

Effectiveness of Regular Online Quizzing in Increasing Class Participation and Preparation

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Abstract

Research suggests that frequent, regularly scheduled quizzing is associated with pedagogically desirable outcomes such as higher performance on exams. It was hypothesized that requiring students to complete brief scheduled online quizzes on assigned reading material before class would also result in increases in both the number of in-class questions and comments and the number of students who read the material prior to class. For each of 3 semesters, students in 1 section of introductory psychology who took time-limited, out-of-class, "open-book" WebCT quizzes on daily readings were compared to students in another section who did not take quizzes during that unit. Because each section participated in quizzing during 2 units and no quizzing during 2 units, within-section comparisons were also made. Analyses indicated that quizzing was associated with increases in both the number of student questions and comments made at the beginning of class and the number of students who reported that they came to class having read the assigned material. It was suggested that the immediate feedback provided by quizzes is particularly efficient in identifying areas of misunderstanding and in challenging students' "illusion of knowing" the material. Spontaneous, anonymous comments on end-of-unit surveys also suggested that a primary value of online quizzing is in helping students maintain a regular reading and study schedule.

Keywords: quizzing, online, scheduled quizzes, student reading, class participation, preparation, question-asking

Introduction

As a teacher of undergraduate psychology courses for 30 years, it has been my experience that many students in the introductory course come to class without having completed their assigned reading. This casual and unsurprising observation has received empirical support from research by Burchfield and Sappington (2000), who found that performance on a brief, unannounced quiz administered early in psychology courses revealed a significant decline in reading compliance over the years of their study (1981-1997). They estimated that only about one-third of undergraduate students -- particularly those in entry-level courses -- complete their reading assignments prior to class. When assessments come infrequently (as in my classes, in which there are typically 4-5 exams during a 14-week semester), it is possible that less mature and academically weaker students will fall further and further behind in their reading. In addition to the increased anxiety that might build in an individual as the completion of assigned course work is delayed (cf. Wesp, 1986), it seems reasonable to suspect that the overall classroom atmosphere might also suffer, with poor

preparation contributing to diminished student involvement, lower-quality discussions, and less efficient use of class time.

One tool that might help minimize these problems is regular quizzing. Early research on college teaching revealed the pedagogical usefulness of quizzing in several domains. For example, Fitch, Drucker, and Norton (1951) found that students who had weekly quizzes were more likely to attend voluntary discussion groups and earn higher grades, and Townsend and Wheatley (1975) found that students who took short daily quizzes had higher course grades than students who took longer or less frequent quizzes. Recent research has suggested that scheduled quizzes are associated with several pedagogically-desirable outcomes such as reduced student procrastination in a personalized instruction course (Wesp, 1986), improved understanding of the assigned reading material (Marchant, 2002), higher performance on exams (DeSouza & Fleming, 2003; Maki & Maki, 2001), and better class attendance (Wilder & Flood, 2001).

It is reasonably well established that regular quizzing can improve grades and comprehension of material. However, there is less evidence as to whether regular quizzing has an effect on classroom participation and preparation. The primary purpose of this study was to determine whether scheduled quizzes increase question-asking by students in class, and a secondary purpose was to determine whether quizzing increases the likelihood of completing reading assignments before class.

Recent developments in Web-based content delivery (cf. DeSouza & Fleming, 2003; Carroll, 2004; White & Hammer, 2000) have made it easier for teachers like me, who are unwilling to use precious class time to administer and review quizzes, to implement a regular, out-of-class quizzing regimen. I used WebCT, an interactive, online, content delivery and classroom management system, as the vehicle for this three-semester pedagogical study. It was hypothesized that requiring students to complete brief quizzes on assigned textbook reading material prior to class would result in: a) an increased number of student questions and comments at the beginning of class and b) an increased likelihood that students read the material before coming to class.

Method

Participants

Participants were students enrolled in six sections of *Introduction to Psychological Science*, a 3-hr undergraduate course taught at the College of Charleston, a liberal arts school in the Southeastern U.S. Data were collected from two sections per semester across three semesters. The total number of participants was 172, with each section having an enrollment between 25-35 students. The sample contained 63.4% women and 36.6% men, similar to the ratio at the College. The class ranks of the participants were 63.4% freshmen, 21.5% sophomores, 8.1% juniors, and 7.0% seniors.

Description of the Course, Quizzing Procedure, and Independent Variable

The two sections involved in the project each semester were taught on the same days, in adjacent time periods, in the same computer-equipped classroom, and by the same professor (the author). Identical online resources, reading assignments, exam schedule, academic policies (e.g., grading scale, office hours, makeup policy), and teaching materials were used for each class.

