

The Use of Mastery Quizzes to Enhance Student Preparation

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Class preparedness is a frequent academic goal of instructors. Students who have read the material before class save class time that is better devoted to more substantive discussion, allowing the instructor and students to discover where weaknesses in understanding may be occurring. It allows a fuller discussion of the material, its application and its relevance to the student, now and in the future. In this study we tested ideas about mastery learning to see if we could improve student learning. Students took a weekly online quiz using a test bank that could be taken as many times as desired in an effort to reach the maximum points as long as it was finished before the class started. This paper describes the quiz process, results, and student comments. An analysis of the number of student quiz attempts and quiz latencies suggests that most students only make one or two attempts, but some will make many attempts, in some cases as many as 22 times. The results showed that students were motivated to take the quizzes, and thought that the process improved their learning.

INTRODUCTION

Mastery learning has been shown to be significantly more effective than traditional instruction and more efficient than one-on-one tutoring, Bloom (1984). In the contemporary classroom, class time is used for discussions of concepts, implications and applications of those concepts, Bishop and Verleger (2013). Productive discussions depend on students' active participation. However, active participation is not enough. Productive discussions where learning takes place, depends on the students' understanding of the basic concepts before they come to class.

Our experience has shown that students often come to class with the expectation that they will get everything they need during the class without reading the material. Some will just 'skim' over the PowerPoint slides before class, if there are any. If the course is not directly related to their major they will ask why they have to know this. "How will I use this?" Students are not eager to invest time in studying as it is not viewed as important to their careers, Strasser (2003). When questioned, students will often admit that they have not bought the text, nor acquired an electronic copy of it. It is not uncommon to have students email and ask if they need the text for the course sometimes when the course is in its third or fourth week.

So instructors in discussion-based courses are in a quandary of how to ‘encourage’ students to read the materials beforehand. Some options that have been used are having an online discussion forum that requires posts before class, handing in, online or hardcopy, a short document that asks questions based on the material. Other instructors have used “mastery quizzes” in class or online. In another experiment, Olsen (2016) states he uses mastery quizzes “to learn material in a timely manner”, as a “confidence builder”, so that “the teacher knows that everyone can do it”. Also, according to Kibble (2007), the intent is to foster learning under conditions that are nonthreatening

Strasser (2003) stated that her objective was not a massive project, which obviously would require grading, but to offer a way to have informal study which could be used as a self-test. Connor-Greene (2000) wanted to ensure that students “had thoroughly read” the material prior to class. Lee, Nagel et al. (2012) suggested that mastery tests are designed to give students immediate feedback on their learning progress. Owens and White (2013) have used mastery quizzes to help reduce plagiarism. We became interested in using mastery quizzes because students were not authentically engaged in the online discussion forums and submission of online “implication” documents. These activities were initially useful, but had degraded to the point where students were just complying with the assignment requirements in the most minimal way. It seemed to us that little learning was taking place. To increase the depth of engagement, instructors tried making the “implications” assignment more detailed, but that required more time and effort on the instructors’ part and students still showed little improvement in learning. This then led us to consider mastery quizzes as an alternative that could be delivered and graded in an automated online fashion.

Several studies stated that students found the quizzes useful for learning though there is some question as to whether they helped in later summative exams Maki and Maki (2001); Peat, Franklin et al. (2005). The intention here was not to prepare students for a summative test, but to enhance their ability to be informed participants in class discussions.

For the online quiz to be effective for the student feedback should be available soon after quiz completion. To accomplish that suggests multiple choice (MC) questions rather than constructed response (CR) questions be used. MC questions have several advantages; they are quickly, consistently and accurately graded, many course management systems can do the grading and MC questions can cover a wide variety of topics in a short time period. Kuechler and Simkin (2010) state the major disadvantage vs. CR questions is the perception that they do not test a deeper understanding of the topic. The disadvantage of CR questions is the time needed to grade them and so the delay in providing feedback to the student. Since the intent is to provide incentive to the student to re-read or research those questions that were wrong, immediate feedback is key.

METHOD

The course was a discussion course that focused on ethics, and the impact of technology on society. The course is required of all majors in Computing Sciences and serves to meet accreditation requirements. Six face-to-face sections were involved with approximately 180 students. The University uses Moodle as its learning management system (LMS) and in each course section an online quiz was set up for most weeks of the course corresponding to when a chapter from the text was being discussed.

The format of the quiz process is similar to that used by Dobson (2008). The quiz would open approximately 7 days before the week the chapter was to be discussed and would stay open until the start of the class during that week. The day sections met twice a week while the evening sections only met once. For the day sections the quiz would close at the start of class on the first day the class met that week. Since evening sections only met once a week their quizzes closed at the start of class.

