

IF AT FIRST YOU DON'T SUCCEED: COMPARISON OF LIMITED VS. UNLIMITED ATTEMPTS AT ONLINE QUIZZES IN AN INTRODUCTORY GEOGRAPHIC INFORMATION SYSTEMS COURSE

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ABSTRACT. It is common for instructors to assign readings to students which cover topics that will be discussed again during class meetings, but it is also common for students to either delay doing so until just prior to exams, or not at all. Short reading quizzes, both in-class and online, are frequently used as a means to motivate students to complete reading assignments in a timely manner. At the instructor's discretion, online quizzes allow students multiple chances to attempt a particular quiz, perhaps with time limits on each attempt, and with the possibility of the questions being drawn from a larger question pool each time. In this study, online reading quizzes were examined across two consecutive semesters in an introductory geographic information systems course, with the students in the first semester allowed unlimited attempts to complete each quiz before a deadline, and a limit of five attempts per quiz for students taking the same course the following semester. Questions were drawn from a pool for each attempt, and students were shown their overall score after an attempt, but were given no indication which questions were answered correctly. Analysis of the frequency with which students attempted the quizzes, and comparisons between the scores achieved between the two semesters, suggest differences in reading frequencies in subsets of students.

Keywords: Online quiz, reading quiz, science education

INTRODUCTION

Many instructors assign reading to be completed outside of class, often as a means of preparing students for material which will be covered during subsequent class meetings. Likewise, most know that many students either do not complete these reading assignments at all, or only do so prior to examinations. Prior studies have investigated the reading habits of undergraduate college students, revealing similar results. For instance, Baier et al. (2011) surveyed students at two universities in the Midwestern United States, finding that many spent less than one hour per week completing assigned readings, and only a quarter of those surveyed did so before the class meeting during which the material was to be covered. Other studies (e.g., Clump et al. 2004; Phillips & Phillips 2007) found similar rates of reading completion before class, or slightly lower, and between 50% and 66% of students reading the assigned material only prior to exams. This avoidance of reading is not just contained to undergraduate students; Clump & Doll (2007)

examined the reading habits of graduate students in a forensic psychology class, revealing that slightly more than half read the assigned material before class, but most completed these reading assignments prior to exams.

One method that is used by instructors to encourage students to complete readings prior to class meetings is through the use of quizzes (Cook & Babon 2017), both online and in-class. In this study, the effects of imposing a limit on the number of times a student could attempt online reading quizzes were examined for an introductory course in geographic information systems (GIS). While the author assigned reading quizzes in this course as a means of encouraging students to complete their reading assignments, it is hypothesized that by allowing an unlimited number of attempts some students may view taking many repeated attempts as an alternative to completing the reading assignment, while limiting the number of attempts might curtail this approach.

Numerous studies have examined online quiz completion and their relationship to student performance, focusing mainly on in-class summative examinations, with specific attention paid to whether: time limits were imposed, the quizzes

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were taken voluntarily, and the number of attempts students was allowed for each quiz. In a very extensive study, Anthis & Adams (2012) investigated the effects of various online quiz parameters on the performance of students on in-class exams in infant and child development courses. Through different configurations of online quizzes that included unlimited attempts to complete each quiz, a maximum of three attempts, and various time limits imposed on each quiz, these authors found that the number of attempts did not have any relationship to the exam scores, but the time spent on the quizzes correlated negatively. Other research of online quizzes which included information about attempts (e.g., Kibble 2007; Johnson & Kiviniemi 2009; Muchovej 2009) only describe the limitation of attempts, or lack thereof, with respect to the description of the quizzes, and do not explore relationships between this parameter and student outcomes. The use of quiz attempts in these studies ranged from a single attempt to unlimited attempts.

The use of attempt limits for online quizzes is the focus of this study, with respect to students' performance on these quizzes, and their quiz-taking behavior. The purpose of the quizzes by the author was to encourage students to complete reading assignments prior to the material being covered in the classroom, so the focus of this work will be on implications toward the completion of assigned reading. While there has been a focus by several studies on relationships between exam scores and online quizzes, the results have been mixed, with some authors finding no relationship (e.g., Brown et al. 2015), and others finding small improvements (e.g., Hadsell 2009; Johnson & Kiviniemi 2009; Kibble 2011; Pape-Lindstrom et al. 2018), although the quizzes were voluntary in some of these studies. Although the relationship between online quizzes and summative exam scores is a topic worth further exploration, this research will only examine the quizzes themselves.

