotic, I feel comfortable that I can counsel a patient correctly on the important side effects and monitoring parameters with that drug. <sup>a</sup> $P < 0.001$ : main campus postcourse mean score vs. main campus precourse mean score. <sup>d</sup> $P = 0.005$  and <sup>f</sup> $P = 0.05$ : main campus postcourse mean score vs. distance campus postcourse mean score. <sup>b</sup> $P = 0.003$ , <sup>c</sup> $P = 0.004$ , and <sup>e</sup> $P = 0.002$ : distance campus postcourse mean score vs. distance campus precourse mean score.

likely to feel that they succeeded in the course and to have favorable feelings about the amount of credit hours and duration of the course.

The results from our small study were surprising, especially since course materials used for both campuses were identical, and delivery of material was synchronous. The main difference in the delivery of course material was the location of the instructor on the main campus. Although a satellite campus was opened in 2011 at our school, this course is taught in the spring of the second year of pharmacy school. Therefore, one hypothesis for the lower course grades on the satellite campus in Spring 2014 could be that this was only the second time this course was taught using IVC, and the main campus faculty were still relatively inexperienced at relaying the information to the students on the satellite campus effectively. Although faculty were always available to answer any students' questions via email and phone, perhaps the availability of faculty on the main campus made the students on the main campus more comfortable asking questions regarding the course material during face-to-face encounters, either before/after class or during faculty members' office hours.

Another hypothesis for lower course grades on the satellite campus revolves around baseline demographics related to students' prior practical experience in preparing/dispersing antibiotics. Twice as many students on the main campus had more than 1 yr of practical experience with antibiotics compared with students on the satellite campus (30 vs. 16%). Although we did not see any statistically significant differences in any of the baseline characteristics, our sample size was small.

The findings of our exploratory study contradict those that have been reported in the majority of studies from other schools of pharmacy with a satellite campus, albeit none of the published studies were performed in an Infectious Diseases Pharmacotherapy course.

Analyses from four different school of pharmacy have previously shown that students' performance in the pharmacy curriculum (examination scores, course grades, GPA) was not adversely affected by distance education (3, 7–10). It should be noted that these studies were not uniform in their design and had some notable differences from our report. Most were performed over 15 yr ago, when technology was not as advanced as it is today (3, 7, 8, 10). Published trials either had much smaller (3, 10) or larger (8, 9) class sizes, and two of the studies had more than one distance campus (7, 8). A 2004 meta-analysis of 39 nonpharmacy school-related studies found that, on average, there was a small improvement in performance (test scores, grades) for the distance education courses (2). Course content made a difference, with natural sciences and education courses having no effect, military-related instruction showing lower course performance, and foreign language instruction demonstrating superior performance when distance education was instituted (2).

Results from a study performed in a Clinical Pharmacokinetics course at the West Virginia University School of Pharmacy did mirror our results. The study found that students on the satellite campus, receiving instruction via IVC, had statistically significantly lower final course grade compared with the students on the main campus receiving "live" instruction (87.8 vs. 90.7%;  $P = 0.02$ ), although the authors concluded that all

students performed well overall, despite the statistical difference (5).

Our study has several important limitations. We did not include end-of-semester course and instructor evaluation results; this information would have been very useful in comparing distance students' satisfaction with the course and instructor and relating our data to the other published studies in this field. Our study had a small sample size and included data only from one course and one semester. It would be interesting to see how the results from this course compare with the results from other courses in our program and from subsequent years, as the distance campus became more established and faculty got more experience with teaching via IVC. Our survey data are subjective and may not be reproducible or applicable to other groups of students.

Outdated publications in the field of IVC distance pharmacy education make it challenging to apply our study results to experiences at other institutions. As distance campuses become more common in higher education, data regarding students' performance in the classroom and satisfaction with this type of learning should be collected in a prospective, longitudinal manner.

**Conclusion.** In contrast to the results of the majority of studies performed at schools of pharmacy with distance campuses, our study showed that, in the Infectious Diseases Pharmacotherapy course in the Spring 2014 semester, the overall course grades were lower in the group of students on the distance campus compared with the students on the main campus. Mirroring the final course grades, subjective survey results showed that distance students were less likely to feel that they succeeded in the course.

#### DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

#### AUTHOR CONTRIBUTIONS

O.M.K. and K.A. performed experiments; O.M.K. and C.D. analyzed data; O.M.K., K.A., H.A.K., and J.A.W. interpreted results of experiments; O.M.K. prepared figures; O.M.K. and C.D. drafted manuscript; O.M.K., C.D., H.A.K., and J.A.W. edited and revised manuscript; O.M.K. approved final version of manuscript.

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