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Research

The use of application-based learning techniques in a college of pharmacy-based biostatistics course

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Abstract

Objective: This work aims to evaluate whether a pharmacy statistics course utilizing application-based teaching strategies increases students' confidence in their ability to read the medical literature and interpret study statistics.
Methods: Application-based assignments were developed and incorporated into weekly live discussion sessions. Assignments included interpretation of statistical results from medically related journal articles, from statistical program output, and determination of which statistical methods are most appropriate for a given set of data. Students completed pre- and post-course surveys regarding demographic information and confidence in ability to perform these tasks.
Results: A comparison of the pre-and post-course surveys demonstrated that the percentages of students' agreeing or strongly agreeing that they (1) feel comfortable in reading a journal article increased by 22%, (2) know how to classify studies increased by 41%, (3) know how to evaluate statistics increased by 64%, and (4) understand significance, *p* value, and power increased by 66%. These findings were statistically significant and consistent across campuses and years.
Conclusion: Following completion of an application-based pharmacy focused biostatistics course, students had more confidence in their ability to perform tasks associated with interpretation of statistics and medical literature.

Keywords: Biostatistics; Applied learning; Bloom's taxonomy; Active learning; Statistics

Introduction

The Center for the Advancement of Pharmacy Education (CAPE) has published educational outcomes intended to guide development of pharmacy curricula.[1] Under Domains 2 (Essentials for Practice and Care) and 3 (Approach to Practice and Care) of the 2013 CAPE outcomes, students are called upon to be able to retrieve, analyze, and interpret, to provide drug information, and to develop evidence-based treatment protocols among other skills.[1] In addition, according to the Accreditation Council for Pharmacy Education (ACPE) Standards and Guidelines for the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree, effective February 2011, the PharmD curriculum should be designed to develop critical thinking and problem-solving skills through active learning.[2] The 2016 ACPE accreditation standards again emphasize the use of active learning, defined as "a style of teaching that requires the learner to formulate answers to questions based on acquired knowledge while continuing to search for new

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knowledge that may provide better, more complete answers."[2] While active learning has been associated with activities during class sessions, learners can be called upon to search for new knowledge and formulate knowledge based on acquired knowledge outside the classroom using application-based activities.

There is evidence of active/application-based learning being used in statistics courses. A study by Carlson and Winquist[3] looked at the use of active learning in a college-level statistics course The authors compared post-course perceptions between students who used an active learning workbook approach and those who had taken other statistics courses with similar content offered in the college. Students who used an active learning workbook had more confidence in their ability to perform and understand statistics, liked statistics more, and thought that statistics was more difficult than did the comparison group. According to a descriptive report by Dolinsky,[4] 60−80% of contact time was spent doing computer-based activities, written and oral presentations, group activities, and then assessments. While course grades and evaluations did not differ after the change in course structure to increase active learning, course comments were very different, reflecting an understanding of material and a confidence and pride in the students' ability to solve problems. A study by De Jong et al.[5] looked at a problem-based statistics course in a Masters of Public Health program in the Netherlands. They looked at a problem-based learning approach using both an in-class model and an asynchronous online model. Both models performed well and students had positive perceptions overall. In contrast, an older study by Bland[6] found that schools did not use an active learning approach for statistics and often did not have a focused course but rather inserted material as appropriate into other courses.

A thorough literature search did not reveal any studies that evaluated the use of application-based or active learning in a statistics course in a pharmacy curriculum. An evaluation of curriculum and instructional methods for drug information, literature evaluation, and biostatistics indicated that there is a change toward more active learning, but the impact of this change had not been assessed.[7] Statistics was viewed as a good course for the use of application-based knowledge because it can be challenging to translate facts to use in practice where there is variability in approach and methodology. There is emphasis on literature evaluation and interpretation and the need for pharmacy students to be critical thinkers and problem solvers in the CAPE outcomes. In addition, the 2016 ACPE Accreditation Standards indicate that biostatistics (defined as "appropriate use of common statistical tests and the evaluation of the validity of the conclusion based on the application of these tests") should be a required component of pharmacy curricula.[3] These standards reflect the importance of these skills in providing care for patients and in fact are referred to as "central." It is therefore important to incorporate instruction and assessment of these skills into statistics and literature evaluation courses within the curriculum.

Some may consider this a minimal level of preparedness. As pharmacy practice models evolve and pharmacists seek advanced training (residency and fellowship) and board certification they will be called upon to demonstrate and utilize biostatistics skills. An evaluation of pharmacy resident knowledge by Bookstaver et al.[8] showed that residents performed poorly on an evaluation of biostatistics and the authors concluded that enhanced biostatistics training should be included in both PharmD and residency training programs.

The purpose of this study was to evaluate the entry-level PharmD course redesign and determine if student confidence in his/her ability to evaluate and interpret statistics in the medical literature would increase following completion of a course using an application-focused curriculum.

Materials and methods

The University of Florida College of Pharmacy curriculum is delivered using a blended model of synchronous and asynchronous learning across four campuses. There are approximately 300 students per class with students divided roughly 50−60 students at each of the distance campuses and approximately 120–130 students at the main campus. Statistics was not a prerequisite for admission to the College of Pharmacy during this time period. There are two required courses in the entry-level PharmD curriculum designed to teach students how to evaluate and interpret the medical literature. The first course is in the fall of the second professional year and focuses on statistical methods in medical research. This course is designed to introduce pharmacy students to the concepts and methods of biostatistics and study design. The overall goal of the course is for students to develop the ability to critically evaluate the pharmacy and medical literature statistics to identify findings that have implications for their practice.

In the fall of 2010, prior to the 2011 ACPE Accreditation Standards going into effect, the first of these two courses, Introduction to Quantitative Methods course (statistics designed for the pharmacy student), was redesigned due to personnel changes. The course was transitioned from a three-hour, strictly asynchronous didactic lecture and exam-based course to a course with live application-based learning sessions, quizzes, and exams. Students were given pre-class readings and two hours of lecture content was video captured and posted to the course management site each week for view by students across all campuses. The students were also given discussion guides that they were to complete prior to class.

During the live sessions, students were called upon randomly to answer discussion guide questions. Students may also be asked related or clarifying questions to provide additional application experience. The purpose of the