DATA AND METHODS

Course description.—The course examined in this study is Introduction to Geographic Information Systems (GEOG 265), an undergraduate course offered within the geography and meteorology department at Ball State University, a mid-sized Midwestern 4-year public university. It is a required course for all geography and meteorology majors and geography minors, and is one of 56 courses that satisfy the natural and social sciences require-

ment of the University Core Curriculum, which is required by all students. As a result, there are several sections of this course offered each semester, and enrollment in any particular section usually includes more non-majors than geography and meteorology majors, as well as students from all years of study. Since this course is taken by students who are not majoring in geography and meteorology, many of whom may not have taken a college-level geography course previously, there is the need to cover many basic geographic principles beyond those specific to the sub-discipline of GIS. Topics covered include map basics, coordinate systems, projections, and visualization techniques and best practices. A large component of the course is dedicated to learning GIS software.

Four sections of Introduction to GIS were taught by the author during a single academic year: two in the fall semester and two in the spring semester. In the fall there were a total of 42 students enrolled, including eight majors and one minor; by year of study there were 3 freshmen, 15 sophomores, 16 juniors, and 8 seniors. During the spring semester, there were a total of 37 students enrolled, divided into 3 freshmen, 12 sophomores, 13 juniors, and 9 seniors. There were only six majors and no minors between the two sections in the spring. The same material was covered between the two semesters, and both shared the same required texts: a physical book that mainly provided step-by-step instructions for learning the course software, and an e-book that emphasized theoretical concepts, both general to geography and specific to GIS.

Reading quizzes.—During both semesters, students were assigned sections of the e-book to read ahead of the time when the content would be covered in class. Online reading quizzes accompanied the assigned readings, and were to be completed prior to the class meeting. The university's learning management system (LMS) was used to administer the quizzes. There were 13 quizzes in total, with the 10 best scores contributing to the overall course grade (5% in a weighted grading system). Each quiz consisted of five multiple-choice questions written by the instructor, which were randomly drawn from a pool of 5 – 12 questions, with both the questions and answers randomly ordered. The number of questions in each pool varied according to the length of the reading assignment, whereby

shorter readings (covering less material) resulted in fewer questions in that pool.

During the fall semester, students were allowed unlimited attempts at each quiz until the start of class, and the best score out of all attempts was retained as the grade for each quiz. For the spring semester, students were limited to a maximum of five attempts per quiz, with the best score still used as the grade for that quiz. This limit was expanded to 10 attempts for the first quiz due to a miscommunication by the author, but remained at five for the other 12 quizzes. There was no time limit imposed on any quiz during either semester, except for the class-time deadline, after which no more attempts could be made to take a particular quiz. At the conclusion of each quiz attempt, students were shown their overall score for that attempt, but there was no indication as to which questions were answered correctly.

Given that students were able to take these reading quizzes on their own time, and on any internet-connected device they wished, it was accepted and acknowledged by the instructor that students could use their e-book to find or check their answers before submitting. In fact, most questions were purposefully written to mirror the wording found in the text, which could make it easier for students to check their answers in the text. These reading quizzes were both designed to motivate students to complete their reading assignments in a timely manner, and do so before the material was covered in class. This intent, and the small contribution to the course grade, made these quizzes nominally instruments of formative assessment.

Analysis procedures.—For each quiz, it is possible through the LMS to export the information associated with each attempt at that quiz by each student. The attempts were listed in chronological order. From these data, it can be determined how many attempts each student made at each quiz, their best score of all attempts (or over a subset of attempts), and the total score of their best 10 quizzes. Using this information, the results of limiting the number of attempts at these online reading quizzes was examined, with a focus on both the frequency that students attempted each quiz, and the effects on their quiz scores.

