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Effects of Quizzing Methodology on Student Outcomes: Reading Compliance, Retention, and Perceptions

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Abstract
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Keywords
Quizzing methods, reading compliance

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Cover Page Footnote
I would like to express special thanks to the research assistants involved with this project: Billy Rush, Teresa Davis, Mia Kloth, and Brittney Stone. I would also like to express sincere appreciation to Conor Dowling and the reviewers for their feedback on previous versions of this manuscript.
Effects of quizzing methodology on student outcomes: Reading compliance, retention, and perceptions

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This study set out to replicate and extend research on students’ reading compliance and examine the impact of daily quizzing methodology on students’ reading compliance and retention. 98 students in two sections of Abnormal Psychology participated (mean age = 21.5, SD = 3.35; 72.4% Caucasian). Using a multiple baseline quasi-experimental design the daily quizzing methodology was changed at different points in the semester from Clicker questions to Clicker questions plus random written quizzes. The classes did not differ significantly on predictors of success and only differed significantly on one demographic variable. 77.6% of students failed Sappington et al.’s (2002) objective measure of reading compliance and the majority lied about their reading compliance. There was mixed evidence for the impact of quizzing methodology on learning outcomes. Daily quizzing appears to be effective, but adding written quizzes may not improve learning outcomes enough to justify increased grading time.

INTRODUCTION

An undergraduate college education in psychology has multiple desired learning goals (APA, 2012). In order for students to meet these goals, it is necessary for them to actively participate in their education. As educators who desire to help students succeed in college we must understand what predicts their success and what we can do to help them succeed.

One of the first ways students can actively participate in their education is to prepare for their classes by completing reading assignments. Research suggests this preparation is important because it is associated with overall class performance (Sappington, Kinsey, & Munsayac, 2002) and students report lack of preparation for class is a barrier to their class participation (Karp & Yoels, 1976). However, recent research suggests that a majority of college students do not complete reading assignments prior to coming to class (Burchfield & Sappington, 2000; Clump, Bauer, & Bradley, 2004; Connor-Greene, 2000; Sappington et al., 2002). Sappington et al. (2002) found only 22% of students passed their objective measure of reading compliance. Unfortunately, this trend of lack of preparation for class might be increasing (Burchfield & Sappington, 2000). Yet, it is possible that students’ reading compliance varies by the testing schedule of the course, with students reporting they are more prepared for classes with daily quizzing than classes with exams only (Connor-Greene, 2000).

If students’ reading compliance is declining and consistently at levels below 30%, it is important to determine effective strategies for increasing and maintaining student reading compliance across the semester. Multiple strategies have been implemented to increase student reading compliance and course performance, such as completion of out-of-class assignments that require reading (Carkenord, 1994; Ryan, 2006), daily written quizzes (Connor-Greene, 2000), and randomized reading quizzes (Ruscio, 2001).

Although reading is not required to complete in-class quizzes, quizzes may be an effective means of improving reading compliance (Connor-Green, 2000; Ruscio, 2001) while also improving course performance. Quizzing has been found to positively impact exam grades when done in a manner to simulate basic research on the testing effect (see Nguyen & McDaniel, 2015). Research on the testing effect suggests that testing itself and testing with feedback are powerful means to improve the learning of material (Butler, Karpicke, & Roediger, 2008; Roediger, Agarwal, McDaniel, & McDermott, 2011; Roediger & Karpicke, 2006). Immediate feedback after testing allows the learner to correct erroneous knowledge as well as correct metacognitive errors regarding low confidence in correct answers (Butler et al., 2008). Therefore, it is not surprising that previous research has found utilizing student response systems (SRS) during class to quiz and provide immediate feedback to students improves students’ course and examination performance (Brady, Seli, & Rosenthal, 2013; Hall, Collier, Thomas, & Hilgers, 2005; Morling, McAuliffe, Cohen, & Di Lorenzo, 2008) and increases course engagement and motivation (Hall et al., 2005).

Although SRS and written quizzing have shown positive benefits for students, these methods are not without concerns. First, there are multiple time demands on professors that may make grading of written quizzes impractical, especially in large sections. Additionally, multiple time demands are a large source of stress for faculty (Gmelch, Lovrich, & Wilke, 1984), so it is especially important to examine if assessments that require grading confer enough of a benefit to justify the grading time. Second, while utilizing SRS during class reduces (or eliminates) grading time, it is easier for students to guess the correct answer even if they have not read the material, thus potentially reinforcing students who did not read and perpetuating their perception that they can succeed without coming to class prepared. A third concern with utilizing both forms of quizzing has to do with potential negative ramifications on student evaluations. Individuals responsible for evaluating teaching effectiveness rate student evaluation scores and written comments among the top three most important measures to use for evaluating teaching effectiveness (Shao, Anderson, & Newsome, 2007). Thus, it is pragmatic for professors to be concerned about poor student evaluations.

