ILLUMINATIONS

Impact of distance learning via synchronous videoconferencing on pharmacy student performance in a biological science course sequence: an 8-yr analysis

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INTRODUCTION

Distance learning is becoming increasingly popular among health professions programs (5, 6), including pharmacy education programs. Currently, ~25% of accredited schools and colleges of pharmacy have satellite campuses (3). Development of satellite campuses is an effective means to reach students who may not be able to relocate and to generate additional revenue. Satellite campuses are often financially viable because they do not operate with a full complement of faculty or support staff and, therefore, function on the reliance of technology for distance learning capabilities and communication.

With the rise in the number of satellite campuses, the equality of student outcomes between campuses using distance learning technology is essential, being an important component of an accrediting organization’s assessment of the program or university. It has been reported that ~30% of students at distant sites or satellite campuses connected via distance learning technology sleep or talk during class (1, 11). Furthermore, only one-half are willing to ask questions (1, 11). Despite these reported concerns, several studies have suggested that various modes of distance learning are able to deliver equality in learning outcomes in a variety of health professions curricula (2, 7, 9, 10, 12–14). Use of synchronous videoconferencing has been a popular option for communication between campuses, which can be used in the classroom to allow faculty located on the primary campus to teach and communicate with students on satellite campuses in real time. Although videoconferencing has been used in a variety of settings for distance learning, assessment of this technology on student outcomes in a pharmacy education classroom setting is relatively sparse (2, 8, 10, 12–14) and have their shortcomings. The majority of these studies measured outcomes from only one course offering. Just one study was longer term and suitably robust, assessing outcomes in multiple course offerings over several semesters (13). Furthermore, to our knowledge, no studies have assessed the use of synchronous videoconferencing on learning outcomes of pharmacy students in a basic biological science course. Thus the aim of this study was to determine the impact of distance learning via synchronous videoconferencing on student performance in an integrated biological sciences course sequence within a doctoral level pharmacy curriculum over an 8-yr period.

METHODS

Subjects and experimental design. Subjects were first-year pharmacy students who completed the Biological Sciences Integrated (BSI I and II) courses on the main and satellite campuses from the years 2011–2019. Final course grades in BSI I and II were compared between campuses among all students enrolled over the 8-yr period. Each course was offered one time per year. BSI I is offered every fall semester, whereas BSI II is offered every spring semester. All procedures were approved by the Institutional Research Review Board.

Description of satellite campus. A satellite campus for the pharmacy school began enrolling students in the fall semester of 2011. The health professions building is located ~140 miles from the main campus and contains synchronous videoconferencing-enabled classrooms, laboratory space, conference and break-out rooms, and faculty offices. The building houses the physician assistant and pharmacy satellite programs, along with a nursing program offered by a local community college. The pharmacy satellite program has dedicated administrative and computer information technology support staff and approximately eight full-time faculty members. Since the satellite campus does not house a full complement of faculty, synchronous videoconferencing from the main campus is the primary means of delivering most of the pharmacy curriculum to the distant students. All course syllabi, schedules, notes, and assignments are electronically available to all students via Canvas, the university’s learning management system.

Description of the BSI course sequence. The goal of the BSI course sequence was to provide first-year pharmacy (P1) students with the basic biomedical and pharmaceutical sciences foundation on which the processes of applied pharmaceutical care can be built. This course sequence emphasized the basic principles of biochemistry, molecular biology, cellular biology, anatomy, physiology, and pathophysiology, with emphasis placed on application to clinical cases and pharmacy-related subjects, such as drug mechanisms. The course sequence was primarily delivered in a lecture format. Active learning activities were emphasized in and outside of class to supplement the lectures. BSI I and BSI II made up a two-semester course sequence, each offered 5 days/wk for 15 wk with 50-min class times, thus making each a 5-credit course. Assessments in each course included four exams and a comprehensive final exam. In addition, the assessments in BSI II included student lectures covering selected disease states. Each selected disease state was presented by a group of three to four students in a 20-min lecture format. The same course materials were used for both campuses and accessed via Canvas. Course content was delivered synchronously between campuses using videoconferencing technology; thus, students on the satellite campus were able to communicate with the instructor and students on the main campus during the lectures or discussions. Faculty visited the satellite campus approximately two times per semester for in-person office hours. Review sessions were held before each course exam on the main campus with connection via synchronous videoconferencing to the satellite campus. Students on the satellite campus were also able to communicate...
with the faculty members via e-mail, phone, and Skype for additional help outside of class. For a more comprehensive description and assessment of BSI I and II, please refer to the study published by Dirks-Naylor et al. (4).

Statistical analysis. Student’s t test with unequal variance was used to determine statistical significance on student course performance between campuses. Course performance equates to final course grade to determine statistical significance on student course performance are presented as mean percentage.

RESULTS

The data suggest that distance learning via synchronous videoconferencing does not impact pharmacy student performance in lecture-based basic biological sciences courses. There was no statistically significant difference in the mean BSI I course scores between the main campus and the satellite campus for any year evaluated. Furthermore, there was no difference in BSI I course scores between campuses when all years were combined ($P = 0.409$). See Table 1.

Results for BSI II were similar in that there was not a difference in course performance between campuses when all years were combined ($P = 0.391$). For most years assessed, there was also no difference in course performance between campuses. However, there were 3 yr in which there was a significant difference between campuses. Students on the main campus outperformed those on the satellite campus in 2012 (80.9 ± 0.50.82 vs. 78.0 ± 4.67%, $P = 0.030$) and 2013 (83.3 ± 0.56.8 vs. 79.2 ± 4.21%, $P = 0.004$). In 2018, the satellite campus outperformed the main campus (78.3 ± 0.7 vs. 82.9 ± 7.97%, $P = 0.037$). See Table 2.

