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Experiences in Teaching and Learning

## Assessing a traditional case-based application exercise and a student question creation exercise on student performance and perceptions

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## ABSTRACT

**Background and purpose:** To compare the impact of a traditional case-based application exercise with a student question creation exercise on a) student exam performance, b) student perceptions of enjoyment, competence, understanding, effort, interest in continuing participation, and interest in the subject.

**Educational activity and setting:** Subjects were 84 second-year pharmacy students in a pharmacotherapy course. The research focus was active learning involving the topic of chronic kidney disease-mineral bone disorder. Student teams were randomly assigned to either case-based or student question creation exercises using PeerWise. Student performance was assessed by a pre- and posttest and on block and final exams. After completion, an online survey assessed student perceptions of both exercises.

**Findings:** Statistically significant differences were revealed in favor of the student question creation group on enjoyment and interest in the subject matter. No statistically differences were found between the traditional case-based group and the student question creation group on gain score from pre-test to posttest. The student question creation group performed slightly better than the case-based application group on two of the five questions on the block exam but none of these differences reached statistical significance.

**Discussion and conclusions:** Students randomly assigned to groups that created and reviewed questions exhibited slightly improved summative exam performance and reported significantly more positive perceptions than students engaging in a more traditional case-based learning activity. Student question creation has demonstrated potential as a useful learning activity. Despite inherent difficulties in designing studies involving educational research in a controlled environment, students who have submitted, created, rated, and answered peers' questions have overall performed well.

### Background and purpose

The role of active learning strategies in developing students' higher order thinking skills is well-documented.<sup>1,2</sup> Pharmacy curricula commonly assess student learning through case-based learning (CBL). Case studies are useful learning tools to integrate and apply acquired knowledge.<sup>1</sup> However, CBL requires considerable time for case construction, classroom administration, and formative

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assessments.

The Accreditation Council for Pharmacy Education (ACPE) recommends that curricula emphasize active learning pedagogies to foster student learning and achievement of ability outcomes.<sup>3</sup> Student construction of multiple choice questions and peer learning are two active learning strategies that can impact student performance.<sup>4-8</sup>

Studies point to the significant utility of student question creation to learning.<sup>9-16</sup> First, students are transformed into active learners by constructing, sharing, explaining, and discussing questions.<sup>9-11</sup> Second, students participate in “deep learning” through generation and answering of questions.<sup>16</sup> Third, student question creation creates a collaborative community of learners through collective sharing, answering, and commenting on student-generated questions.<sup>10,17</sup> Lastly, a large repository of questions can be created without extensive guidance and instruction, minimizing faculty investment of time and improving engagement in large student bodies.

PeerWise (<https://peerwise.cs.auckland.ac.nz>; University of Auckland, Auckland, NZ) is a free online technology platform in which students create, answer, rate, and discuss their peers’ multiple-choice questions (MCQs). Students participate anonymously with other students but are identifiable by the instructor. Evidence shows that students’ use of PeerWise technology positively correlates with exam performance.<sup>9,10</sup> Denny et al.<sup>9</sup> also studied PeerWise in a computer programming course in the United States and found positive outcomes on class rank and performance. Another article by the same authors<sup>10</sup> noted that students who actively used PeerWise performed better on final examinations and written (non-MCQ) responses.

Despite widespread use in many disciplines, there is limited to no evidence comparing this innovative technology to traditional CBL learning in pharmacy education. This pilot study’s primary objective was to compare the impact of a traditional case-based application exercise and a technology-enhanced peer learning exercise, PeerWise, on student performance. The secondary objective was to evaluate pharmacy students’ perceptions of learning and satisfaction with both exercises.

## Educational activity and setting

Participants included 84 second-year pharmacy students enrolled in a seven-week Integrated Pharmacotherapy Renal course in the Fall 2015 semester at the University of North Texas Health Science Center College of Pharmacy. Students met for didactic lectures seven hours per week on two non-consecutive days for a total of 42 hours. The remaining seven course hours were dedicated to exam blocks. Students were assessed by two “block” exams and one final exam. The block exams were non-comprehensive (i.e., they covered material since the previous examination). The final examination contained a non-comprehensive portion and a comprehensive portion. All exam questions were multiple-choice format.

### *Selection of PeerWise*

Eight active learning methods, including PeerWise and CBL, were implemented in a different recitation course conducted in Fall 2014. Students provided feedback through a survey which showed that students favored PeerWise over the other active learning methods.<sup>18</sup> Therefore, the lead facilitator aimed to assess the impact of student question creation on student performance.

### *Study design*

The course dedicated six hours to chronic kidney disease (CKD). The first two didactic hours consisted of a lecture on pathophysiology and diagnosis of CKD, pharmacotherapy of CKD, and complications of CKD, including chronic kidney disease-mineral and bone disorder (CKD-MBD). Active learning exercises (CBL or PeerWise) focusing on CKD-MBD comprised the remaining four hours. The didactic and active learning activities took place on two separate days within the same week. The same faculty member served as both the lecturer and lead facilitator for the active learning portion. The lead facilitator designed and developed the content for the active learning exercises and provided instructions to students. Due to the large student body size, two additional faculty members helped facilitate the active learning session. Tasks of the facilitators included answering student questions and providing students with feedback.

Students had access to readings and learning objectives related to CKD-MBD one week prior to the active learning session. The pre-class reading assignment included textbook sections and instructor-prepared handouts. Rubrics and student instructions for both the PeerWise and case-based application exercise were provided one week prior to the session. No outside classroom activities were assigned to the students. The active learning session comprised ~1% of total course points.

### *Pre- and posttests*

At the beginning of class, students completed a six-minute, four-question individual pretest on CKD-MBD to assess baseline knowledge. Immediately after the interventions, students completed another six-minute, individual four-question posttest to assess short-term knowledge retention. The pre- and posttest had different questions derived from the learning objectives and contained three application-based questions and one comprehension-based question. Students completed the pre- and posttest via Canvas (Canvas, Inc.). The number of correct answers was recorded.

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