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Research

The Keller personalized system of instruction in a pharmacy calculations course: A randomized trial

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Abstract

Objectives: To compare learning outcomes as measured by exam scores in a pharmacy calculations course between students who are randomly assigned to the Keller personalized system of instruction and a control group.

Methods: The Pharmacy Calculations course was designed with ten learning modules; equally divided before and after the midterm. Students were randomly assigned (1:1) at the beginning of the semester to the Keller method or a control group. Students continued in the group they were assigned until the midterm exam at which time they crossed over into the other learning method. Baseline, midterm, and final exam scores were compared between the groups.

Results: Baseline (38.7 ± 13.2% and 39.9 ± 13.8%), midterm (90.3 ± 8.1% and 91.8 ± 5.9%), and final exam (87.7 ± 10.4% and 90.5 ± 7.3%) scores were not significantly different between the groups. The mean preference on a ten-point scale for the Keller method and the control method was 8.7 and 4.2, respectively ($p < 0.001$).

Implications: Learning outcomes as measured by exam scores were similar between the groups in a calculations course. At the conclusion of the course, students significantly preferred the Keller method of learning compared to the control method.

Keywords: Personalized system of instruction; Pharmacy calculations; Keller method

Introduction

Background

The Keller personalized system of instruction (PSI) is a strategy that has been shown to reduce variation in student learning outcomes. The Keller PSI was first applied in a psychology course and has now been utilized in a variety of disciplines, including pharmacy, with similar success.[1–4] Pharmacy courses that have implemented the Keller method have included anatomy and pharmaceutical calculations.[3,4] The PSI was designed to overcome the limitations of the traditional didactic lecture and classroom assessment. The major components of the PSI included a self-paced learning process through a series of course modules, a demonstration of mastery on each assessment before proceeding to the next module, immediate feedback with coaching on each assessment, written materials for course content, and the use of lectures for demonstration and motivation.[1,5] The Keller method has documented a reduction in the variation of students' outcomes by requiring demonstration of mastery as a gateway for course progression, utilizing formative assessments that provide feedback on learning progress, and providing individual guidance to correct learning errors.[1]

Lockman and colleagues were the first to apply the Keller PSI in a pharmacy course. An anatomy cell biology course was divided into 23 modules with corresponding computerized examinations on WebCT.[3] Classroom observations, student feedback, and exam scores revealed that the Keller approach may be well suited for basic science

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pharmacy courses.[3] Fike and colleagues[4] also demonstrated that the application of the Keller method in a distributed educational model provided equitable learning outcomes regardless of whether the students were taking the course at the host location or a remote location. When applied to an anatomy and a pharmaceutical calculations course at one institution and a prescription practice course at another university, the Keller method has been shown to reduce the achievement gap between Hispanics and Caucasians and to promote positive learning gains, particularly, for minority students.[6,7]

To our knowledge, the present study is the first randomized trial to evaluate the effectiveness of the Keller PSI in a pharmacy course. The purpose is to compare learning outcomes as measured by summative exam scores (midterm and final exams) and preference for learning method in a Pharmacy Calculations course, using the Keller personalized system of instruction or a control group.

Methods

Setting

Pharmacy Calculations is a two-semester credit hour course in the first professional year of the Doctor of Pharmacy program at the University of New England (UNE). This course integrates basic concepts of mathematics and chemistry with the fields of pharmacy and medicine to accurately calculate the weights and measures required to prepare, dispense, and administer medications. The Pharmacy Calculations course at UNE is designed with ten learning modules (Fig.). Each module contains learning objectives: instructional materials, including lectures and practice problems that mirror the required textbook by Ansel,[8] and a module quiz with random selection of questions from a comprehensive test bank. Major course assessments include a midterm exam that covers material from the first five modules and a comprehensive final exam with emphasis on the latter five modules. The total course grade is comprised of quiz scores (60%), midterm exam (20%), and final exam (20%).

Study design

Students ($n = 96$) in a pharmaceutical calculations class performed a 30-item baseline assessment (three questions from each of ten modules) on the first day of class. Students were then randomly assigned (1:1) to two groups (Groups A and B) utilizing a crossover design for group assignment. Students in Group A engaged in a learning environment grounded in the Keller method during the first half of the semester; they crossed over to a traditional learning environment for the second half of the course. Students in Group B had a traditional format for the first half of the semester, and then they crossed over to a Keller method format for the second half of the course (Fig.). This approach to group assignment was implemented in an effort to allow all students to use the Keller method during half of the course.

Though this approach is characteristic of a traditional crossover design, this particular study could yield carryover and sequence effects. Thus, traditional crossover analysis methods were not used. Rather, the study may be viewed as consisting of two distinct phases with each phase analyzed separately. The first phase (first half of the semester) entails a comparison of two groups (Keller method vs. traditional instruction) on performance on the comprehensive midterm. The second phase (second half of the semester) entails a

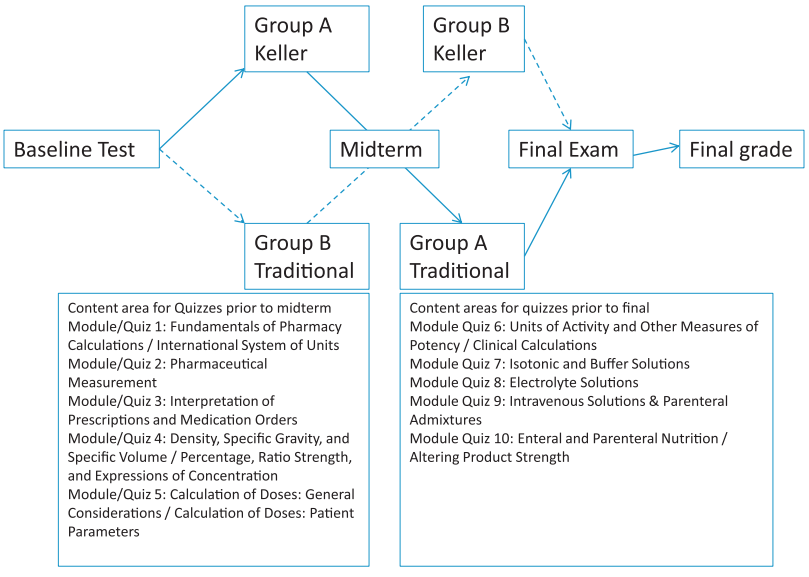

Fig. Design for student cross over and modules assessed in each summative exam