PROMOTING INTEGRATIVE LEARNING IN ONLINE COURSES: A MASTERY APPROACH

By

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ABSTRACT

Due to the anonymous nature of online courses, many instructors require some type of proctored, comprehensive exam at the conclusion of the course. While comprehensive final exams are not unique to the online classroom, the integration of a proctored, high-stakes assessment helps to ensure that the student registered for a course is actually the student who is completing course assignments and activities. While this type of approach can ensure the identity of online students, it can be cognitively demanding for students to master the wide-range of material covered in a single, comprehensive exam. The purpose of the current study is to examine the impact of required weekly cumulative quizzes on students' retention and integration of information. One online class completed weekly assignments with optional cumulative review quizzes while another online class completed identical assignments plus required cumulative review quizzes. Results indicated that students required to complete the weekly cumulative reviews retained more information as indicated by significantly higher final exam scores than students with access to the optional comprehensive review quizzes. Discussion highlights the value of integrating mastery-learning strategies, such as comprehensive review quizzes, into the course mix.

INTRODUCTION

Ensuring whether registered students are completing course requirements is a key challenge in achieving academic integrity in the online environment. Although numerous methods can be used to confirm a registered student's identity, one of the most popular approaches in online education is to require a substantial comprehensive exam with a live proctor to verify the student's identity. While this type of high-stakes comprehensive exam is often a hallmark of face-to-face courses as well, in the online environment, this assessment approach plays a dual role by reducing concerns about a student's identity in relationship to his/her grade. However, reliance on high-stakes comprehensive exams raises a host of new questions concerning the validity and effectiveness of comprehensive exams for measuring students' mastery of course material.

Ideally, a comprehensive exam would demonstrate true mastery of course material; yet in reality students often score poorly on comprehensive exams (McKeachie, 1999). Furthermore, comprehensive exam outcomes may relate more strongly to the mastery of test-taking *strategies* than to the mastery of course material.

Underlying these concerns is the fact that many students lack the metacognitive ability to accurately judge the importance and significance of concepts embedded within a course (McKeachie, Pintrich, Lin, Smith & Sharman, 1990). Thus, students become overloaded with the daunting task of "learning everything." This overload is one of the main factors leading students to approach learning as a shallow memorization task rather than studying for deep understanding.

Compounding the problem, most students dedicate their study time and energy to learning the information that is required for a specific assignment or activity (McKeachie, 1999). Since most course activities focus on discrete course topics or ideas, and are not comprehensive, students do not invest the necessary time to integrate information. While students may understand the specific concepts, topics or themes, a lack of integration of these discrete pieces of information presents additional challenges when trying to demonstrate knowledge on a comprehensive exam that combines all course information.

Current Study

For the purposes of the current study, mastery as a

learning outcome is defined by students' ability to synthesize and integrate learning across time, as demonstrated by success on a cumulative final assessment. Promoting mastery learning, then, becomes key to effective online course design. Toward that end, the purpose of this study is to examine the effectiveness of online cumulative review questions in promoting retention of key course concepts. Specifically, the study investigates whether online students complete mastery-based weekly online cumulative review assessments, and whether it would show increased retention of course material as indicated by enhanced performance on the high-stakes, comprehensive final exam.

Literature Review

Value of Assessments in Online Learning

Research has repeatedly found that students' attention and focus are driven by the assessment measures, not the educational goals of a course (McKeachie, 1999; McKeachie, Pintrich, Lin, Smith & Sharman, 1990). Thus, if assessments focus primarily on discrete units of information, students will devote their time and effort toward the shallow memorization of these apparently unrelated facts and definitions. On the other hand, if assessments require students to demonstrate a more complex understanding, students will concentrate their effort on acquiring the relevant skills. This leaves the instructor with the task of implementing measures that accurately reflect the desired educational objectives. If an instructor wants learners to be able to effectively integrate the cumulated knowledge across a number of units, it is important that assessments require students to practice this type of integrated, cumulative understanding. Combining the value of mastery learning strategies with the necessity for practice in cumulative understanding, the use of cumulative mastery learning quizzes in an online course has the potential to enhance student understanding while allowing instructors to maintain the use of high-stakes, proctored exams to ensure students' identity in the faceless environment of online education.