RESULTS

Students in the two sections of the introductory GIS course that the author taught fall semester were not limited in the number of times they could

attempt any of the 13 reading quizzes, and approximately three quarters of the students in this course took advantage of this by attempting at least one quiz more than five times (Table 1). However, slightly more than half of the class (53%) only attempted a quiz more than five attempts once or not at all, and only a third of the students did so for three or more quizzes. If one compares the students in the fall semester (Table 2), who had unlimited attempts, with those from the spring semester, who were limited to no more than five attempts (except for the first quiz), the frequency at which students attempted a quiz only once or twice was comparable between the two semesters, with 54% in the fall and 58% in the spring. However, more students attempted quizzes five times during the spring semester (20%) than in the fall (6%), most likely because this represented their upper limit. Alternatively, these could have been students who either did not do the reading at all, or who only did so when their previous attempts did not yield an acceptable score.

Number of Quizzes with > 5 Attempts	Number of Students	Frequency
0	9	0.24
1	11	0.29
2	5	0.13
3	3	0.08
4	1	0.03
5	1	0.03
6	2	0.05
7	1	0.03
8	0	0.00
9	1	0.03
10	2	0.05
11	1	0.03
12	1	0.03
13	0	0.00
Total	38	1.00

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Quiz scores were compared between semesters using a two-sample *t*-test, taking the highest score from all attempts at each quiz for each student (Table 3). Only two quizzes show significant differences between the two semesters, with the

Table 2.—Count and frequency of the total number of attempts by each student for each quiz. During the spring semester, only on the first quiz were students allowed more than five attempts (a maximum of 10).

Attempts	Fall		Spring	
	Count	Frequency	Count	Frequency
1	166	0.39	162	0.44
2	66	0.15	53	0.14
3	31	0.07	38	0.10
4	22	0.05	38	0.10
5	27	0.06	72	0.20
6–10	57	0.13	6	0.02
11–15	30	0.07	—	—
16–20	7	0.02	—	—
21–25	13	0.03	—	—
26–30	6	0.01	—	—
>30	4	0.01	—	—
Total	429	1.00	369	1.00

first quiz significant at the 5% level, and the seventh quiz significant at the 1% level. The mean scores for quizzes in the spring semester were higher than those from the fall, with the exception of the final three. Likewise, the mean overall score from the spring semester, which is based on the best 10 quiz grades out of the possible 13, is higher than that from the fall, although this difference is not statistically significant.

In order to better compare the quiz scores of the students from each semester, given that those in the fall could achieve their desired score (presumably a perfect score) through unlimited attempts, the mean scores for each quiz in the fall (and the first quiz in the spring) were re-calculated based on the best score from the first five attempts for each student rather than from all attempts. Using a *t*-test, the two semesters were compared for each quiz (Table 4), showing significant differences between the two semesters for 9 of the first 10 quizzes, four of which at a significance level of 1%. Included is a comparison of the total scores for each semester using the first five attempts, which also showed significant differences between the two semesters at a significance level of 1%. It is not clear why the second quiz, the only one among the first ten which did not show significant differences between semesters, differed from the other nine, but the values of the mean and variance (not shown) for this quiz lead one to believe that there was some additional factor

Table 3.—Number of students (*n*) who took each quiz and mean score for both the fall and spring semesters. The *p*-values from two-sample *t*-tests are shown, with values that are significant at the 1% level are displayed in bold, while those significant at 5% are displayed in italics. “Best 10” total quiz scores are the sum of the best 10 scores for students that completed at least 10 quizzes. The maximum possible score for each quiz is 5, and therefore the maximum score for the best 10 quizzes is 50.

Quiz	Fall		Spring		<i>p</i>
	<i>n</i>	Mean	<i>n</i>	Mean	
1	36	3.92	33	4.42	<i>0.0129</i>
2	24	3.83	32	4.09	0.3226
3	35	4.03	28	4.36	0.1231
4	36	4.22	32	4.59	0.0633
5	37	4.22	29	4.41	0.3406
6	31	4.45	30	4.57	0.5919
7	36	4.56	28	4.89	0.0088
8	29	4.03	31	4.35	0.2584
9	33	4.12	29	4.31	0.4783
10	36	4.42	28	4.64	0.2643
11	33	4.45	24	4.29	0.4919
12	32	4.28	27	3.93	0.2258
13	29	3.72	18	3.72	0.9955
Best 10	31	43.97	29	45.72	0.2257

influencing the results of this quiz for students in the spring semester. Since the total quiz score was based on the 10 best quiz scores, this explains the decline in performance on the final three quizzes,

Table 4.—As in Table 3, except the mean scores are based on the highest score from the first five attempts at each quiz.

