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EXAMINING THE INFLUENCE OF THE DELIVERY OF STRATEGIC ONLINE CONTENT

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ABSTRACT

This article describes the development and strategic application of online quizzes to enhance student performance and overall course experience. Although research has increased in the field of technological delivery of educational content, there is yet a dearth of studies when compared to the quantity of activity in practice. The experimental situation that this study presents is generalizable to any regional, public business school with no major in operations management. These schools tend to use operations management as an integral part of its core curriculum. Students are required to take only one required operations course in their program; thus, it becomes challenging to cover all the appropriate subjects. Faced with low student performance and below average student satisfaction with the course, this study details the effect of delivering content using online quizzes. Based on a before–after comparison, quizzes were found to be a very effective and efficient way to overcome these challenges and have proved a very successful method of content delivery for both the students and the instructor.

INTRODUCTION

Over the past 20 years, online and distance learning usage in higher education has gone from interesting novelty to necessary teaching tool. It has been employed to not only deliver content more effectively, but to deliver that content to numerous end-users spread across infinite destination possibilities. This technological imperative has spawned many online universities and degree programs, catering to the changing nature of the student population (Sloan-C, 2004).

The digital age has bought a sea of change in the nature of college students. Students are more technology savvy and bring technology into the classroom (Vilano, 2007; Wood, 2004). Using tools such as Web sites and learning management systems, instructors have been able to encourage online learning outside the classrooms. The digital era has also enabled nontraditional students, who need greater time and space flexibility, to gain access to education that was

difficult to attain earlier. Thus, technology tools have found their way inside and outside the classroom, creating a "digital surround" aimed at facilitating student learning. Today over 80% of all institutions of higher education offer some form of distance learning or online education (Sloan-C, 2004). Universities are continuing to realize that this untapped student learning opportunity will not only increase their reputation and goodwill, but will also provide generous revenue streams and enrollment growth into the foreseeable future.

Unfortunately, these achievements and advancements in technology have not come without their share of issues (Sasidharan & Santhanam, 2006; Hannafin et al., 2004). Professors who deliver online content have been criticized for being generic, lax in security, and ignoring the human needs of the end-user (Kim, 2002). These same instructors have also complained of excessive workloads, technological limitations, high student failure rates, and poor student evaluations. Additionally, critics of online education have continued to posit that distance learning "looks great on paper" with numerous positive outcomes, but poor execution has led to a significant effectiveness gap in actual practice. This lack of quality control has actually led to calls to go back to traditional content delivery and abandon distance and on-line learning altogether (Kovalchick & Dawson, 2004).

For distance learning and online delivery to thrive as viable pedagogy and to deliver on its promised potential, studies must explore how this technology can be best employed to not only increase the effectiveness and efficiency of the content delivery method, but also the quality control of the final product (Gupta et al., 2008). The strategic use of this distinct pedagogy, taking into consideration its unique strengths and benefits, should be the application method of choice. Unfortunately, in the past, online content delivery has been employed in a wholesale manner without any thought or consideration to its numerous weaknesses, pitfalls, or drawbacks. The strategic application of this pedagogy to address specific issues within determined contextual constraints is the major research thrust of this manuscript.

This paper seeks to address and assess the impact of the strategic application of online technology in a particular course. It attempts to illustrate how technology improves learning and influences the educational outcome variables, as in Bloom's taxonomy (1956), variables that are typically associated with student learning. The first objective of this paper is to illustrate and explain Bloom's taxonomy, describe the nature of the typical operations management course, and clarify the difference between traditional quizzes and on-line quizzes. After reviewing these concepts, this manuscript details an outcome comparison that contrasts online content delivery (online quizzes) to traditional quizzes and determines the improvement of the educational experience of operations management students. In other words, the presented study compares the learning effectiveness of detailed online quizzes with traditional quizzes and examines the influence of this content delivery method on student learning, and student satisfaction with the course content and the professor. Finally, the results and the implications of those results for educators teaching quantitative business courses are discussed.

LEARNING OUTCOMES BASED ON BLOOM'S TAXONOMY OF LEARNING

Bloom's taxonomy (1956) of educational objectives (Figure 1) provides a good theoretical foundation for understanding the learning outcomes. It is the standard upon which educational

learning objectives are created and student learning is measured. Many study guides and test banks actually chronicle each question or concept and explain which one of Bloom's educational objectives it is actually fulfilling. To this end, the current authors feel very comfortable applying this taxonomy to the current study.

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.