Given the multiple time demands for professors as well as concerns over poor student evaluations, it is beneficial for professors to determine the best methods to simultaneously achieve multiple goals (encouraging students’ reading compliance, engagement with the material, and learning of the material; avoiding an unduly difficult grading load; and avoiding unfavorable student evaluations). Therefore, I set out to determine whether a combination of the use of SRS with pop written quizzes would achieve all of these goals. This study utilized daily SRS quizzes, which require minimal
grade time, and daily SRs quizzes plus written quizzes in only 25% of class sessions, which increase grading load but do not excessively. I hypothesized that, similar to Sappington et al. (2002) it is important to determine whether active learning strategies, such as quizzes, also impact how frequently students read on time and how thoroughly they read assigned readings. A recent study has reported student reading behaviors because student reports of reading on time and the evidence that suggests it improves class participation and performance (Karp & Yoels, 1976; Connor-Greene, 2000; Morling et al., 2008; Ryan, 2006). I hypothesized that, similar to Sappington et al. (2002) utilized an objective measure of student reading comprehension, utilizing a dichotomous “yes/no” system for students to report whether they read the entire syllabus. Thus, students who had skimmed the entire syllabus or read most of the syllabus were forced to decide whether they felt what they did counted as “reading the entire syllabus” and potentially increased the chances of students engaging in self-enhancement bias. Thus, I set out to determine if when students were given multiple options regarding the class readings, the class readings contained in class readings such as “read all, read at least some, skimmed all, did not look at any,” whether they might show less self-enhancement bias and more valid responses. I hypothesized that, similar to Sappington et al. (2002), it is more difficult to support a self-enhancement bias and a majority would lie on their self-reported reading compliance, but that students who failed the objective measure of reading the entire syllabus would report lower levels of reading compliance than those who did not fail the objective measure. Previous research on predictors of students’ success in college classes has found that students’ performance goals (Elliot & Church, 1997; Elliot & Murayama, 2008), intrinsic motivation (Clark, Middelton, Nguyen, & Zwick, 2014), conscientiousness, intelligence, and SAT performance (Conard, 2006; Kappe & van der Flier, 2012), all predict students’ success in college classes. However, it is unclear what role the effectiveness of teaching methodology that also examine whether groups of students in experimental conditions vary significantly on these or other variables of potential importance such as intrinsic motivation for the course material that students may have prior to the course. Therefore, the second aim of the present study is to determine if the students in each quasi-experimental condition differed significantly on any of these other potential predictors of students’ success in college classes. The present study therefore aimed to determine if there would not be significant differences between students who chose to sign up for an 8 AM versus 9 AM section of the class. Although the study was designed to primarily evaluate students’ understanding of the psychological model?”). Students were given approximately ten minutes to complete the written quizzes. Students received feedback on written quizzes the following class but answers were not reviewed because the material had been covered immediately after the written quiz. Quiz questions (both types) were intentionally basic recognition questions designed to be difficult to answer without reading the assigned reading but not so difficult that they required students to do study outside of class. I occasionally used quiz questions that resembled exam questions for practice, but only after we had reviewed the relevant content for the exam. These quiz questions were designed to be helpful practice for exam questions, but they did resemble class activities. Exam questions were designed to primarily evaluate students’ understanding of the material and ability to apply knowledge gained (e.g., by correctly answering the question and by using other, sometimes more complex, processes). A portion of exam questions also assessed recall and recognition of important facts. Measures Demographic questionnaire. The demographic questionnaire created for this study requested information on major demographic characteristics such as participants’ age and year in college. Predictors of Student Success. Four questionnaires were given to students to evaluate whether the sections differed significantly on variables found in previous studies to significantly predict course success. Revised (AGQ-R; Elliot & Murayama, 2008) was included in the pre-post assessment to measure mastery-approach, mastery-avoidance, performance-approach, and performance-avoidance goals (Cronbach’s alphas for this study were .85, .80, .86, and .71, respectively). Second, the average score of two items by Elliot and Church (1997) were utilized to measure how well students read and understood the material. In the present study, these two items consisted of questions embedded in the class plan for the day Clicker questions were primarily designed to test their reading comprehension and open class discussions at the class meeting centered on same concepts. Third, students were asked to return the envelope sealed with the envelope and the manila envelope was used to protect students and keep me blind to percentages participating in each course until the end of data collection. Students who were absent were given individual objective measure of whether students read the entire syllabus (Sappington et al., 2002) was utilized to determine if the Clicker plus written method would have higher grades than the section being quizzed with the Clicker only method on assessments of that portion of material. METHOD Participants All students enrolled in my Spring 2014 Abnormal Psychology sections (taught at 8 AM and 9 AM MWF) were recruited for this study (56 students per section at the start of the semester). Although 101 students originally consented to participate in the study, 55 were enrolled in the 9 AM section and 56 in the 8 AM section. Students completed the pre- and post-packets of the 46 students who consented, 9 AM section, 45 completed the pre-packet and 51 completed the post-packet. Of the 46 students who consented, 11 were missing data in the pre-packet, 9 AM, and 45 completed the pre-packet and 42 completed the post-packet. 