AC 2009-1591: IMPROVING MOTIVATION AND KNOWLEDGE RETENTION WITH REPEATABLE LOW-STAKES QUIZZING

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Improving Motivation and Knowledge Retention with Repeatable Low-Stakes Quizzing

Abstract

Introductory level materials and methods courses in a Construction Management (CM) program generally require students to acquire an enormous new vocabulary. This vocabulary includes terminology pertaining to the materials themselves, as well as terminology defining the construction processes using the materials. Courses such as these form a backbone of knowledge that is necessary in nearly every other CM course, whether they are formal prerequisites or not.

A one-credit materials and methods lecture was modified, initially to provide more classroom lecture time. All testing during the semester was replaced with short online quizzes within a web-based course management system. Students were permitted to take each quiz multiple times until they achieved their desired grade. This testing method improved student excitement and motivation regarding the course material, as well as improving students' retention of information.

This paper presents preliminary results illustrating the effects of repeatable low-stakes quizzing on students motivation and their retention of information in an introductory level materials and methods course.

Introduction

The desire of every educator is to build excitement within their students about the topics they teach – to engage the students at a level where they talk about the material outside the classroom and investigate questions using materials beyond the text and lecture notes. We want them to *want* to learn about our topic, not just be there because they have to. We also have a desire for the students to retain the material they learn – preferably longer than 10 minutes after they turn in their final exam.

This paper presents preliminary results illustrating the effects of repeatable low-stakes quizzing on students motivation and their retention of information in an introductory level materials and methods course within a Construction Management (CM) program. Introductory level materials and methods courses generally require students to acquire an enormous new vocabulary. This vocabulary includes terminology pertaining to the materials themselves, as well as terminology defining the construction processes using the materials. Courses such as these form a backbone of knowledge that is necessary in nearly every other CM course, whether they are formal prerequisites or not.

A one-credit materials and methods lecture was modified, with the intent of providing more classroom lecture time. All testing during the semester was replaced with short online quizzes taken outside of class time in a web-based course management system. Students were permitted to take each quiz multiple times until they achieved their desired grade. The online quizzing was continued in the following semester, due to the improved student excitement and motivation

regarding the course material. It appeared that student retention of material had improved from previous semesters as well.

Literature Review

Low-stakes repeatable quizzing is a relatively new phenomenon, enabled primarily by online course management systems. Students can now take short quizzes outside of class and have them scored automatically and immediately, as well as retake them to improve their scores. While instructors could have provided students with this type of quizzing option in the past, it was impractical without computerized grading [1]. This form of quizzing is essentially allowing the students to practice taking the quiz until they are ready to count their score for real.

The idea of low-stakes repeatable quizzing has been documented in a few disciplines including statistics [1], general psychology [2], and child and adolescent psychology [3]. In the statistics study, the quizzing was found to reduce test anxiety, as well as improve motivation, by allowing the students to retake the quizzes and helping direct their studies [1]. In the general psychology study, the quizzing improved final exam scores by approximately 14%, though the authors acknowledge that there may be other aspects that have at least partially influenced the improvement [2]. In the child and adolescent psychology study, three sections were compared: in-class quizzes, online quizzes, and no quizzes [3]. Once the cheating aspects were addressed for the online quizzes, the exam scores for the group with online quizzes were found to be equivalent to the group with in-class quizzes. Student satisfaction was higher in the online quizzing group however.

Other disciplines have used portions of the concept. For example, in biology, regular weekly quizzes have been evaluated and did not seem to improve student performance on exams [4], although this is contrary to many other studies [5]. In engineering technology, computer based testing where students were given a range of several days to complete exams was evaluated [6]. Results indicated that students preferred having the freedom to determine the time and location for test taking, but collusion between students can be an issue. In a college algebra course, students were allowed to retake exams where they received less than a B [7]. Performance was greatly increased for 90% of the students who took the test again. Final exam scores were also improved for those retaking unit exams, though this result was not statistically significant. A larger study involving many disciplines was performed at Ball State University where students took many tests on the computer and this was compared with fewer paper based tests [5]. Students overall preferred taking more tests during the semester and preferred taking the tests on the computer instead of on paper.

Methodology

The aim of the work presented in this paper is to evaluate (1) how multiple online quiz attempts influence student motivation in a construction materials and methods course; and (2) how multiple online quiz attempts influence retention of material in the course. The researcher collected online quiz data from students enrolled in a one-credit materials and methods lecture course. The results of the data collection were analyzed to examine relationships between the

quiz data and student motivation, as well as knowledge retention. The following sections describe the data collection and analysis in more detail.