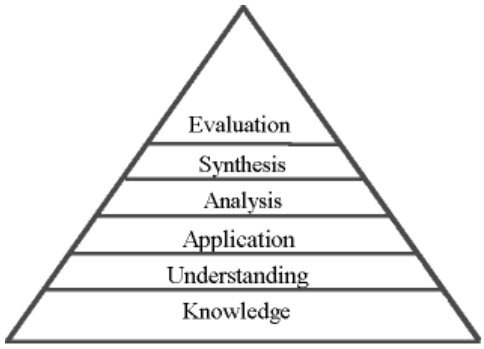

FIGURE 1: BLOOM'S TAXONOMY OF EDUCATIONAL OBJECTIVES

Any course should at least be able to achieve the lower levels in the hierarchy. Because, 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 and feedback (referred to here as the 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.

OPERATIONS MANAGEMENT: A TYPICAL QUANTITATIVE BUSINESS COURSE

Across the various courses that make up the curriculum of business programs, quantitative courses (statistics, economics, finance, marketing research, and operations research) are perceived by students to be among the most difficult (e.g., Paulos, 1988; Burlingame, Lebsack, Luthans, & Palmer, 2002). This might be explained by the well-documented student weakness with mathematics in general (e.g., Morris, Kellaway, & Smith, 1978; Levitt & 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 nonquantitative courses and that might, 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.

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, in their core curriculum, 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.

The nature and structure of a successful operations management course is one that can be successfully related and applied to real-life scenarios. For instance, inventories might be related to the students as "the products in a typical store when you visit the store to purchase an item." From this visualization, the professor can branch off and talk about appropriate levels of inventory, just-in-time inventory, and opportunity costs from having too much inventory or revenue losses from not having enough inventory. This "real world" example can now be explained within the context of the appropriate concepts and theories of inventory management. Mathematical problems are assigned and solved in class to further address the quantitative side of the issue. Additional problems are assigned as homework so students can practice the techniques further. Student homework issues are addressed and quizzes are then given to test the students' knowledge, retention, and ability to apply the delineated concepts. Typically, 10 quizzes are given in any semester with the cumulative impact on their grade at about 5–10%. Exams, which are based almost wholly from these quizzes, make up the other 90–95% of the students' grade.

TRADITIONAL QUIZZES VERSUS DETAILED ON-LINE QUIZZES

Traditional quizzes have been used by professors for years to deliver concepts and test students' on various types of academic subject matter. Usually quizzes are employed because the subject matter is very narrow, important, and will probably appear on a more global test. Quizzes are also good tools to track students and assist with very specific subject problems as they happen instead of waiting for a midterm. Finally, quizzes also serve as a motivational factor for students to keep up with the material instead of leaving it to the last minute before a test, where they will also be required to demonstrate mastery of many new concepts. In sum, traditional classroom quizzes serve numerous purposes, all of which are beneficial to the students.

Detailed online quizzes are online quizzes that are typically offered through a learning content management system (LCMS), like Blackboard, WebCT or Moodle. A characteristic of online quizzes is the flexibility of time that they provide. These quizzes allow students to take the quiz at their own choice of time. They also do not take time away from classroom. Thus, the students have greater duration of time available to work through the quiz. Next, 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 (1956). The following narrative is an example of a context used 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, 3–4-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 enhance significantly the learning effectiveness of the students. Additionally, it was expected that the students' overall view of the course and the instructor would also increase.

THE COMPARISON STUDY

As stated above, quizzes (online or in-class) are common tools, 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 used in operations classes taught by the instructor until fall 2006.

Detailed on-line quizzes were implemented in Spring 2007. This was the only aspect that changed from the previous semesters (exams, grade distribution, syllabus and everything else stayed the same). Again, the only aspect of the classes that were different was that the in-class quizzes were substituted by detailed on-line quizzes. Students could take the quiz on blackboard any time during a 4-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.

RESULTS AND INTERPRETATION

The columns labeled Fall 2006 in Table 1, 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 1 clearly illustrates 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 quantitative methods of business and marketing research. The columns labeled Spring 2007 in Table 1, represent the learning outcomes measured after the implementation of the detailed online quizzes.

First, the average student GPA in Spring 2007 is substantially better than that of Fall 2006. Similar observations can be made regarding the student satisfaction as reflected in the ISQ's. This is a clear indication that the on-line quizzes helped students do better on their exams. This is reflected in the ISQs as well (ISQ question "lectures were organized and provided framework for learning" shows a dramatic increase in scores). Interestingly, when referring to the question "I found this class to be challenging" on the ISQs, students still viewed the course as challenging as before, if not more. Based on this evidence, one might reasonably conclude that the online quizzes helped achieve the first, basic element in Bloom's taxonomy (1956): gaining knowledge.

Detailed on-line quizzes made students contemplate 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 were better prepared and knew what to ask ("involves students in class activities," and "uses class time well" in Table 1).