11 students who consented in the 8 AM section, 49 completed the pre-packet and 51 completed the post-packet. Of the 46 students completed the post-packet in the 9 AM section, 45 completed the pre-packet and 42 completed the post-packet. Participants mean age was 21.5 years (SD = 3.35), they were primarily juniors (46.8%) or seniors in college (40.4%). 60.2% of the participants were female (39.8% male). To assess self-enhancement, the Revised Abnormal Psychology Questionnaire (AGQ-R; Elliot & Murayama, 2008) was included in the packet to permit the examination of self-enhancement bias. The demographic questionnaire included questions to assess demographic variables such as age, gender, year in college, and ethnicity, as well as questions to assess anxiety levels, test anxiety, and GPA. A demographic questionnaire was completed by 46 students. All students were given the post-assessment packet with their ID number at the start of the final examination and asked to complete the packet of questionnaires (if participating) at the end of the final exam along with a course evaluation (which was not part of this study), thereby ensuring that I was unaware if they were completing the final exam, the post-assessment packet, or the course evaluation. All students were told to place the post-assessment packet in a manila envelope regardless of whether they completed it or not. I sealed the envelope at the end of the final exam period. Students completing the pre- and post-packets were entered into a raffle for one of two $10 Amazon gift cards. Quiz questions Students’ quiz grades accounted for 15% of their final grade in the course. Throughout the semester for both sections, exam questions were generated from the unit readings. The exam questions embedded in the class plan for the day Clicker questions were primarily designed to test their reading comprehension and open class discussions at the class meeting centered on same concepts. Students were asked to return the envelope sealed with the envelope and the manila envelope was used to protect students and keep me blind to percentages participating in each course until the end of data collection. Students who were absent were given individual objective measure of whether students read the entire syllabus (Sappington et al., 2002) was utilized to determine if the Clicker plus written method would have higher grades than the section being quizzed with the Clicker only method on assessments of that portion of material. Procedure During the fourth class, I explained the study and protections for students. I then placed the room and the envelope was sealed by the research assistant and was kept sealed until after final grades were submitted. Students were given a pre-packet and the and the manila envelope was used to protect students and keep me blind to percentages participating in each course until the end of data collection. Students who were absent were given individual objective measure of whether students read the entire syllabus (Sappington et al., 2002) was utilized to determine if the Clicker plus written method would have higher grades than the section being quizzed with the Clicker only method on assessments of that portion of material. I then left the room and the envelope was sealed by the research assistant and was kept sealed until after final grades were submitted. I gave students a pre-packet and a copy of the syllabus and asked students to return the envelope sealed with the packet completed if they consented and blank if they did not. During the second class an SRS quiz was given (Sappington et al., 2002) results, the following line appeared near the bottom of the syllabus: “Students who have read this far in the syllabus will receive 1 point added to their homework grade.” Students were asked to report their compliance with reading the syllabus first at the end of homework #1 and again using their clickers at the start of class reviewing the syllabus/homework #1. Students were asked for the e-mail address they use the most on their homework assignment to verify they had access to an e-mail address. Students experienced the course as if the study was not being conducted. However, the quiz method was modified according to a multiple-baseline quasi-experimental design (the 9 AM section was randomly chosen prior to the semester to receive the manipulation first). At the start of the semester both sections participated in daily multiple-choice clicker quizzes (referred to as the Clicker only method). Following Exam 1, the 9 AM section continued their reading comprehension quizzes with the Clicker only method, whereas the 8 AM section continued their reading comprehension quizzes with the Clicker plus written method. The class lectures and clicker questions were identical with the exception of variations in student responses to questions and student questions promoting varying responses from students. I occasionally used clicker questions that resembled exam questions for practice, but only after we had reviewed the relevant content for the exam. Quiz questions were generated to primarily evaluate students’ understanding of the material and ability to apply knowledge gained (e.g., by correctly answering the question and by using other, sometimes more complex, processes).
**RESULTS**

