DETAILED ONLINE QUIZZES: A TOOL TO ENHANCE LEARNING EXPERIENCE IN QUANTITATIVE BUSINESS COURSES

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ABSTRACT

This article describes the development and use of detailed online quizzes to enhance student performance and course experience. The instructor's situation is very typical of a regional business school with no major, minor, track, or any such specialized course of study in operations management. Students only take one required operations course in their program. Thus, it becomes challenging to reasonably cover and expose students to the major themes in operations management and achieve higher learning objectives in the course (based on Bloom's taxonomy of learning (Bloom, 1956)). Faced with low student grades/performance and low student satisfaction with the course/instructor, on line quizzes were utilized to improve the course experience. Based on a before-after comparison, quizzes were found to be a very effective and efficient way to overcome the challenges and proved to be very successful for both, the students and the instructor.

I. INTRODUCTION

Across the various courses that make up the curriculum of business programs, quantitative courses (statistics, economics, finance, marketing research and operations research, etc.) are perceived by students to be among the most difficult (e.g., Paulos, 1988; Burlingame et al., 2002). This may be explained by the well documented student weakness with mathematics in general (e.g. Morris et al., 1978; Levitt and Hutton, 1984). This perceived difficulty is also reflected in lower student satisfaction from the course. In addition, students' grades in quantitative business courses tend to be lower when compared to non-quantitative courses and that may, in turn, signify lower levels of student learning and retention.

As a result, instructors face a constant challenge of getting the students excited about the course while making sure that they learn the needed concepts. This article describes a successful study of applying advanced information technology as a solution to the above problems. The quasi-experiment (Shadish et. al., 2002) presented compares the learning effectiveness of detailed online quizzes with traditional quizzes. Practical implications of the results for educators teaching quantitative business courses are discussed.

II. OPERATIONS MANAGEMENT: A TYPICAL QUANTITATIVE COURSE

Operations management is the design, operation and improvement of systems that create a firm's primary products and/or services. Major topics typically covered in an operations course are demand forecasting, production planning, materials requirements planning, inventory management, and quality management. Almost all business programs have at least one course in operations management that every student is required to take. Mathematical tools are part of almost all the topics typically covered in the course. To be successful in this class, students must first master the mathematical tools and then be able to apply these tools to address business decision-making situations. The course is very similar in nature to most other quantitative business courses.

III. LEARNING OUTCOMES BASED ON BLOOM'S TAXONOMY OF LEARNING

Bloom's taxonomy (1956) of educational objectives (Figure I) provides a good theoretical foundation for understanding the learning outcomes. The lowest, most basic level of learning is gaining knowledge. This involves the recall of basic theories and other important information. Comprehension signifies the ability to grasp meaning and interpret given information, translate knowledge into a new context, predict consequences, and so on. Application refers to the ability of using the methods, concepts, and theories in new situations; and solving problems using acquired skills and knowledge. Analysis involves seeing patterns, recognizing hidden meanings, and breaking down the material into component parts to understand the organization structure of a given situation. Synthesis is the ability to use old ideas to generate new ones, to generalize from given facts, and to predict and draw conclusions. Finally, evaluation means to compare and discriminate between ideas, recognize subjectivity, and make choices based on reasoned arguments.

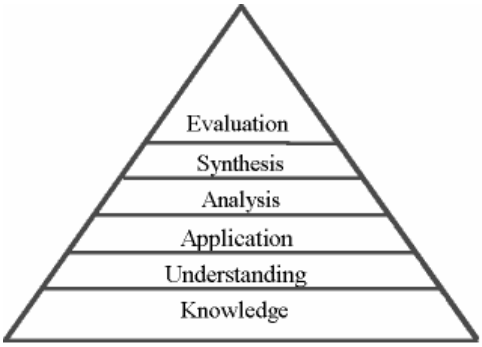

FIGURE I: BLOOM'S TAXONOMY OF EDUCATIONAL OBJECTIVES

Any course should at least be able to achieve the lower levels in the hierarchy. Since, for most of the students, this is their only exposure to formal training in operations management (very few business programs have a major in operations management), it is desirable that the course also achieves the higher level learning objectives. To the extent that the exams are designed to assess the various levels of learning, average student GPA should be a good objective indicator of learning outcomes. In addition, the end of the semester student course evaluation/feedback (referred to here as Instruction Satisfaction Questionnaire, ISQs) should serve as an excellent subjective measure to assess the level and the extent of learning outcomes achieved in the course.