The quiz consisted of 5 randomly selected multiple choice or true/false question from a pool of chapter related questions obtained from a publisher supplied test bank. The students could take the quiz as many times as they desired until the quiz closed. At the end of each attempt the student was shown the grade for the attempt so they could determine whether they wanted to try again or not. There was no delay between attempts and the students were only shown that a question was incorrect, not what the correct

answer was. Each attempt had a time limit of 15 minutes so students could look up answers in the text or use some other method such as searching the web. The intent of course was to encourage the student to “look-up” the question and discover the correct answer thus allowing them to test their knowledge and providing an opportunity to learn more while still being able to take the quiz again.

At the end of the term there was a short extra credit survey that students could answer anonymously that asked:

- The quizzes were offered an unlimited number of times; did you take advantage of that to do the weekly quizzes more than once? Y/N
- As an average over the term, how many times did you take the quizzes each week? A dropdown box with choices 1 thru 9 and 10+
- Do you think being able to take the quizzes multiple times helped you to understand the material so you could participate in class? Y/N
- Should we continue using weekly quizzes next term? Y/N
- What is your age? Dropdown box with a series of ranges
- Are you a full time student? Y/N
- And then a place where students could make any comment they may wish to.

DEMOGRAPHICS

The undergraduate student population tends to be similar to the diverse demographic makeup of New Jersey with the exception of age and gender. There are a few older students, usually part time or those who were in the military and there are few female students. It is not uncommon to have only one or two females in the class and so gender was not asked or considered. We were also not interested in any differences due to race so that was not asked either.

Though we do have the student’s final grade, it should be mentioned that the weekly quizzes only made up 10% of their grade and there were other assignments that weighed more heavily on the final grade. Again the intent of the weekly quizzes was to encourage students to read the material and understand it well enough to be able to participate fully in the class discussions.

ANALYSIS OF THE QUIZ DATA

Our LMS, Moodle, allows the downloading of the quiz attempt information in a CSV format including the following information; user name, quiz title, attempt timestamp and the attempt grade. The fields are text fields but can be loaded into an Excel worksheet for examination and editing. The attempt timestamp, being text, is not a true date field and includes the day of the week, a spelled out month based date and the time in 12-hour clock format. Downloading was done for each individual quiz within each section, which was then loaded into Excel. Once the data was loaded into Excel some editing needed to be performed to allow sorting of the dates into proper order. This editing involved removing the weekday from the data leaving the date and time. Additional editing involved adding columns for: section identifier, year-term identifier, number of attempts and the final grade. Since the downloaded data was the attempt information for a section, the section identifier and the year-term were added. The number of attempts was obtained by sorting the data by quiz title, then user name, and then attempt timestamp. The number of attempts by a student for that quiz was counted and that number then entered in the last row of the student’s attempts. Final grades were obtained from the grading lists of the instructors and entered by sorting the data by user name and copying and pasting it into the corresponding student record. The section and the year-term identifiers were added to allow future comparison/analysis of the data over time.

After the initial editing was completed, the data was re-sorted by section, quiz title, user name, and attempt timestamp to allow perusing for any obvious patterns or anomalies. One of the things that showed

up quickly is that some students had a large number of attempts, 6, 8 and higher with a few as many as 22 times. Given these numbers, we looked at some of the students' scores for the attempts and the corresponding timestamps. One of the first things that stood out was that the attempts in these cases were usually done in a short period of time. For example one student made 6 attempts in approximately 10 minutes, with the attempts separated by only a minute or 2. Another student made 22 attempts in approximately 34 minutes, while still another made 9 attempts in 15 minutes.

This was not the norm as most of the students made only one or two (2), possible three (3) attempts and they were separated by several minutes. For example, there are 180 registered students for the six (6) sections, ten (10) quizzes, and a total of 1410 attempts at the quizzes. Of that 1410, 755 students made one attempt (53.5%) and 298 students made two attempts (21.1%).

There were instances where a student took 20 minutes to make four attempts and another student made three attempts in five minutes, and then waited approximately 27 hours to make the fourth attempt. Still others made several attempts quickly then waited about 10-15 minutes before the next attempt. At least one student stated that he kept taking the quizzes so he would see all the questions even though he had gotten the full score on the first attempt and most of the following ones. In general, students who made four or more attempts tended to retake the next quiz as soon as they finished the previous one and were shown the grade. The attempt count reflects the number of quiz attempts. Each quiz consisted of a series of randomly selected questions.