The course comprised five regular units with 4-5 class periods per unit and an exam at the end of each unit. Every non-exam class period had a scheduled reading assignment whose average length was 21 pages. Students were reminded in the syllabus that the course was primarily structured as an independent reading, lecture, and discussion class. They were also reminded in the syllabus and throughout the semester that they should complete the assigned reading before they came to class, that I would begin each class by asking if they had any questions or comments about the assigned reading, and that I would spend as much time as needed clarifying difficult topics encountered in the textbook (Gray, 2002). Independent reading and learning were touted as major goals of the course, and these goals were backed by emphasizing that approximately 60% of the items on exams would be based on material assigned in the textbook, whether or not it was reviewed during class.

A quiz consisted of 5 multiple-choice items randomly selected by the WebCT software from a pool of 15-20 test-bank items chosen to represent the content of the upcoming class's assigned reading material (typically, about 5 new items were added to a unit quiz each semester). Quiz questions were not reused on exams and could not be readily answered by consulting the glossary for a definition or the author index for a page referral to the relevant study. Following Brothen and Wambach's (2004) procedures, quizzes were administered online, unproctored, and immediately followed by feedback on the correctness of the answers and the quiz grade. Because Brothen and Wambach found that untimed quizzes encourage an inefficient study strategy of searching for answers in unread text, I adapted their timing parameters and allowed students 7 min (8 min during the third semester) to complete the 5-item quiz. Students were told in the syllabus, and reminded in class, that they could use their textbook and notes while taking a quiz, but that it would be an Honor Code violation to receive help from another person.

Each quiz was posted at least 48 hr before class and taken, at the student's convenience, at least 1 hr before class began. Although a student could take a quiz only once, he or she could review a completed quiz online anytime during the semester. Students who experienced a computer malfunction (e.g., loss of Internet connection while taking a quiz) could arrange to take a hardcopy makeup version of the quiz. Syllabus and in-class reminders stressed that a quiz should be taken after the student had completed an assigned reading for a class.

Students in each section took scheduled 5-point quizzes on 13 of the 22 assigned readings. The total score on quizzes comprised 6% of the final point total. Students in both sections participated in quizzing during Unit 1 in order to learn how to use the WebCT software (the first of the four quizzes in Unit 1 was a non-credit practice quiz that remained available throughout the semester). Before the semester began, a coin flip determined which section took online quizzes during Units 2 and 4 (9 quizzes), and which section took online quizzes during Units 3 and 5 (9 quizzes). The two units within a pair were chosen so that one unit represented the "natural science" side of psychology (e.g., nervous system and perception) and the other unit represented the "social science" side of psychology (e.g., social psychology and personality). When a section was not scheduled to take online quizzes, the students were unable to view or take quizzes. Nevertheless, they had the same scheduled readings and were expected to complete the readings before class. Students in each section, then, experienced over the semester the manipulation of having or not having online quizzes associated with the assigned reading.

Although students knew from the syllabus that data were being collected for a research project, they were not told the specific nature of the project. They were told that the

purpose of the research project was “to explore whether certain course practices increase the effectiveness with which this class is taught.” The course included several novel components (e.g., use of digital graphics, video clips, and sounds posted on WebCT; continuous availability of PowerPoint outlines; post-unit surveys for course improvement; discussion threads; scheduled quizzing) as well as regular practices (e.g., lectures, discussions, demonstrations, exams) that might have been the focus of research. Students were also told in the syllabus that the data would be reported as class averages and have no impact on their grade in the class. Although students were provided the option not to participate in the research project, none chose to do so. Additional details about the organization of this course and the description of the research project to the student participants can be found in syllabi posted online at my public [web page](http://www.cofc.edu/~marcellm/research.htm) <<http://www.cofc.edu/~marcellm/research.htm>>.

Dependent Variables

Participation. During the first 5 min of each class, I asked if there were any questions or comments relating to the assigned reading. These were listed on the board and addressed after all questions and comments were solicited. The dependent variable, the number of student questions asked or comments made at the beginning of class, was inconspicuously recorded after the class ended. No more than two items from a given student were counted towards this total. Only questions and comments about the assigned reading (not questions about the class schedule, the upcoming exam, the correctness of a quiz item, and so on) were tallied. No attempt was made to evaluate the quality of the questions and comments. Questions and comments made by students after the initial 5-min period of solicitation were not tallied because of the greater likelihood that they would be influenced more by in-class developments than out-of-class reading.

Preparation. Students had the option of completing extra-credit, anonymous WebCT surveys posted online within a few hours after the last class of a unit and available until 24 hr before the exam. Syllabus and in-class reminders stressed that survey responses would not be associated with one’s identity, and that names were recorded separately only to allow proper recording of the extra credit. Surveys consisted of 10 randomly-ordered multiple-choice, Likert scale, and text box items that assessed overall understanding of material in the unit, ease of use of online WebCT resources during the unit, preferred ways of viewing classroom graphics, two aspects of the unit that they disliked or liked, and so on. The dependent variable was provided by 1 of these 10 questions - a text-box item in which students estimated the number of days (out of the 4 or 5 class periods in that unit) that they came to class prepared, which was defined as “having completed all or most of the assigned reading.”