IV. DETAILED ON-LINE QUIZZES

Detailed online quizzes are online quizzes that are typically offered through a learning content management system (LCMS), like Blackboard, WebCT or Moodle. Apart from being online, the major characteristic of a detailed online quiz is the fact that the arrangement of questions takes the students from lower to higher levels of learning on Bloom's taxonomy. For example, the following narrative gives the context utilized for a detailed on-line quiz or the topic of inventory management:

> *A restaurant uses 5,000 quart bottles of ketchup each year. The ketchup costs $3.00 per bottle and is served only in whole bottles because its taste quickly deteriorates. The restaurant figures that it costs $10.00 each time an order is placed, and holding costs are 20 percent of the purchase price. It takes 3 weeks for an order to arrive. The restaurant operates 50 weeks per year. The restaurant would like to use an inventory system that minimizes inventory cost.*

Based on the information given above, students would have to answer several questions on finding inventory levels to take care of uncertainties in transportation, supply times, customer demands, various levels of customer service, and so on. This forms an intensive, three to four hour self study session facilitated by the quiz. According to Pelz (2004), making students work on most of the aspects of the mathematical tools on a self-study basis forms one of the three principles of effective online pedagogy.

When compared to traditional quizzes, detailed online quizzes offered the following advantages

1. Students had enormous flexibility in terms of when they can take the quizzes.
2. Since it was graded, students would be more willing and less hesitant to discuss their difficulties in the classroom
3. Even if a student was absent, he could still attempt the quizzes.
4. Since the quizzes were online, it could be for a longer duration (typically 3-4 hours).
5. As the quizzes would be open notes, open books, students would give their best shot at taking the quizzes and thus were very well prepared to discuss the quizzes in-class.
6. Quizzes were highly time efficient. Class time freed up because of not having the usual in-class quizzes could be used for other value adding class discussions.

Thus, the author expected detailed online quizzes to significantly enhance the learning effectiveness of the students.

V. THE STUDY: TRADITIONAL QUIZZES VS. DETAILED ONLINE QUIZZES

Quiz (online or in class) is a common tool that had been used in various contexts to aid learning. Martyn (2003) describes the use of online quizzes in a hybrid course to help students stay current with their reading assignments. Peng (2007) used online quizzes in a finance course to free up in-class time. Naslund (2005) describes the successful implementation of an online assessment testing students similar to an in-class exam. Traditionally, quizzes are short problem solving exercises based on a single most

recently covered mathematical technique to test student understanding of the given technique and to give them a feeling of exam type questions before an actual in-class exam. Traditional quizzes were utilized in operations classes taught by the instructor until Fall 2006.

Detailed on-line quizzes were implemented in Spring 2007. The only aspect that changed from the previous semesters (exams, grade distribution, syllabus and everything else stayed the same) was that the in-class quizzes were substituted by detailed on-line quizzes. Students may take the quiz on blackboard any time during a four-day time-window and they only had one attempt to take the quiz. Taking a quiz involved solving a problem, arriving at a solution, and then selecting the best choice. The total number of quizzes stayed the same after the implementation of on-line quizzes. Demographics of the students also remained the same, making the sample comparable.

VI. RESULTS AND INTERPRETATION

Fall 2006 columns in Table I represent the end-of-semester student feedback for the course (or ISQs) and the instructor, and the average student grade in the course. Responses to all the questions are on a 5 point scale with 5 being the best and 1 the worst rating. Average GPA is arrived at by assigning A = 4, B = 3, C = 2, D = 1 and F = 0 and then averaging the number for all students. Overall, Table I clearly brings out the challenges faced by the students and the instructor in this course. Based on discussions with other faculty members, this experience is typical of other quantitative business courses such as marketing research. The Spring 2007 columns in Table I represent the learning outcomes measured after implementation of the detailed online quizzes.

First, the average student GPA in Spring 2007 is substantially better than that of Fall 2006. Similar observation can be made regarding the student satisfaction as reflected in the ISQ's. This is a clear indication that the detailed on-line quizzes helped students do better on the exams. This is reflected in the ISQs as well (ISQ question "lectures organized and provide framework for learning," Table I). Interestingly, referring to the question "I found this class to be challenging" on the ISQs, students still view the course as challenging as before, if not more. Based on this evidence, one may reasonably conclude that the online quizzes helped achieve the first, basic element in Bloom's taxonomy: gaining knowledge.