Within an online course, study questions provide a means by which instructors can focus students' attention and highlight areas of emphasis. This focus helps to decrease overreliance on text vocabulary and factual information by reducing the cognitive demands placed on the student. In addition, research in cognitive psychology has highlighted the constructive nature of learning, emphasizing that effective learning is the result of incorporating new information with prior knowledge (McKeachie, 1999). Thus, to promote optimal learning, instructors must ensure that whether the students possess a basic understanding from which future learning can build. Since many students will not initially demonstrate the required high level of understanding, the opportunity for practice and multiple reviews is vital.

Practice, feedback and the use of multiple reviews form the foundation of mastery learning approaches to education. Mastery learning strategies are widely accepted as an effective and efficient method of instruction for post-secondary education (Guskey & Gates, 1985; Kulik & Kulik, 1979; Kulik, Kulik, & Bangert-Downs, 1090; Kulik, Kulik, & Cohen, 1979). Mastery learning is based on the notion that "when instruction is of good quality, appropriate, and adequate time is spent on learning, almost every student can master basic skills and acquire the knowledge that forms the core of a school's curriculum" (Montazemi & Wang, 1995, p. 186), Typically, mastery learning involves breaking instructional material into small units and requiring students to demonstrate mastery (a designated percentage or higher) on each unit before proceeding to the next. Keller's (1968) seminal work on mastery learning outlined a specific teaching methodology based on mastery learning theories. Keller's Personalized System of Instruction (PSI or Keller plan) has several components:

- instructional material is presented via written text
- material is divided into small units as outlined by study objectives
- students proceed through the instructional units at their own pace
- students must demonstrate mastery on each unit before moving to the next (if a student fails a unit test,

she/he must retest until mastery is reached)

- individual feedback is provided immediately after each testing session

By utilizing mastery learning strategies, students take responsibility for their own learning and have the opportunity to learn from their mistakes. The instructional tools available in an online course management system form an ideal environment for incorporating individualized, repeatable mastery learning approaches.

Research on Effectiveness of Mastery Learning

The use of repeated formative assessment to facilitate understanding is unique to mastery learning programs. If a student demonstrates mastery (by reaching a minimum designated percentage on the unit test), he/she is allowed to proceed to the next unit; if the student has not mastered the unit, feedback is provided on errors, then the student retests at a later time. In this sense, unit tests serve a dual purpose of assessment and instruction. Key to the instructional aspects of mastery learning instruction and repeatable testing is the immediate, individualized feedback provided after each testing session. Traditionally, this feedback has been provided by human proctors who grade unit tests and discuss the results with individual students, but recent advances in computer technology have challenged the reliance on human proctors to provide instructional feedback.

Despite the potential value of human proctors, research suggests that the human component is not essential to effective mastery instruction (Buskist, Cush, DeGrandpre, 1991; Caldwell, Bissonnettee, Klishis, Pipley, Farudi, Hochstetter, & Radiker, 1978; Kulik, Kulik, & Smith, 1976). An early component analysis of mastery learning courses found that the number of unit tests, the quality of instructional objectives and the criteria set for mastery performance was considerably more important than human proctors (Caldwell et al., 1978). In addition, research by Kulik, Jaksa, and Kulik (1978) indicated that human proctoring does not significantly increase students' achievement scores. Outcome measures from a mastery learning course conducted completely via computers (see Crosbie & Kelly, 1993) found that student

achievement was high and that ". . . students did not lament for the absence of personal proctors" (p. 369).

Due to the success of mastery learning programs in promoting enhanced retention, they serve as an ideal model for integrating mastery learning strategies into the online classroom. Since mastery learning programs do not utilize traditional lectures or live discussion sections, they are a cost-effective means of handling the large enrollments often found with the growing popularity of online learning. The structure of mastery learning programs (repeatable testing, immediate feedback, and minimal live intervention) make them an ideal target for online instruction.