Results

Participation

Analyses were performed on the number of questions asked by a class at the beginning of a class period. For each section, there were nine class periods in a pair of units (e.g., Units 2+4) that did not have quizzes and nine class periods in a pair of units (e.g., Units 3+5) that did have quizzes. A 2 (quiz) × 6 (section) mixed factorial ANOVA, with repeated measures on quiz, revealed a significant main effect of quiz, $F(1, 48) = 62.45, p < .0000001$, partial eta squared = .565. Classes that received quizzes asked over twice as many questions at the beginning of class ($M = 2.94, SD = 1.65$) as classes that did not receive quizzes ($M = 1.20, SD = 1.22$). The analysis also revealed a main effect of section,

$F(5, 48) = 8.62, p = .000007$, partial eta squared = .473, that was qualified by a significant quiz x section interaction, $F(5, 48) = 4.32, p = .0025$, partial eta squared = .310. Table 1 contains the results of comparisons between the number of questions asked by each section

Table 1: Mean Number of Questions and Comments at Start of an Average Class Session as a Function of the Section's Quizzing Condition

Semester	Section	No Quiz	Quiz	Mean Difference	t^a	Sig.	Cohen's d
1	1	0.33 (0.50)	4.11 (1.90)	3.78 (1.99)	5.71	.0004	1.90
	2	1.67 (1.00)	2.22 (1.39)	0.56 (1.33)	1.25	.247	0.42
2	3	1.89 (1.36)	3.11 (1.05)	1.22 (1.56)	2.35	.047	0.78
	4	2.33 (1.12)	4.33 (1.58)	2.00 (2.00)	3.00	.017	1.00
3	5	0.33 (0.50)	1.44 (1.01)	1.11 (1.27)	2.63	.030	0.88
	6	0.67 (1.00)	2.44 (0.88)	1.78 (1.39)	3.83	.005	1.28

Note. The number in parentheses following the mean is the standard deviation.

^a Related samples t test with 8 degrees of freedom.

during its no-quiz and quiz classes. Although all six sections showed results in the predicted direction (more reading-related questions and comments occurred on days in which reading assignments were accompanied by quizzes), the difference did not reach statistical significance for one of the sections. Using Cohen's (1988) guidelines, four of the six differences represented large effect sizes and 2 represented medium effect sizes.

Table 2: Mean Number of Days Students Reported Being Prepared as a Function of the Section's Quizzing Condition

Semester	Sections ^a	No Quiz	Quiz	Mean Difference ^b	T^c	df	Sig.	Cohen's d
1	2 vs 1 (Units 2+4)	2.52 (1.26)	3.08 (1.12)	0.57 (0.29)	1.97	68	.052	0.48

	1 vs 2 (Units 3+5)	2.29 (1.22)	3.29 (0.80)	1.00 (0.25)	3.97	63	.0002	0.97
2	3 vs 4 (Units 2+4)	2.43 (1.62)	4.28 (0.85)	1.86 (0.32)	5.88	70	.000001	1.39
	4 vs 3 (Units 3+5)	2.53 (1.57)	3.74 (1.31)	1.20 (0.36)	3.34	62	.001	0.84
3	5 vs 6 (Units 2+4)	3.18 (1.69)	3.93 (1.10)	0.75 (0.37)	2.04	60	.046	0.52
	6 vs 5 (Units 3+5)	2.85 (1.36)	3.48 (1.39)	0.63 (0.42)	1.51	41	.140	0.46

Note. Each unit had a maximum of either 4 or 5 days of reading assignments. The number in parentheses following the mean number of days that students reported being prepared is the standard deviation.

^a For example, in the first semester, during Units 2 and 4, students in Section 2 were randomly assigned to the no-quiz condition and students in Section 1 to the quiz condition. During Units 3 and 5 of the same semester, the no-quiz/quiz assignments were reversed for the sections.

^b The value in parentheses following the mean difference is the standard error of the difference.

^c Independent samples *t* test.

Preparation

Analyses were also performed on the anonymous self-report survey item in which students estimated the number of days in a unit that they came to class prepared. Independent samples *t* tests were performed between the section receiving quizzes and the section not receiving quizzes for each pair of units. (Paired samples *t* tests could not be used because the surveys were anonymous.) As can be seen in Table 2, across semesters, students who received quizzes reported that they were prepared for more classes than students who did not receive quizzes (5 of the 6 differences were statistically significant; 3 of the 6 comparisons represented large effect sizes and 3 represented medium effect sizes).

