Improving student learning and retention in both on- and off-campus learning environments through quiz delivery

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What aspect of student learning and/or your teaching do you want to investigate?

What is already known?
In a study published in 2009 in the Journal of Biochemistry and Molecular Biology Education by Addison et. al., student response devices (clickers) were used in an introductory biochemistry course to deliver in-class subject matter questions to which students responded anonymously. The results of the student answers were then shown to the class and feedback was given. The investigators of this study used the clickers approximately 4 to 5 times per 50 minute class period. The results indicated that, while there were no significant differences in mean scores between sections of the class using clickers and sections of the class not using clickers, the number of students in the highest performance category (91-100%) increased significantly when the clickers were used when compared to sections of the class that did not use clickers. We would like expand upon this prior research by investigating whether weekly recall quizzes, given in class with clickers, or proctored for off campus students, combined with feedback improves learning and retention in a graduate-level biochemistry course. We propose to investigate this question by examining the following hypotheses.

Hypotheses.
1. In-class quizzes, given to BBMB 405 students, improve the performance on hour exams on those topics covered on in-class quizzes.
2. In-class quizzes, given to BBMB 405 students, improve student retention on those topics covered on in-class quizzes on the final comprehensive examination.
3. Proctored quizzes, given to BBMB 405XW students enrolled in the online section of the course, improves the performance on hour exams on those topics covered on in-class quizzes.
4. Proctored quizzes, given to BBMB 405XW students enrolled in the online section of the course, improve student retention on those topics covered on in-class quizzes on the final comprehensive examination.

Methods.
One section of the on campus course (BBMB 405; Spring 2015, expected enrolment 100 students), and 3 sections of the online version of this course (BBMB 405XW Fall 2014, Spring 2015, Summer 2015, expected enrollment 80 students total) will be presented material broken into 16 units that each focused on one biochemistry topic. Eight of the units will feature quizzes (worth 5 points each; 5% of total grade) and eight of the units will not. Exam questions on both the hour examinations and the comprehensive final exam will be identified as either a topic that was covered by a quiz or a topic that was not covered by a quiz. In class quizzes will be delivered using clickers, and quizzes given to extension students will be proctored. Quizzes will be given in a multiple choice format, with questions designed to emphasize recall rather than recognition. Additionally, students will be given a survey at the end of the semester, utilizing the Likert-scale for questionnaires, to identify the student's perceived worth of the quizzes and the student's perceived learning related to the quizzes (e.g., "Did quizzes change your study

habits?"). Statistical analysis will be done to analyze the effectiveness of proctored quizzes given to online students on learning and retention and the effectiveness of in-class quizzes delivered by clickers. Additional comparisons will be made between the performance of the students enrolled in the online version of this class and the students enrolled in the in-class campus-based section of this class to assess the differences between effectiveness of content being delivered entirely online and content being delivered in a standard lecture format (with and without supplemental quizzes). All statistical analysis will be done with a collaborator in the statistics department.

Assumptions
1. All topics are of equal difficulty, and all topics are taught equally effectively.
2. The student enrollment in the Spring 2015 on campus section of this class (approximately 100 students) will be normally distributed in terms of performance so that the results of this study will be applicable to future sections of this course.
3. The student enrollment of the pooled 3 sections of the online-based course will be normally distributed in terms of performance.

How will you benefit from this experience?
I will benefit from being able to scientifically investigate the benefit of in-class quizzes, using clickers, and proctored quizzes for the online course, on the learning and retention of biochemistry knowledge by students. I, and my collaborators, will benefit from this experience by scientifically investigating the effectiveness of a technology that is becoming more popular for encouraging active learning in the large classroom. Additionally, this experience will provide me with experience in SoTL experimental design and interpretation, which will help with future SoTL research in which I participate. Finally, the biochemical education community will benefit from this experiment by dissemination through a peer-reviewed journal publication to be submitted to the Journal of Biochemistry and Molecular Biology Education as well as dissemination through presentation at the CELT/CIRTL-sponsored TAR symposium and possibly at the annual meeting of the American Society of Biochemistry and Molecular Biology. Funds received from this grant will be used to cover expenses related to dissemination of this research (i.e., page charges and travel expenses).

How will your students benefit from this experience?
The students of this class (expected enrollment of approximately 100 students on campus and 80 students online) will benefit as a result of the expected improvement in performance and retention of the materials covered on the quizzes. Results of this study also will help to shape delivery and testing future sections of this course, thus benefitting future students.