**Assessments of Reading Compliance and Behavior**

To obtain an objective measure of whether students read the syllabus, they were expected to follow the directions embedded in the syllabus regarding e-mailing the instructor if they read the entire syllabus carefully. Students who did not read the syllabus less than students who passed the objective measure of reading the entire syllabus (the objective syllabus reading check) would report reading all of the syllabus whereas only 70.1% of those who failed did (the remaining students chose four other options).

**Exploratory analyses of daily clicker reading check**

Following the analysis indicating a high level of dishonesty on the syllabus reading level checks, exploratory analyses were conducted to determine if the intended dependent variable, daily clicker reading checks, could be trusted as valid. This was done because the daily clicker reading check was an identical clicker reading check question but was given at the start of all classes with a quiz.

**Global reading behavior**

Although students’ self-report on the global reading behavior questions may also be invalid, it is interesting to note their responses. Wilcoxon signed-rank tests were conducted to find out if students who self-reported reading the syllabus more than in previous classes and the present class.

**TABLE 1. Percentages of self-reported global reading timing in the present course**

<table>
<thead>
<tr>
<th>Time</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before class</td>
<td>66.7%</td>
</tr>
<tr>
<td>Shortly after</td>
<td>16.1%</td>
</tr>
<tr>
<td>Several days</td>
<td>6.6%</td>
</tr>
<tr>
<td>Before test</td>
<td>10.4%</td>
</tr>
<tr>
<td>Day or night</td>
<td>11.8%</td>
</tr>
<tr>
<td>Did not read</td>
<td>11.8%</td>
</tr>
</tbody>
</table>

**TABLE 2. Descriptive Statistics and Results by Assessment**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1a</td>
<td>52</td>
<td>78.52</td>
<td>16.28</td>
<td>46</td>
<td>83.00</td>
<td>15.19</td>
<td>-1.40</td>
<td>.16</td>
</tr>
<tr>
<td>Exam 1b</td>
<td>51</td>
<td>75.70</td>
<td>15.30</td>
<td>46</td>
<td>81.72</td>
<td>11.52</td>
<td>-2.20</td>
<td>.03</td>
</tr>
<tr>
<td>Exam 2a</td>
<td>28.07</td>
<td>15.63</td>
<td>46</td>
<td>80.07</td>
<td>12.51</td>
<td>-1.29</td>
<td>.20</td>
<td></td>
</tr>
<tr>
<td>Exam 3a</td>
<td>25.13</td>
<td>16.70</td>
<td>46</td>
<td>17.50</td>
<td>2.33</td>
<td>-8.50</td>
<td>.10</td>
<td></td>
</tr>
<tr>
<td>Exam 4e</td>
<td>22.00</td>
<td>4.92</td>
<td>46</td>
<td>22.48</td>
<td>4.56</td>
<td>-4.86</td>
<td>.63</td>
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</tr>
</tbody>
</table>

A series of independent means t-tests were performed to determine if students in each section differed significantly on any of the measured psychological characteristics. There were no significant differences found for self-reported current or high school GPA, competency expectations, intrinsic motivation for the course, AGG-R achievement goals, or TIPI personality factors.

**Assessments of Retention of Material**

As shown in Table 2, the sections did not differ significantly in their scores on behaviors that they had the same quizzing method (i.e., pre-manipulation and post-manipulation in both sections). There were mixed results for the hypothesis that the 9 AM section would score higher when they had the Clicker plus written quizzing method than the 8 AM section. As hypothesized, the 9 AM section scored significantly higher on Exam 2. However, contrary to hypotheses, the 9 AM section did not score significantly higher on the first portion of Exam 3 and did not perform significantly higher on any of the assessments in the semester, indicating that students assessed using the 9 AM section and 8 AM section were performing at the same level.