The assessment features available in most course management systems provide an efficient means of managing mastery learning approaches. Online assessment programs can efficiently administer, grade, and provide feedback on individual student tests. In addition, opportunities for cheating are reduced by the method in which tests are compiled. Using the randomization features available in most online assessment programs, each time a student accesses an exam, the computer randomly selects the appropriate number of questions from the computerized test bank. In this way, each exam is a unique combination of items with item-responses randomly ordered. Further, security features of online assessment programs often allow instructors to control the pace and sequencing of test progression. Specifically, when utilizing mastery learning methodology, it is important to ensure that students are testing sequentially, have demonstrated mastery on one unit before moving on to the next, and take time to study between testing attempts (to prevent the testing from turning into a guessing activity- this study time allows students to reflect on their mistakes and correct conceptual errors). Most importantly, online testing tools allow the instructor to pre-populate the assessments with explanatory text so that upon completion, students can see an item-by-item analysis and response to their work.

Method

Forty-four students enrolled in the accelerated, online

version of an advanced psychology course participated in the study. Students self-selected into one of two sections (22 students per section); both sections were taught by the same instructor and utilized identical instructional resources (textbook, assignments, papers, exams, etc.). Both sections were required to complete weekly assessments (10 multiple-choice questions) covering the topics and readings for that week. In addition to this assignment, students in the control condition were given optional weekly mastery-based cumulative review self-assessments and students in the experimental section were required to complete a set of weekly mastery-based cumulative review questions (10 multiple-choice questions), covering all readings up to that point in the course. Both weekly cumulative reviews were identical; the only difference between the two groups was whether the review was *optional* or *required*. All assignments (weekly readings questions and cumulative questions) were conducted in mastery learning format; thus students could repeat the assignment as many times as they wished to reach the desired score. Both groups were informed that the weekly cumulative review would prepare them for the high-stakes cumulative final exam.

Results

A comparison between-groups ANOVA on final exam score indicated that students required to complete the weekly cumulative review scored significantly higher on the comprehensive final exam than students who were provided optional cumulative review self-assessments [$F(1, 43)=4.719$, $p=.036$]. The average final exam score for students completing the weekly cumulative assessment was 75.09% compared to 66.33% for students who were not required to complete this type of weekly review.

Discussion

As hypothesized, students who were required to complete weekly mastery-based cumulative reviews retained more information and demonstrated higher performance on the final exam than students completing traditional weekly assignments with optional cumulative reviews. Not surprisingly, students who were not required to complete
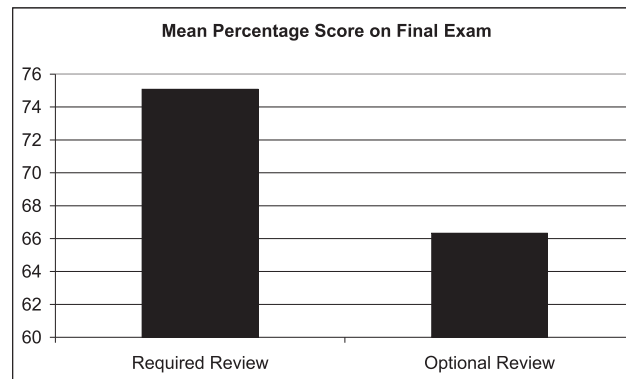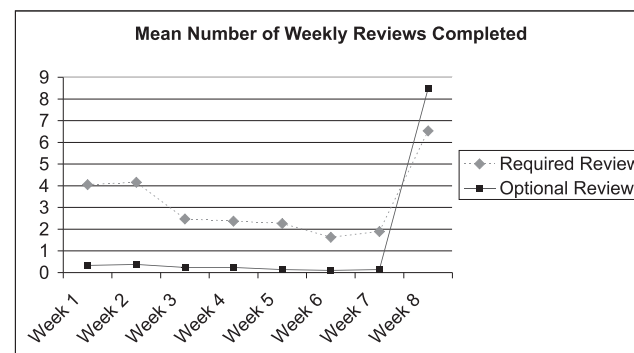

Figure 1. Mean Percentage Score on Final Exam

Figure 2. Mean Number of Weekly Reviews Completed

the weekly cumulative reviews did not take advantage of the optional review assignments until the final week review; this "cramming" strategy did not promote effective retention and integration of the material. In fact, students who had the optional reviews completed more of the final cumulative reviews, performed worse on the final exam than students who were required to complete cumulative reviews each week (Figures 1 and 2).