Data Collection

Each student was permitted to take each quiz multiple times in a 48-hour period until they achieved their desired grade. Only their last score was counted toward their course grade. Each quiz had 20 multiple choice and true/false type questions on it, which were randomly chosen from a larger pool of questions for each quiz attempt. Questions appeared in a random order each time the quiz was taken and the answers to multiple choice questions were also randomized on each attempt. The students received their quiz score immediately after submitting their exam, but no additional feedback was provided to assist them in determining which questions they missed.

Online quiz data was collected for two semesters (total n = 54). Data of interest included number of attempts, amount of time (minutes) per attempt and final score for each quiz. Final exam score data was also collected. Additionally, anecdotal information was collected related to student excitement and motivation.

Data Analysis

Student motivation was assessed by examining data regarding number of attempts and amount of time (minutes) per attempt. The data was aggregated for all students who took each quiz. Figures 1, 2, and 3 show the aggregate data collected, with high, mean, and low values shown for each quiz. Figure 1 shows the total time spent taking the quiz in minutes. Figure 2 shows the total number of attempts per quiz. Figure 3 shows the final score on each quiz. Each quiz covered a different topic, so it is difficult to directly compare one quiz with another. Pre-course comprehension levels may present some validity issues as well, but the student population is relatively homogeneous, so this aspect was considered negligible.

