Online Quiz Use in a Large-Lecture Genetics Course

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Introduction

There have been many pedagogical practices implemented and examined within the sciences as a result of a growing need to improve the quality of instruction within the Science, Technology, Engineering and Mathematics (STEM) fields.These practices include several active learning techniques, concept mapping and use of formative assessment. Many studies within the biological sciences have focused on the use of active learning approaches in large introductory biology courses. The research pertaining to effective methods used in large, upper-level undergraduate courses, such as Genetics, is more limited. These large upper-level courses serve as an important step in furthering students' knowledge within a given discipline.

Here we ask whether the use of online quizzes as a formative assessment correlates with student performance in a very large lecture-based undergraduate Genetics course.

Biology 305: Genetics at University of Michigan

Biology 305 Course Structure

Biology 305 (Genetics) is co-taught during the Fall and Winter semesters at UM. This study examines student data only from the first half of the Winter semesters when P.J.W. taught the course. This focus is intended to reduce instructor variation. Several learning strategies have been incorporated into Biology 305 as a way to help student learning. These include online quizzes, iClicker use, interactive lecture slides, consolidated pre-readings & homework problems. Student GPA, ACT and SAT scores were compared across semesters (Table 2) and GPA and SAT scores found to be similar (Table 2). Student ACT scores were found to differ significantly, but only slightly between semesters (Table 2).

Online Quiz Use

Online quizzes were used during the 2010 & 2012 semesters (Table 1). Students were required to complete an online quiz, consisting of ~8 multiple-choice questions prior to lecture. Half of the quiz questions covered material from previous lectures, and the other half covered material from pre-readings for that day's lecture. Student responses were monitored by the instructor and lectures could be modified based on how well students were understanding course material based on their quiz scores.

"Comparable Questions" Used for Student Performance

Exam questions were identified by the instructor (P.J.W.) as most comparable across semesters for a total of 14 different genetics topics. These questions were "average" level questions (i.e. A "C-level" student should be able to answer questions of this difficulty). Student scores from comparable questions correlate with average exam scores (R^2=0.597, y=0.0097x + 0.0963). The average exam scores for each student were calculated from the only two exam scores within this study's timeframe. Exam scores included performance on higher level, difficult questions, as well as "average" level questions.

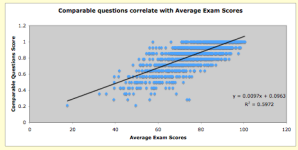


Table 1. Biology 305 Course Make-up

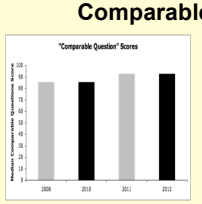
Semesters	2008	2010	2011	2012
Number of Students in Analyses	340	435	400	384
Percent Female	54.7%	54.3%	52.8%	49.2%
Percent Minority	7.4%	7.1%	6.0%	7.3%
Online Quizzes Used	No	Yes	No	Yes

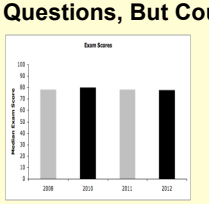
Table 2. Students are Comparable across Semesters

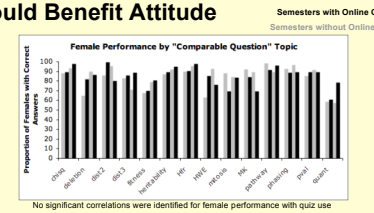
Semesters	2008	2010	2011	2012	N (Total=1559)	*P* value*
Mean GPA	3.29	3.36	3.33	3.35	1559	0.1694
Mean SAT Composite Score	1322	1321	1320	1342	708	0.3537
Mean ACT Composite Score	28.9	29.5	29.7	29.8	1315	0.0011*

* *p*-values calculated using ANOVA of a linear model of each test by semester using individual student data.*Significant *p*-value <0.01.

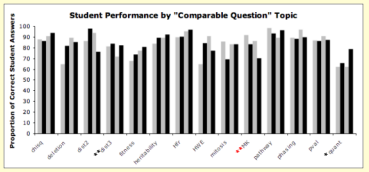
Results: Online Quiz Use Does Not Appear to Impact Student Performance on Comparable Questions, But Could Benefit Attitude

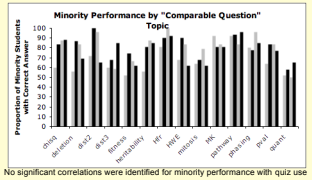






No significant correlations were identified for female performance with quiz use





No significant correlations were identified for minority performance with quiz use

Semesters with Online Quiz Use

Semesters without Online Quiz Use

For all graphs, black bars represent semesters when online quizzes were used, and gray bars represent semesters when online quizzes were not used. Significance was determined using a generalized linear mixed model, with whether the student answered the question (for a particular topic) correct or not as the dependent variable and independent variables including whether quizzes were used, sex, or ethnicity and accounting for "year" as a random independent variable. * indicates a *p* values≤0.05 with a positive association, ** indicates a *p* values≤0.01 with a positive association and ** indicates a *p* values≤0.01 with a negative association. No significant associations with quiz use was identified for both female and minority performance. For minority analyses, students were classified as minority if they were not "White" or "Asian". Minority categories included "Black," "Hispanic," "Native American," & "Hawaiian" as reported by students to the University Registrar.

Table 3: Qualitative Data from Student Feedback Suggests Students Value Use of Online Quizzes

% of Students Who Submitted Feedback in 2012	Overall "Feeling"	Representative Student Comments
39%	Positive	-"The quizzes required for every class was helpful because it kept me on a regular schedule for studying" -"While I hated the quizzes during the semester-I must admit they helped."
7%	Negative	-"I did not like the online quizes however. Yes, it made you study the material on a regular basis, but the questions were not helpful in planning for the exam and I really only completed them for the points. They were not challenging nor did they really help me learn the material. -"I really didn't like the online quizes just because I did the reading and the coursepack problems and still struggled to get more than 6 correct."

Conclusions

Surprisingly,we found no evidence of a positive association between student performance and the use of online quizzes in a large-lecture genetics course. Although we did not find any correlation using these comparable questions, the online quizzes may help students in other respects. For instance, these questions were an "average" level of difficulty range; the use of quizzes may be more correlated with higher level questions not assessed here. The quizzes also appear to help students "keep up" with the material as evident from student feedback (Table 3). This could be very important for students in a course that moves quickly with a substantial amount of content. The positive sentiments towards the quizzes are shared by the instructor, P.J.W., based on the higher quality of questions students asked during the semesters when quizzes were used. Factors not examined in this study that could affect the impact of quizzes include the content and format of quiz questions, other course components (e.g. that could replicate the effect of quiz use in years they were not used) or variation in instructor effectiveness from year to year.

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