DISCUSSION

Distance learning and addition of satellite campuses have expanded over the years in higher education, including pharmacy education. There are various means to deliver a distance curriculum, one being synchronous videoconferencing, which allows for live interaction between the instructor and students on distant campuses during class time. Although studies in the literature regarding pharmacy education have reported that this mode of distance learning does not impact student performance, most have only assessed performance across one course offering.

The analysis from 8 yr of data suggest that distance learning via synchronous videoconferencing does not impact performance in basic biological sciences courses among professional degree pharmacy students. The data are consistent with the majority of studies shown for pharmacy-specific course work, such as pharmacotherapy (2, 10, 12–14).

Table 1. Biological Sciences Integrated I course scores

| Year | Main Campus | Satellite Campus | $P$ Value |
|------|-------------|-----------------|-----------|
| 2011 | 80.7 ± 6.46 (85) | 77.7 ± 5.45 (18) | 0.051 |
| 2012 | 84.5 ± 7.83 (92) | 81.6 ± 5.80 (16) | 0.089 |
| 2013 | 81.7 ± 8.14 (88) | 85.2 ± 7.63 (12) | 0.161 |
| 2014 | 82.5 ± 7.20 (90) | 81.8 ± 8.40 (8) | 0.816 |
| 2015 | 79.2 ± 7.35 (101) | 80.0 ± 6.93 (15) | 0.780 |
| 2016 | 80.0 ± 8.56 (83) | 84.7 ± 9.18 (17) | 0.061 |
| 2017 | 78.3 ± 8.25 (84) | 83.1 ± 8.98 (17) | 0.054 |
| 2018 | 77.3 ± 8.63 (68) | 77.1 ± 10.59 (13) | 0.956 |
| All  | 80.6 ± 8.06 (691) | 81.3 ± 8.52 (116) | 0.409 |

Values are means ± SD (with no. of students in parentheses).

Table 2. Biological Sciences Integrated II course scores

| Year | Main Campus | Satellite Campus | $P$ Value |
|------|-------------|-----------------|-----------|
| 2012 | 80.9 ± 5.82 (82) | 78.0 ± 4.67 (18) | 0.030* |
| 2013 | 83.3 ± 6.58 (91) | 79.2 ± 4.21 (15) | 0.004* |
| 2014 | 81.9 ± 7.11 (86) | 85.7 ± 7.00 (10) | 0.128 |
| 2015 | 79.9 ± 6.65 (89) | 79.9 ± 5.93 (8) | 0.987 |
| 2016 | 80.3 ± 6.19 (91) | 83.1 ± 8.34 (12) | 0.288 |
| 2017 | 79.7 ± 8.62 (78) | 82.1 ± 8.17 (19) | 0.256 |
| 2018 | 78.3 ± 7.00 (79) | 82.9 ± 7.97 (17) | 0.037* |
| 2019 | 76.8 ± 8.77 (61) | 77.16 ± 8.16 (11) | 0.903 |
| All  | 80.3 ± 7.26 (657) | 80.9 ± 7.23 (110) | 0.391 |

Values are means ± SD (with no. of students in parentheses). *Statistically significant.

The data from our study do differ with another, which reported that students on the satellite campus were negatively impacted by distance learning via synchronous videoconferencing (8). The difference is likely due to the length of the evaluation period; one course offering versus eight course offerings of the same course. Although our results show no difference in student performance between campuses for BSI I in any year assessed, in certain years we did see a significant difference in performance between campuses in BSI II. The main campus outperformed the satellite campus in two course offerings, whereas the satellite campus outperformed the main campus in another. This is consistent with Steinberg et al. (13), who assessed the impact of synchronous videoconferencing on student performance in a pharmacotherapy course across multiple course offerings. It was reported that, when combining data from all course offerings, there was no difference in student performance between campuses. However, there was a significant difference in student performance between campuses for a few course offerings, with no consistency on which campus performed superiorly.

Although there was no difference in student performance between campuses when all years were combined, the discrepancy in a few of the course offerings may be due to the small number of students on the satellite campus. With relatively few students, small changes in the academic ability of the admitted student cohort could impact the results. Therefore, it is likely that the discrepancy in course performance between campuses in 3 of the 16 course offerings assessed was not due to use of synchronous videoconferencing, but rather some other external factor, such as academic strength of the admitted students in those cohorts. Other factors may include level of ability for independent learning, which is related to academic strength, or personality traits that favor or discourage success in such an environment, which may require more self-discipline due to less direct supervision.

Conclusions. This is the first study that evaluated the impact of distance learning via synchronous videoconferencing across multiple course offerings over several years of a basic biological sciences course in pharmacy education. The results are consistent with the bulk of the literature in that student performance was not impacted via this distance learning method. The data support the use of this technology to provide educational outcomes for distant learners equal to outcomes for students on the main campus.

DISCLOSURES

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

A.J.D.-N. conceived and designed research; A.J.D.-N. performed experiments; A.J.D.-N. and E.B. analyzed data; A.J.D.-N. interpreted results of experiments; A.J.D.-N. drafted manuscript; A.J.D.-N. and E.B. edited and revised manuscript; A.J.D.-N. and E.B. approved final version of manuscript.

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