Discussion

The primary finding of the study was that brief, regularly-scheduled, out-of-class quizzes were associated with asking more reading-related questions and making more reading-related comments at the beginning of class. This result replicates and extends a finding recently reported by Urtel, Bahamonde, Mikesky, Udry, & Vessely (2006) that students in a functional anatomy course asked over twice as many questions in the second half of the semester (when online quizzing was used) than in the first half of the semester (when online quizzing was not used). Urtel et al. also classified the type of question asked and found that questions relating to comprehension and application of material were more likely to be asked during the period of quizzing than non-quizzing.

Speaking as a teacher, it was my distinct impression that when a class was not taking online quizzes, its members tended to be more passive, less prepared, and less willing to shape the direction of the class's activities with initial questions and comments. In contrast, when a class was quizzed on a unit's reading assignment, they were more likely to ask for clarification of concepts in the assigned reading. For professors who value student-teacher interaction during class, the finding that regular quizzing can encourage greater student participation is a small but welcome addition to the collection of techniques to get students to say more in class.

Why students ask more questions and make more comments in class after taking a quiz cannot be determined from the data collected in this study. One possibility is that immediate feedback from a quiz is particularly efficient in revealing areas of poor understanding – in helping students identify topics in independent reading that they thought they understood, but really did not understand. Pashler, Bain, Bottge, Graesser, Koedinger, McDaniel, & Metcalfe (2007) suggest that many students experience an "illusion of knowing" in which they overestimate their mastery of new material they have studied. Pashler et al. suggest that "This 'illusion of knowing' is reflected in the assertion that many students make after they receive a poor grade on a test: 'But I studied so hard. I thought I really knew the material cold. How could I have failed?'" (p. 23). By immediately identifying an area of misunderstanding, quiz feedback may challenge students' belief that they understand the reading material. Asking for clarification in the next class may be one way to resolve the dissonance created by identifying an area of poor understanding.

A secondary finding was that online quizzing was also associated with students being more likely to complete the assigned reading before class. Like Ruscio (2001), who found that *randomly*-administered quizzes increased the likelihood of students completing their assigned reading on time, the current results suggest that *regularly-scheduled* quizzes also promote well-paced, independent reading of assigned textbook material before it is covered in class. Nevertheless, it is important to remember that our conclusion may be limited by the use of self-reports, and not actual observation, of student preparation for class.

Interestingly, many students spontaneously reported that regular quizzing provided a structure for studying that encouraged them to pace their reading and to work harder to understand the material. A post hoc tally of students' anonymous responses to two questions on the end-of-unit surveys ("What were two things that you liked [*or disliked*] about this unit?") revealed that favorable comments containing the root word "quiz" far outweighed unfavorable comments. Across the 3 semesters, 80%, 70%, and 79% of the unsolicited comments about quizzes were complimentary, with the most frequent response being a complaint about not receiving quizzes. Here are some examples of students' comments:

I find that the quizzes on WebCT help me a lot to pick out the key points in each chapter and would rather have them every unit.

I disliked not taking the online quizzes. I really enjoyed them and felt like while I was reading I absorbed much more just because I KNEW I would be taking a quiz after reading the chapter.

In a way I missed the quizzes because I didn't follow the reading as closely as I had in the previous unit.

...not having quizzes made it easier to get behind in my reading.

One thing I disliked about the unit was the lack of on-line quizzes; only because I felt like they help me to keep up with my readings in class.

These comments are similar to observations made by other researchers (e.g., Graham, 1999; Ruscio, 2001; White & Hammer, 2000; Urtel et al., 2006; Wilder, Flood, & Stromsnes, 2001) who noted that students believe frequent quizzing, whether scheduled or unannounced, assisted them in establishing good study habits and maintaining a regular reading schedule. Future studies may wish to determine whether Graham's (2000) finding about the effect of quizzing on test grades (that it is strongest for mid-range students and weakest for top students) also applies to the effect of quizzing on classroom participation and reading preparation. In any case, it is clear from this study that regular quizzing motivated at least some students to read and study assigned material before class and to contribute questions and comments about that material during class.

Note

I thank the staff of the Academic Computing Department at the College of Charleston for allowing me to be a part of their excellent summer Faculty Technology Institute and for providing technological instruction in online course development. I also thank the Chair of the Psychology Department, Dr. Charles Kaiser, for his flexibility in scheduling my classes during this study, and my students in *Introduction to Psychological Science* for serving as participants. An earlier report of this project was presented as a poster at the August, 2005, meeting of the American Psychological Association in Washington, D.C. The project was reviewed and approved by the College of Charleston Institutional Review Board (#IRB-04-042).

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