Quiz	Fall		Spring		<i>p</i>
	<i>n</i>	Mean	<i>n</i>	Mean	
1	36	3.50	33	4.33	0.0004
2	24	3.71	32	4.09	0.1643
3	35	3.71	28	4.36	0.0053
4	36	4.03	32	4.59	0.0089
5	37	3.78	29	4.41	<i>0.0110</i>
6	31	3.87	30	4.57	<i>0.0131</i>
7	36	4.03	28	4.89	0.0001
8	29	3.52	31	4.35	<i>0.0117</i>
9	33	3.67	29	4.31	<i>0.0389</i>
10	36	4.19	28	4.64	<i>0.0369</i>
11	33	4.09	24	4.29	0.4600
12	32	3.81	27	3.93	0.7412
13	29	3.34	18	3.72	0.3034
Best 10	31	40.38	29	45.66	0.0074

especially during the spring semester. It is likely that some of the best students may have elected not to take one or all of these quizzes depending on their performance on the first ten. This is especially evident with the final quiz, which had the lowest mean score for each semester, and the lowest number of participants in the spring semester.

DISCUSSION

When considering the primary motivation that the author had for assigning reading quizzes, the fact that the majority of students only attempted quizzes one or two times (Table 2) may indicate that many students either completed the reading before taking the quiz, requiring few attempts to achieve their desired score, or did not complete the reading assignment and settled for their best score from their first two attempts. The increase in frequency of 6–10 attempts in the fall and five attempts in the spring suggests that these students either did not complete their reading assignments and were employing strategies such as randomly guessing, or may have had other motivations for taking numerous attempts (such as trying for a perfect score rather than settling for a 4 out of 5). It could be argued that for many students the existence of a reading quiz, and their determination that it would be easier to complete the reading and receive a score on the quiz that they deem satisfactory, was enough motivation to complete the reading assignment. This was the instructor's intended purpose of assigning reading quizzes. However, a subset of these students (less than 25%) may not have completed the assigned readings for some quizzes, taking more than five attempts on at least six quizzes. One student took more than five attempts on 12 quizzes. In five cases, a student attempted a single quiz more than 30 times, perhaps spending more time taking the quiz than they would have spent completing the reading assignment.

The results of comparing mean quiz scores using only the first five attempts between the two semesters were striking, showing significant differences in nine of the 13 quizzes, and in all but one of the first 10 quizzes (Table 4). When applied to the highest scores from all attempts, there were only two quizzes in which significant differences between semesters existed (Table 3), which suggests that many of the students who attempted a quiz more than five times did so until their score was at least adequately high, enough so that most differences between the two semesters were

nominal. Possible conclusions from these results include that by imposing a limitation on the number of times a quiz could be attempted, more students seemed to complete their assigned reading, either initially, or perhaps after taking the quiz once or twice, but further study on the motivation and reading habits of students is necessary.

The author's goal in assigning a reading quiz was to motivate students to complete their reading assignments in a timely manner; it is believed that this goal was achieved for many students. However, with no limitation on the number of times that some students were choosing to attempt quizzes, it was thought that these students were simply taking the quiz without reading, and repeatedly submitting random guesses. By imposing a limit on the number of attempts each student could make on a quiz, there was an improvement in quiz scores over the first five attempts, which could be related to the frequency that students were completing their assigned reading. It is difficult to determine how much of a role this change made, since not all variables could be controlled (e.g. class demographics, other outside influences). Based on these findings, it is suggested that instructors who use online quizzes, especially in conjunction with assigned readings, set a limit on the number of attempts that students are allowed. By imposing a limit, a small number of students who may otherwise forgo the reading in favor of attempting the quiz repeatedly to achieve a satisfactory score might instead elect to complete the reading before attempting the quizzes. The effect that limiting the attempts had on exam scores was examined, but showed no statistical significance, and was not included in this study. In the future, the effects of imposing a time limit on quiz attempts may be examined, as it has been the focus of other research in this area (e.g., Anthis & Adams, 2012), and may yield additional benefits beyond those of imposing limits on total attempts. Also, it would be worthwhile to investigate the effects of further reducing the number of attempts allowed, while also increasing the sample size. While it would require self-reporting, administering a survey to students regarding their reading habits would also be beneficial in working toward supporting the hypothesis of this study.

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