Among the 180 registered students across six sections, a total of 1410 attempts broke down as follows:

**TABLE 1
NUMBER OF ATTEMPTS BY STUDENTS**

Attempts	Number of times students made an attempt	Attempts	Number
1	755	12	1
2	298	13	3
3	145	14	4
4	64	15	1
5	51	16	2
6	27	17	0
7	17	18	1
8	12	19	1
9	8	20	1
10	11	21	2
11	5	22	1
Grand Total		1410	

As shown in Table 1, the maximum number of attempts was 22, but in the overwhelming majority of cases, the students made three attempts or fewer. Of the 1410 attempts, one, two or three attempts accounted for 84.9% of the cases.

DISCUSSION OF THE SURVEY DATA

The survey was used primarily to obtain comments from the students. The survey was optional, but students received extra credit for completing it, so a majority of the students (126 of 180 registered students completed it. The survey questions are below. A majority of students (91%) thought taking the quizzes multiple times helped them understand the material so they could participate in class and 95% thought the weekly quizzes should be continued as part of the course. This would seem to indicate overwhelming success of the program, but there are some limitations to this method of measurement. The validity of self-reported data has been widely questioned and discussed (Pike, 2011). In this case, students may have provided self-evaluations of their own improvement in learning of which, they believe, the instructor would approve. In the future, a multiple measures of student success that include direct assessment of student work product would greatly enhance the validity of this measure. The survey questions asked were:

Q1. The quizzes were offered an unlimited number of times; did you take advantage of that to do the weekly quizzes more than once? Y/N

126 responses – 5 no's, 121 Yes'

Q2. As an average over the term, how many times did you take the quizzes each week? A dropdown box with choices 1 thru 9 and 10+

26 – 1's

62 – 2's

18 – 3's

4 – 4's

6 – 5's

4 – 8's

1 – 9's

4 – 10+'s

Q3. Do you think being able to take the quizzes multiple times helped you to understand the material so you could participate in class? Y/N

7 – No's

4 – no response

115 – yes'

Q4. Should we continue using weekly quizzes next term? Y/N

6 – No's

120 – Yes'

Q5. What is your age? Dropdown box with a series of ranges

113 – age 15-25

11 – age 26-35

1 – age 46-55

1 – age 66+

Q6. Are you a full time student? Y/N

1 - no response

4 – No's (i.e. part time)

121 – Yes' (i.e. full time)

Q7. A place where students could make any comment they may wish to.

Six students who thought the quizzes should not be continued (Q4) commented:

“Instead of a weekly quiz it should be a single short answer response to a question. That would require reading the material as it stands now the quiz can be answered without reading the material”

“Make up your own questions instead of using preexisting ones. Also, i don't entirely understand why a book is required for this course, i learned a lot just from class conversations, written reports, and the professor's slides. The online quizzes did not seem to fit in this class. This class would benefit from staying away from it.”

“I forgot to do them a lot due to the confusing moodle sidebar”

“They should not be weekly, maybe every two weeks.”

The first two responses are interesting in that they question the need for the text, while students who answered yes tended to think the quizzes were helpful with many of the respondents saying it required them to read the text and helped in their understanding.

CONCLUSION

Overall, the responses suggest that many students used the quizzes as a vehicle to test their knowledge of the upcoming material. It also suggests that they did read the material because the majority only took one or two attempts per quiz. Another possible explanation is that some students decided just to guess at the answers. It is not known what, if any, preparation those students made. It is possible that they just viewed the PowerPoint slides for the chapters, or even that they just guessed. It is also possible that simple exposure to the subject matter by reading the questions and reviewing the correct answers was a form of preparation for class.

This then suggests that the quizzes, with credit, acted as a motivator for the majority of students, which was the intention of the instructors. But there were still who made many attempts and, based on the attempt timestamps, likely made little or no effort to go back to the source material. Perhaps there was no “economic” cost to the student for that behavior, as they had no penalty for just taking the quiz repeatedly until they got a “good” grade. Repeated attempts would not affect their grade, nor even take much time.

Thus the quiz credit acted as a motivator to take the quizzes, but apparently was not enough to induce a subset of students to actually review the material. As a note, no student came to any instructor’s office hours to say that they did not understand the material and needed help with it. Two of the instructors said that they found good student participation but two others noticed no difference.

This paper discussed the use of master quizzes to prepare students for in class discussions. While much of the literature uses mastery quizzes as preparation for summative exams, Conner-Greene (2000) mentions that discussions were improved. Our results are mixed at this point and this process will be observed closely in future terms.

FUTURE

The preliminary results were discussed with the instructors to determine possible changes to decrease the student taking the tests over and over without studying in between. Therefore, in an attempt to increase the number of students who engaged with the material in order to complete the quizzes, a change in timing will be implemented. The same type of quizzes will be given again in the fall and spring terms, but with a delay of 30 minutes between attempts for the fall term. In the spring term there will be no delay as in the original study, but the number of attempts will be limited to three.

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