As students spent significant time in solving the on-line quizzes, they got comfortable with the mathematics of the techniques and were able to appreciate better the practical aspects and applications during class discussion. The improvement on the ISQ question "relates course material to current examples" provides evidence for this argument.

Student interest in the course was greatly enhanced ("stimulation of interest in course," Table 1). 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)."

The on-line quizzes helped create extra time (in the form of time saved on in-class quizzes) and a

favorable environment conducive to student learning (in terms of student preparedness). This facilitated student comprehension and understanding. There was also an obvious appreciation of the mathematical and "real world" applications of the course material which only further confirmed that the higher level objectives in Bloom's taxonomy (1956) for (student) learning were being met (Figure 1).

TABLE 1. 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

Overall, the single 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" in Table 1). In addition, there were other unintended and highly desirable consequences as well (please refer to the objective comparisons in Table 1). If one puts the outcomes of student evaluation in words, the instructor generally came across as a respectful, caring, knowledgeable, challenging, and enthusiastic teacher.

PRACTICAL IMPLICATIONS

If the desired outcome of this experiment was to improve student learning as well as the overall views of the course and the instructor, then the study must be considered highly successful. This is just one of the practical implications of this experiment for educators. Although the employment of online content delivery methods is not without its drawbacks, there are more than enough positive results to justify its application. In sum, this technology should be used as a method to enhance the student-professor relationship, not replace it.

Determining the level of questions that can be covered in an online quiz versus a traditional quiz is another practical implication of this study. Since the students are given more time to take the quiz and more in-depth questions can be asked, higher levels of Bloom's taxonomy (1956) can be attained, even at the quiz level. This presents numerous opportunities and implications for concept coverage, subject inclusion, and rigor maintenance. In fact, the nature of this dichotomy can be illustrated in a 2x2 Table, indicating the question depth and the types of quizzes (Figure 2).

Type of questions and depth of learning	Type of quiz	
	Traditional	Online
Tier 1: Surface learning	*Very High Facilitation*	*Low-High Facilitation*
Tier 2: Deep learning	*Very Low Facilitation*	*Very High Facilitation*

FIGURE 2. QUIZ – LEARNING COMPARISON CHART

Tier 1 can be considered the bottom three objectives of Bloom's taxonomy (1956): knowledge; understanding; and application. Tier 2 can be considered the top three levels of Bloom's taxonomy: analysis; synthesis; and evaluation. Figure 2 illustrates that for surface learning issues (i.e., memorization or very basic application) or the attainment of Tier 1 objectives; traditional quizzes facilitate the learning process much better than online quizzes. For these surface level questions, the opportunity to cheat could be much greater level than the potential for impropriety with the quizzes done under instructor supervision. However, with emerging technology, more quiz delivery tools are looking at solutions to curb this problem. Thus, we label this box as having low-high facilitation depending on the quality and implementation of the quiz.

On the other hand, online quizzes are great at facilitating the learning process with the deeper learning questions that emphasize the Tier 2 objectives of Bloom's taxonomy (1956). Therefore, if a course can gain from having in-depth quizzes as a part of its grading method then online quizzes would be the more effective tool of choice. The higher level of learning combined with

the time crunch that the unprepared student experiences due to the depth of the questions, make cheating a tougher proposition. Again, these questions can be formulated in such a way that cheating can be eliminated, easily discovered, or discouraged. One hopes that there will be many other studies in addition to the current study that explores or mentions the security issue of online quizzes, so that its benefits are not mitigated by student cheating. This is the final practical implication of this study.

CONCLUSION

Quantitative business courses are integral parts of any quality business program. Unfortunately, students have continuously faced significant challenges in these courses to achieve higher levels of learning. Although there are various tools that an instructor might have at his disposal to facilitate student learning, technology might provide an effective means to address and resolve this specific situation. The strategic application of technology used in the study, indicates that there is no "one remedy cures all" approach. However, modern management theorists have determined that a contingency approach to management is more applicable and generalizable to organizational practice.

The study provides evidence on how contemporary students are open to new and innovative ways of presenting content. It also 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. This truly created a win-win scenario for both parties involved. This is the major contribution of the current paper.

Instructors in similar contexts might find this experience very useful in their efforts to improve student learning and satisfaction without sacrificing any academic rigor. In fact, academic rigor might actually increase as professors get acclimated and begin to feel comfortable with this type of technology. Interested educators might very easily replicate this in other quantitative business courses using commonly used online learning management systems such as blackboard, WebCT, Moodle. In summary, the current authors hope that, over time, this will only be one in a field of future studies that strategically look at online content delivery, and its true influence on students and instructors.

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