AC 2011-2793: JUST-IN-TIME DAILY QUIZZES AS LEARNING TOOL FOR SELF ASSESSMENT AND CONTENT MASTERY

William J. Sawaya, Texas A&M University

William J. Sawaya is an Assistant Professor in the department of Engineering Technology and Industrial Distribution in the Dwight Look College of Engineering at Texas A&M University. He teaches courses in quality management and process improvement. He has done work and research on the topics of inter-organizational collaboration, inventory management, new product development, product introduction, healthcare products, transportation systems analysis-focusing on railroads and multi-mode container operations, product testing, customer satisfaction, quality management, facility location, and sustainability. Prior to joining the faculty at Texas A&M he was a Post Doctoral Associate at Cornell University in the Transportation Systems and Management group of the School of Civil and Environmental Engineering. His Ph.D. is from the Carlson School of Management at the University of Minnesota with an emphasis in Operations and Management Science. He has a M.S. in Industrial and Systems Engineering from the Georgia Institute of Technology and a B.S. in Manufacturing Engineering from Brigham Young University.

Just-in-time Daily Quizzes as a Learning Tool for Self Assessment and Content Mastery

Abstract

In order to facilitate student learning, daily quizzes with a novel grading scheme have been developed to aid students in doing self-assessment on their learning progress and comprehension. The quizzes and the related grading structure and usage were constructed to provide quick and specific feedback on comprehension and mastery of technical material under the supposition that students will be better able to learn if they are provided with quick and specific feedback of what they do and do not know after they have immediately struggled to solve problems. The unusual grading approach has been adapted in order to increase the likelihood of the intrinsic benefits to the student of the self assessment tool rather than focusing on the graded aspect of the quizzes. These quizzes have been used in a number of technical courses over years of teaching. Although students have been skeptical at first due to the relatively large number of quizzes, there has been overwhelming support for the methods by the end of each course implementation.

At the conclusion of each lecture a short quiz for the next class periods lecture is constructed by the instructor such that it emphasizes key points from the concluded lecture, provides example problems, and in some cases- may introduce material for the next lecture. Students are given these quizzes at the beginning the next class period, and work on them for the first few minutes of class. The quizzes are then graded as a class as the instructor asks students how they approached each problem and provides solution if none of the students were able to answer them correctly. The innovation is in the fact that each quiz is prepared just-in-time based on the current level of coverage of the course topic, and the fact that the grading scheme is unique and intended to provide the students with specific and detailed feedback on their performance to aid in the learning process without creating anxiety about the grade. This helps the students to view the quizzes as aids in the learning process, and transforms the quiz from an end in itself into a tool to facilitate learning and engage students in taking greater responsibility for their own learning. Student and faculty feedback has judged the quizzes to provide a valuable contribution in the learning process.

Introduction

Engaging students as active partners in the learning process can be challenging. But it is also widely believed that interactive learning has significant benefits. [1,2,3] This research presents a novel approach to both constructing and evaluating daily class quizzes that facilitate positive student learning related outcomes. This system has been designed to aid in the repetition and emphasis of key concepts [3], to facilitate comprehension[2, 4] and knowledge construction[1], and to provide a mechanism for student self evaluation [2, 4] of the state of their knowledge and show them where they have room for improvement. It is also been developed in a manner to decouple the learning from the grading, as grading has been shown to actually deter student learning in some settings.[5] The intent is that solutions such as those presented here that strike a balance between encouraging learning and also providing a form of evaluation that may be helpful.

The quiz and grading system has been applied to courses in statistics, operations management,

and quality improvement. They have also been adapted for use by an additional faculty member who obtained a draft of this paper. The technique should be easily adapted to virtually any academic discipline or course, but should be particularly beneficial to courses with a significant technical content where the repeated integration of concept and the practice of working problems is key to student's ability to master the material. Individual adaptation to students and course requirements will increase the quizzes' effectiveness.

Quiz Design

Quizzes are delivered on a daily basis with several key objectives and benefits. First, they are constructed to review material that has been recently covered in order to solidify the concepts in the minds of the students. It also allows the students immediate feedback, via the grading mechanism, on how well they comprehend the material. Second, it can facilitate the introduction of new material by adding incrementally to topics that have already been covered in the course. Third, it allows for the identification and emphasis of key concepts or principles from the course material. Fourth, the quizzes are a forum for practice working quantitative problems, with aid from other students or the instructor if needed.

The format of the quizzes and the unique grading mechanism allow for a number of quiz features that might not be possible with traditionally constructed and graded quizzes. First, because the forum is open and the questions do not necessarily need to have a 'correct' solution it is possible to construct thought provoking questions that can stimulate a class discussion with a high degree of student involvement and interaction. Since there is no correct answer, or because there are varying degrees of 'correctness' the questions can be used to approach complicated scenarios and concepts that are difficult to evaluate on an exam. This is particularly useful for concepts that test a students' comprehension of various topics and require explicit integration or the demonstration of knowledge construction [2, 4].