The mandatory weekly cumulative review prompted students to distribute study time throughout the eight-weeks of the course; this continued active engagement with course material promoted the encoding of smaller segments of information, enhanced integration of information, and a deeper understanding of course material as demonstrated by achievement on the final exam. The continuous requirement of cumulative understanding via the mastery quizzes required students to practice integration of information and prevented challenges inherent when material is learned as discrete, unrelated components.

It is also interesting to note that for students who were

required to complete the weekly cumulative reviews, the mean number of assignment attempts required to demonstrate mastery decreased throughout the term. Thus, as students mastered the small segments of information, they became more efficient at integrating novel course material. On average, students required 3.17 cumulative review assignment attempts to reach mastery. An examination of assignment statistics revealed that students spent an average of 11.37 minutes on each review assignment. For less than an hour of additional homework per week, the results of this study indicate that students can significantly increase the amount of information they retain through a mastery approach.

The results of this study have several important implications for instructors of online courses:

- Assessments should be structured in a manner that promotes continued student involvement with course material to promote ongoing integration of course material.

- Students seem more responsive to the immediate contexts and consequences of the online mastery quizzes than to the delayed reality of the final exam.

- Utilizing a mastery-learning perspective provides incentive and opportunity for students to effectively integrate key course concepts and theories.

As previously highlighted, one of the main advantages of mastery-based, online assessment is the ability to provide immediate feedback on individual student responses. In general, effective feedback provides the student with two types of information: verification and elaboration (Kulhavy & Stock, 1989). Verification is the simple judgment of whether an answer is correct or incorrect, while elaboration is the informational component providing relevant information to direct students toward a correct answer and thus toward greater comprehension. Most researchers now share the view that successful feedback (feedback that facilitates the greatest gains in student learning) must include both verification and elaboration. This combination can highlight response errors, give correct response options, and provide information that

both strengthens correct responses and makes them more memorable. In addition, educators tend to agree on the educational value of providing students with performance feedback in a timely manner. Feedback effectiveness research has repeatedly shown that the immediate delivery of feedback promotes substantial learning gains over delayed feedback (Chickering & Gamson, 1987; Kulik & Kulik, 1988). As such, when structuring mastery learning quizzes, it is vital that the online assessment program be equipped to provide both verification and elaboration; and, this feedback must be available to the student in a timely manner.

In addition to the educational advantages of immediate, elaborative feedback, feedback appears to be an important motivational influence for students in online courses. The impersonal nature of online courses often leads to student frustration and dissatisfaction. Specifically, students in online courses frequently report a lack of available educational resources and inadequate opportunities to monitor their own learning/performance. Online mastery quizzes allow students the opportunity to test their knowledge, while the immediate feedback provides a constant resource for advancing understanding. The motivational aspect of feedback serves the dual purpose of reinforcing correct responses while providing guidance to prevent frustration over inaccurate responses.

Research in cognitive psychology has highlighted the constructive nature of learning, emphasizing that effective learning is the result of incorporating new information with prior knowledge (McKeachie, Pintrich, Lin, Smith & Sharman, 1990). Thus, to promote optimal learning, instructors must ensure that students possess a basic understanding from which future learning can build. Mastery-based online quizzes provide a method of ensuring students' knowledge of core concepts in an online course. While many students will not initially demonstrate the required high level of understanding, the opportunity for practice and multiple test attempts is vital. By utilizing practice and multiple test attempts, students take responsibility for their own learning and have the opportunity to improve and integrate their learning

throughout the course.

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