Detailed on-line quizzes made students contemplate on the mathematical concepts and spend more time thinking about the various issues outside of class time. It also helped them identify their problem areas and be better prepared to discuss them in class. As a result, class sessions became much livelier as the students knew what to ask ("involves students in class activities," and "uses class time well" in Table I).

As students spent significant time in solving the on-line quizzes, they got comfortable with the mathematics of the techniques and were able to better appreciate the practical aspects/applications during class discussion. The improvement on the ISQ question "relates course material to current examples" provides an indication for this argument. In other words, the on-line quizzes helped create extra time (in the form of time saved on in-class quizzes) and a favorable environment (in terms of student preparedness) to achieve student comprehension/understanding and appreciation of the applications of

the course material; the higher level objectives in Bloom's taxonomy for (student) learning (Figure I).

TABLE I: INSTRUCTIONAL SATISFACTION QUESTIONNAIRE AND AVERAGE STUDENT GRADE

Questionnaire items	**Before (Fall 2006)**		**After (Spring 2007)**		
Communicates effectively with students	3.24	3.76	4.28	4.12	4.32
Enthusiasm for course material and teaching	3.76	3.71	4.67	4.60	4.43
Mastery of the course content	4.00	4.14	4.68	4.52	4.78
Relates course material to current examples	3.43	3.76	4.26	4.36	4.22
Clearly explains complex concepts and ideas	3.19	3.24	4.42	4.16	4.30
Lectures organized and provide framework for learning	3.48	3.86	4.53	4.4	4.57
Course syllabus accurately described the course	3.95	4.29	4.47	4.36	4.48
Course instructional materials used effectively	3.57	3.90	4.47	4.24	4.61
Involves students in class activities	3.33	3.62	4.56	4.12	4.33
Uses class time well	3.81	4.05	4.56	4.44	4.68
Fosters environment conducive to critical thinking	3.68	3.86	4.61	4.44	4.50
Treats all students in a consistent manner	4.14	4.48	4.65	4.68	4.52
Exams reflect the material covered	3.29	3.95	4.67	4.48	4.61
Willingly assists students outside of class	4.00	4.29	4.71	4.36	4.59
I found this class to be challenging	4.14	4.48	4.48	4.40	4.57
Description of course objectives and assignments	3.19	3.85	4.47	4.19	4.32
Communication of ideas and information	2.90	3.25	4.50	4.14	3.95
Expression of expectations for this class	3.25	3.71	4.56	4.20	4.13
Availability to assist students in or out of class	3.68	3.74	4.63	4.35	4.52
Respect and concern for students	3.71	3.76	4.76	4.36	4.26
Stimulation of interest in course	3.14	3.05	4.47	4.12	4.30
Facilitation of learning	3.14	3.5	4.53	4.16	4.26
Overall rating of instructor	2.90	3.35	4.63	4.24	4.30
Sample	36	33	33	34	32
GPA	2.22	1.94	2.70	2.56	2.62

Student interest in the course was greatly enhanced ("stimulation of interest in course," Table I). In fact, one student even wrote "…. it is a shame that there is no degree program for quality and other topics in operations (in the university)." Overall, this one change of on-line quizzes enriched the student-teacher communication substantially (e.g., better scores on "communicates effectively with students," and "communication of ideas and information," etc. in Table I). In addition, there were other un-intended and highly desirable consequences as well (please refer to the comparisons in Table I). If one puts the outcomes of student evaluation in words, the instructor generally came across as a respectful, caring, knowledgeable, challenging, and enthusiastic teacher.

VII. CONCLUSION

Quantitative business courses are an integral part of any business program. Students face significant challenges in these courses to achieve higher levels of learning. Among the various tools an instructor may use to facilitate student learning, technology may provide a very effective means to alleviate the situation. This study demonstrates the

effectiveness of on-line quizzes to turn what is perceived to be a challenging and difficult course into a very satisfying and rewarding experience for the students and the instructor, a win-win scenario. Instructors in similar context may find this experience very useful in their efforts to improve student learning and satisfaction while maintaining academic rigor. Interested educators may very easily replicate this in other quantitative business courses using commonly used LCMS such as blackboard. In case such technology is unavailable, there are free internet-based resources (e.g., moodle) that may be utilized to replicate this experiment with little effort.

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