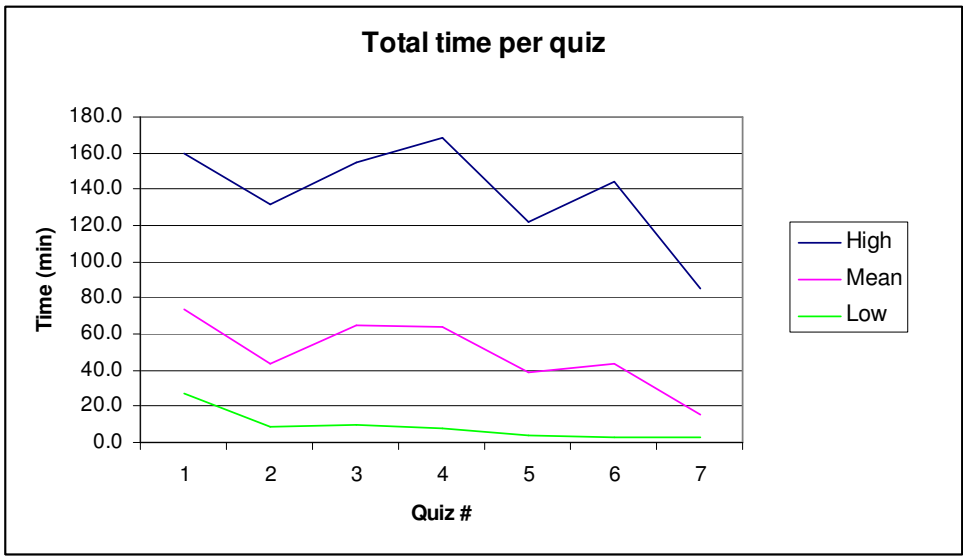

Figure 1

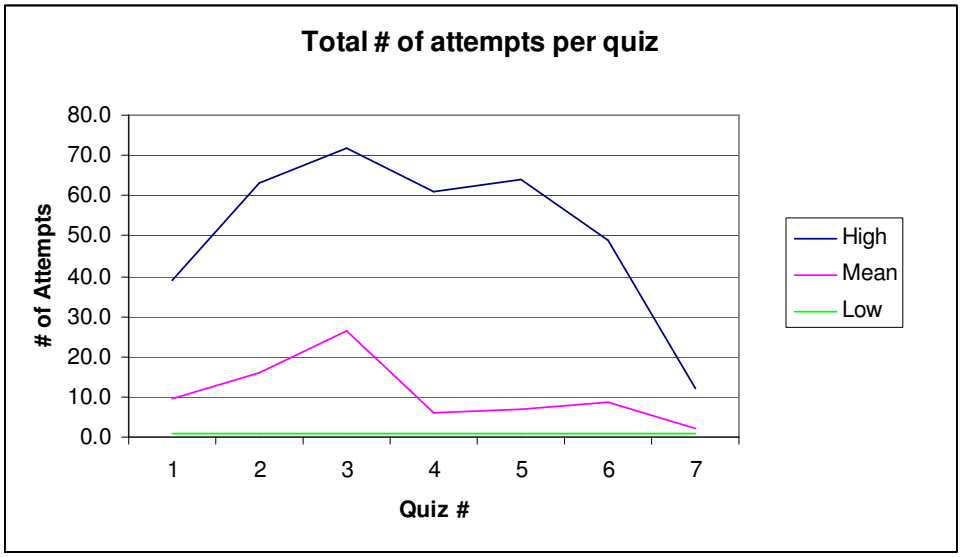

Figure 2

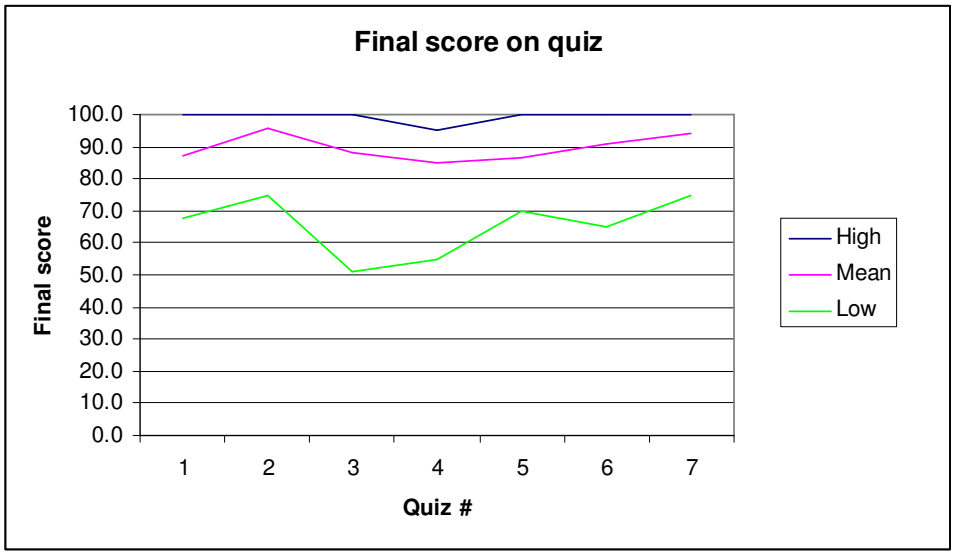

Figure 3

Knowledge retention was assessed by examining the students' final exams which were given in a traditional paper-based exam format. A majority of the questions on the final exams (68% in one semester and 87% in the other) were identical to questions used in the online quizzes. Each student's final exam was graded with two scores – one for the percentage of questions they answered correctly that had been on a previous quiz and one for the percentage of questions they answered correctly that had not previously seen on a quiz.

Findings

How do multiple online quiz attempts influence student motivation in the course? Preliminary data analysis suggests that most students desire a grade of A or B on each quiz and are willing to put in whatever amount of time is needed to achieve this. Because of the immediate feedback received in the form of their quiz score, they are able to self-assess where they stand on their ability to answer questions regarding the course material. Many students first attempt at each quiz was done with no or very little prior studying. This is evidenced by generally low scores on first attempts. Based on their first attempt score, they form a personal strategy for achieving their desired score. This appears to be partly based on trial and error – just retaking the quiz over and over, and partly based on studying course material between trials. These strategies are revealed in the amount of time each trial takes, as well as the amount of time between trials. Over the course of the semester, the students appear to refine their individual strategies, as the amount of time per trial and number of trials decreased, while final scores remained fairly consistent.

With the exception of the last quiz, students were spending on average more than an hour of quiz taking time, and likely more than that studying before or between quiz trials. Compared with the expectation that most students would study very little for a 15 minute in-class quiz, this is a great improvement in the amount of time they spend on course material outside of class.

Anecdotally, students were engaged and excited about the material. They would talk amongst themselves before class about questions on the latest quiz and ask questions during class that showed a genuine interest in the material. Many of them mentioned that if they were having trouble with a particular topic or question on a quiz, they would go to outside references to clear up their misunderstandings – something that is rare at the freshman level.

More significantly, the students actually seemed excited about the quizzes, a definite switch from a traditional paper based quiz. This is likely due to the fact that they had the opportunity to achieve whatever score they wished, if they were willing to put in the time required to do so.

How do multiple online quiz attempts influence retention of material in the course? Preliminary data analysis suggests that the repeatable quizzing improves knowledge retention. 38 of the 54 students (70%) got better scores on their final exams on the questions they had been quizzed on previously than they did on questions they had not seen before.

Obviously, there is much room for debate regarding the significance of this finding. One could argue that any studying done in preparation for the final exam would influence the exam scores. The fact that the questions were the same as on quizzes is another potential issue. However, the students were not given access to quiz questions once each quiz was completed, so they were unlikely to be able to study those questions specifically. Additionally, because the questions came from a larger pool of questions, they may or may not have even seen all of the potential questions. The material on the final exams that had not been quizzed was presented in the classes closest to the final exam, and should be the freshest information for the student. Yet, 70% of them scored lower on the questions covering the most recent material.

Conclusion

While the results presented here are preliminary, they do provide encouraging results regarding both student motivation and knowledge retention. The results indicate that the current work is consistent with other studies and warrants continuing in more depth. Future work needs to be done with more rigor to control for issues that were not addressed in this preliminary work, however. It would also be beneficial to collect some additional data, such as how much time does the student spend studying for each quiz? Overall though, it does appear that repeatable low-stakes quizzing can improve student motivation as well as improve knowledge retention.

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