



Research article

Effectiveness of flipped classroom instructional model in teaching pharmaceutical calculations

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Abstract

Objective: To compare the effectiveness of teaching a pharmaceutical calculations course using a flipped versus traditional instructional method.

Methods: For the flipped method, students were required to watch recorded lectures before class, and class time was used for completing problems. For the traditional method, lectures were delivered in class followed by use of some class time for completing problems. The course material was divided into sections I and II. In 2011, sections I and II were taught by the flipped and traditional method, respectively. In 2012, both the sections were taught using the flipped method. Exam 1 and final exam part A tested the material covered in section I. Exam 2 and final exam part B tested the material covered in section II. Section II scores were compared between the 2011 and 2012 cohorts. Pre-admission criteria and section I scores were compared between the two cohorts to assess whether difference in section II scores could be attributed to differences in-class composition. Student perceptions about the flipped and the traditional instructional method were also examined.

Results: The 2012 cohort (taught by flipped method) achieved a higher score on the section II material (exam 2, $p = 0.013$ and final exam part B, $p = 0.001$) compared to the 2011 cohort (taught by traditional method). Student perception data also indicated that a majority of students preferred the flipped method over the traditional method.

Conclusion: This study demonstrates that a flipped classroom approach for teaching pharmaceutical calculations can improve student performance and satisfaction.

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Keywords: Flipped classroom; Instructional method; Pharmaceutical calculations

Introduction

The pharmaceutical calculations course is a core requirement of the professional pharmacy curriculum.¹ The

development of pharmaceutical calculation skills in students plays a significant role in building a competent and confident practitioner.² Pharmacy students should confirm proficiency in the pharmaceutical calculations course and this proficiency should then be reinforced throughout the pharmacy school curriculum. Because of the importance of pharmaceutical calculations in pharmacy practice, a significant portion of the North American Pharmacy Licensure Examination (NAPLEX) is based on the objectives taught in

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this course, according to the published blueprint of the exam.² Proficiency in a significant course like pharmaceutical calculations can be attained by practicing numerous complex problems multiple times. To increase the number of problems reviewed requires effective use of time in the classroom. Hence, it is critical to adopt efficient methods of teaching and utilize class time in an optimal manner. The flipped classroom instructional model is one such method that can be adopted to use class time efficiently. The flipped classroom instructional model has been utilized by a number of educators in recent years to encourage student learning and engagement.³⁻⁷ In the flipped classroom approach utilized for the pharmaceutical calculations course, the instructor recorded a lecture and made it available to students prior to class. The students listened to the recorded lecture and practiced homework problems prior to class. The pre-recorded lectures (modules) allow students to learn the material at their own pace and review the more complex concepts multiple times. This allows students to come to class with a basic understanding of the material, so that class time could be utilized for working on more complex problems in the presence of the instructor. In the traditional pharmaceutical calculations course setup, the material was taught to students in the classroom and then only limited time was available to help students work through problems of increasing complexity. When homework problems were assigned to students, sometimes they did not have an instructor or peer to help them if they got stuck with the difficult problems.

The objective of this study was to compare the flipped classroom model to the traditional instructional model for teaching a pharmaceutical calculations course. Students were taught pharmaceutical calculations utilizing pre-recorded on-line instructional videos (for the flipped classroom model) or live in-class lectures (for the traditional method). In this study we examined if there was any difference in exam scores between students taught using the flipped classroom instructional model, as compared to students taught using the traditional teaching method. We also explored the level of student satisfaction between the two teaching methodologies.

Methods

Pharmaceutical calculations is a mandatory 2-credit-hour course for all first-year students at South University School of Pharmacy (SUSOP). This course is ten weeks long, and meets two hours per week. Students were expected to attend all scheduled classes and attendance was taken each class period. Based on the syllabus, students were required to attend 85% of the scheduled class periods. If more than 15% of the class periods were missed for any reason, a failing grade would have been assigned. The material for this course was divided into two sections (sections I and II) (Table 1). Achievement of student learning outcomes was assessed by administering exams 1 and 2 at the end of

sections I and II, respectively, and through a comprehensive final exam (Table 2). The final exam questions were divided into two parts (A and B). Final exam part A consisted of questions related to the material covered under section I of the course and final exam part B consisted of questions related to the material covered under section II of the course (Table 2). All exam questions were short answer or fill in the blank questions.

This was a team-taught course. In summer 2011, section I of the pharmaceutical calculations course was taught by the flipped classroom instructional method by one professor and section II was taught by the traditional teaching method by another professor. In summer 2012, both sections I and II of the course were taught by the flipped classroom instructional method (Table 2) by the same professors as 2011.

For the flipped classroom instructional method, pre-recorded video modules were created by recording lectures in a classroom using a video content recorder system available at SUSOP (TelePresence Content Server, Cisco Systems, Inc.). The instructor delivered a lecture using a PowerPoint presentation to an empty classroom. The entire presentation was recorded along with the instructor's voice. The system was set up to record only the PowerPoint presentation on the screen. Annotation equipment was integrated into the computer which was used to record the video modules. This consisted of an LCD display and a wireless pen, with an integrated software (StarBoard T-17SXL Interactive Display, Hitachi, Ltd.). This equipment allowed the instructor to annotate slides and work problems on the screen. After the videos were recorded, the Information Technology (IT) department at SUSOP made the videos available for download by the instructor. The recorded video files were then exported in mp4 format. This format was determined to have an appropriate balance of file size and video quality for the intended delivery to personal computers through a wireless network. The average size of these files was 35 MB.

SUSOP uses an electronic classroom management system (eCompanion and Pearson Learning Solutions) to administer courses and distribute course material such as slides and handouts to students. The mp4 video files were uploaded to eCompanion, and links were provided to students for downloading them to their personal computers. The recorded videos (modules) could then be conveniently viewed offline. All the modules and PowerPoint presentations for the course were uploaded at least seven days prior to the scheduled lecture. Students were required to watch the assigned pre-recorded modules prior to each class and were also instructed to work selected homework problems from the pharmaceutical calculations textbook (Ansel,⁸ 13th ed.) prior to class. The homework problems varied from low-to-moderate difficulty level and were based on the material covered in the pre-recorded video modules. The instructor posted step-by-step solutions to the assigned homework problems as a pdf file on

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