Second, it is possible to ask extremely challenging questions on these quizzes, questions which are much harder than questions that might typically be given on a quiz or exam. Because there is no grade at stake, students are free to innovate or take risks with their answers. The instructor can also provide hints or help while the students are taking the quiz because so much of the grade pressure is mitigated. This technique is particularly useful for quantitative problems that might push students beyond what they have previously seen or which might require the integration of multiple concepts that have not been previously used together.

The quiz for each class period is constructed 'just-in-time' sometime between the end of the previous class period and the beginning of the subsequent period. This allows the instructor in integrated their latest knowledge of the material that has been covered and the students comprehension of the material in the subject matter for the quiz. Often the materials are generated new on the spot, but they may also be drawn from other sources. After a course as been taught a few times, it becomes relatively easy to draw the material that was used in previous classes for constructing the quiz. But the questions that were developed and used previously are specifically chosen based on the current classes' needs. The first time this technique is used it takes additional time to generate the quiz questions, but once a course has been taught a few times it takes relatively little time to produce the quiz material and the problem is reduced to

selecting the problems that will provide the greatest potential benefit to the students. Because the quizzes are evaluated or 'graded' holistically, it is not necessary that quizzes have a set number of questions or points. Nor is it all necessary that each quiz be of equal difficulty or length since their intent is as a tool or aid in the learning process and the grading scheme is flexible enough to accommodate various lengths and difficulty levels. Example quizzes for a class on quality management are provided as an Appendix.

The quizzes are typically given at the beginning of class. Because the grading scheme is so forgiving, it doesn't matter if some students have more time to work on the quiz than others and the quizzes can be started early by students arriving early to class if they wish. The time allocated to the quiz is determined by the length of the quiz and by difficulty of the students in answering the questions. Typically, 4-12 minutes is spent taking the quiz and an additional 4-12 minutes is spent grading them in 75 minute classes. While the quizzes may consume a significant amount of class time, students uniformly believe that the benefits of the quizzes justify the time investment.

Quiz Grading

As mentioned previously, when students are rewarded for their efforts through grades or other mechanisms it can inhibit their intrinsic motivation to learn.[5] However, the societal pressures on instructors to evaluate the students performance are also very high. Therefore, the quiz grading system is motivated to attempt to capture the best of both worlds. Thereby allowing greater room for intrinsic motivation to learn and providing the detailed feedback to the students, while also providing some minimal grading evaluation.

It is important to note that the grading system of the quizzes is in itself crucial for this innovation in that it allows the construction of the quizzes outlined in the previous section. If the quizzes are not graded or evaluated at all, then they lose the face validity with the students and have no value as a feedback mechanism. If they are graded rigidly, then the quiz becomes an end in itself, rather than a learning tool. It also limits the ability to ask open-ended questions, questions that require a high degree of knowledge construction or integration, and challenging question that will push the limits of the more advanced students. These quizzes are designed to be essentially self-graded, with the emphasis being on the learning process rather than the grading process.

After sufficient time has been allocated to the students to finish the quiz in class, they can be graded immediately. One benefit of the flexible nature of the grading system is that it is not necessary that all the students have completed the quiz. So when the majority have finished, then grading can begin.

For each question, the instructor reads the question and then asks the class how they answered it; or approached their answer. Discussion can continue until someone approaches it properly. This is the forum where challenging questions can also be discussed and where connections between interrelated concepts can be drawn if the students have not done so in their answers. It is not necessary to assign point values to the questions, in fact it is not necessary that as the instructor even know exactly how each student did on each question. The important point is that they will

know how they did on each question. They will know which concepts they understood, and what knowledge they have internalized. They will also have valuable feedback on where they may need additional study or practice.

The actual quiz grade itself is approached holistically, and is graded more on what they have done and what they knew rather than what they did not know. Since attendance is tracked at the institution where the quizzes have recently be adopted, some credit is given for simply being in class to get a quiz at all. The precise grading scheme does not need to follow the format presented here. The key feature is that the grading be very generous, this removes the pressure for a grade or the emphasis on achieving points or a score. The structure generally used is that a blank quiz, for someone who attended class is scored a 7/10. A quiz on which a student has attempted to answer at least one question is scored with 8/10. The students are instructed to give themselves a 9/10 if they answered most of the questions or even all of the questions, even if they missed them all completely. A 10/10 quiz is defined as one where nearly every problem has been attempted and at least some of them are right. Thus, there is a very low threshold for a 10/10. Indeed, a student who never misses class, generally absorbs enough material just by attending to make steady 10/10. From what has been outlined in this paper, the benefits of such a grading scheme should be readily apparent. But it does provide some reward for knowing the material, but the majority of the reward is gained in simply attempting the quiz. For students, if they are going to attempt it anyway, it does not require that much additional motivation for them to attempt to do it well. Many students produce excellent answers, in some cases, perhaps better than they would have had they been given a traditional exam or test.

There are many variants of this mechanism or scheme that could be adopted. Some that have been used successfully include the inclusion of an 'extra credit' question on the quiz. In these cases there is an extra question, which, if answered correctly, grants one additional quiz point making a score of 11/10 possible. This inclusion adds in a bit of additional incentive for students to perform well on the quizzes and learn the material. Many semesters it is not uncommon to have students with quiz averages around 101-105 % if they attend regularly and stay on top of the material. Another adaptation is in dropping low scores. One course using this method is composed of seniors who are looking for jobs and occasionally miss class for job interviews. Rather than spend the time address each case individually, when quiz program is introduced the first day of class; the students are informed that a fixed, but reasonable number of the lowest quiz scores will be dropped from the students' grades. This saves the instructor considerable work, and also allows students the power to choose to miss a few classes without the daily quiz negatively impacting their grade. At the same time, it keeps attendance high and many students are sure to not miss class unless they absolutely have to, because they do not want to miss the few points and the knowledge they may gain from the quizzes.

Regarding the overall influence of the quizzes on the grades, they have been used to contribute as little as 5% of the grade to as much as 20%. Because it is likely that many students will have extremely high scores, it does not make sense to make it too significant a proportion of the grade as that might make harder exams and other work necessary if a broad grade distribution is desired. But this can easily be adapted to each instructors' chosen teaching style and grading scheme.

Student Feedback

Student and faculty feedback on the quizzes has been high. Some students are concerned about the time involved initially, and others may initially be worried about the complexity of the grading scheme. But over the course of the semester, students appreciate the knowledge they gain from the quizzes and they see them as an excellent use of class time. Anecdotally, even students who have missed a significant amount of class, and therefore also lost points because they missed quizzes; have also said that they see the benefits of the quizzes and find that they are worth the time they take in class.

Conclusions

Just-in-time daily quizzes with a liberal grading scheme comprise an excellent learning tool for allowing students to do self-assessment of the comprehension of both technical and conceptual topics. They minimize the negative effects of grading, while provided more specific and detailed feedback to students regarding their current knowledge than an instructor could provide for them. Further, this feedback is provided on a frequent basis which allows sufficient time for students to use the information that they get to make changes to their study patterns and habits and obtain additional help if they need it. Student feedback is overwhelming positive for the current version of the quizzes which are in use as they have been outlined in this paper. Additional future research will evaluate the students' perceptions of the quizzes more fully and may attempt to measure the benefits of the quizzes to the students and their learning and comprehension.

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Appendix

Quiz Sample I.

Quiz #3, Tuesday, September 7, 2010   Score _____
Name_____

1. Why might different definitions of quality be problematic for an organization that is seeking to improve?

2. Among the various definitions of quality discussed thus far, what common threads are there among the various definitions?

3. Explain the tradeoff between the cost of quality failures and the cost of improving quality as described in class? What is the insight?

4. Garvin's Eight Product Quality Dimensions were presented in class last time. List four of the eight dimensions. [Worth 1 extra credit pt, worth 2 pts if you list all 8]

Quiz Sample II.

Quiz #18, Tuesday, November 2, 2010   Score _____
Name_____

1. At lunchtime an average of 3 people come into Taco Bell each minute, what is the probability that 6 people come in during 1 minute? What about less than 2?

2. A process has a steady defect rate of 3% of products produced, what is the probability that a sample of size 25 has two nonconforming products?

3. If there are 27 students in a class and there are group projects to be done in groups of three people, how many different combinations of students could be made?

4. If there are 27 students in a class and there are group projects to be done in groups of three people, how many different combinations of students could be made if one member of the team is the team manager and another is designated as the quality control

5. An inspector counts the total number of minor paints defects on five cars as they come off the assembly line. What kinds of control chart should be constructed? 10 groups of five cars have the following counts 4, 3, 6, 1, 5, 0, 3, 8, 5, 3; what are the control limits? Is the process in control?

6. The same factory in question tracks the number of defective products in lots of size 100, they look at a lot of 100 several times a week. What kind of control chart should be constructed? The last 10 days have found defective counts of 3, 4, 0, 1, 0, 3, 5, 2, 4, 2; what are the control limits for the process? Is the process in control?

   Bonus (1 pt)
7. In Powerball, to win the grand prize, you have to correctly pick the numbers of 5 out of 5 numbered white balls drawn from a pool of 55, and 1 out of 42 numbered red balls. What is the probability of winning the grand prize if you buy one ticket?