**TABLE 4. False Beliefs and Critiques**

<table>
<thead>
<tr>
<th>Response</th>
<th>False Beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Students who read the syllabus carefully were more likely to respond honestly.</td>
</tr>
<tr>
<td>2</td>
<td>Students who passed the objective syllabus reading check also reported on both their homework (81.8%) and class by quizzing methodology.</td>
</tr>
</tbody>
</table>
| 3        | Students who read the syllabus less than students who passed the objective measure of reading the entire syllabus (the objective syllabus reading check) would report reading all of the syllabus whereas only 70.1% of those who failed did (the remaining students chose four other options).

**DISCUSSION**

**Assessments of Reading Compliance and Behavior**

Syllabus reading. Despite all students participating in the study, 17% did not read the syllabus carefully enough to read the instructions to send the e-mail, only 22.4% did so. This result almost exactly replicates Sappington et al. (2002) result of 22% reading compliance and extends its results by finding that even when students are given a more nuanced opportunity to be honest in their report of whether they read all of the syllabus, a majority still lie. These results were further supported by the fact that the majority of students who do not read assigned readings at all, or at least not thoroughly (Burchfield & Sappington, 2000; Clump et al., 2004; Connor-Greene, 2000; Sappington & Sappington, 2002) and call into question the validity of students’ self-reported reading behavior.

There was mixed support for my hypothesis that students who failed the objective measure of reading the entire syllabus (the objective syllabus reading check) would report reading all of the syllabus less than students who passed the objective measure. Although lower percentages of students who failed the objective syllabus reading check reported reading all of the syllabus on the homeworke, only 24 of 60 (40%) students who failed the objective syllabus reading check, this difference was only statistically significant for the in-class responses. It is possible that students who passed the objective syllabus reading check were more honest in their responses at both time points and those who reported not reading the entire syllabus on their homework read the remainder of the syllabus prior to class. It is also possible that students who did not read the entire syllabus on their homework did not pass the objective syllabus reading check and may have passed the course with the help of the in-class clickers.

**Course evaluations & self-reported engagement in class by quizzing methodology**

Overall, students did not prefer the possibility of having a random written quiz during 25% of the classes where they were guaranteed to have a quiz. Despite the fact that students had a 100% guarantee that they would have a daily quiz (they just were not sure what format would be used to determine their grade for the day), written quizzes were not preferred over the clicker method. In the mid-semester evaluation reflected that they disliked the random written quizzes. For instance, on an anonymous clicker midterm evaluation question given only in the 9 AM section, 73% reported that they would not prefer the clicker plus written method, and 11% reported that they would prefer to have only a written quiz every chapter.

As in previous classes and the present class, students did not prefer the possibility of having a random written quiz during 25% of the classes where they were guaranteed to have a quiz. Despite the fact that students had a 100% guarantee that they would have a daily quiz (they just were not sure what format would be used to determine their grade for the day), written quizzes were not preferred over the clicker method. In the mid-semester evaluation reflected that they disliked the random written quizzes. For instance, on an anonymous clicker midterm evaluation question given only in the 9 AM section, 73% reported that they would not prefer the clicker plus written method, and 11% reported that they would prefer to have only a written quiz every chapter.

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them to read the material assigned for each class prior to that class. Students who completed the reading assignments by the assigned dates for both classes, class participation, and understanding of course material were not significant. Differences in Exam 2 and no other assessments could be caused an increase in exam performance for both sections, it did not allow for a more clear-cut differentiation between the better quizzing methodologies. Future research should employ the more standard two condition quasi-experimental design for teaching method manipulations.

CONCLUSIONS

The current study adds to two major aspects of the scholarship of teaching and learning literature. First, it adds to the literature suggesting that students do not fully read assigned readings and a majority will lie about their reading level. This finding made it impossible to run an analysis that would be considered valid regarding whether quizzing methodology impacted students’ reading levels on a day-to-day basis. Second, it adds to the literature on the benefits of incorporating daily quizzing methodologies. Given the overall results of this study, it appears that while daily quizzes are beneficial for students’ long-term retention of the course material it does not appear that the additional grading time required by written quizzes is warranted for obtaining outcomes not already obtained by the use of daily clicker reading comprehension quizzes.

NOTES

The change in quizzing methodology was announced during the first class following Exam #1 (class #11) for the 9 AM section. For the 9 AM section, 25% of remaining classes meant they would have a written quiz in six of the remaining 24 classes covering new material. In reality, five of the written quizzes were randomly chosen and the sixth written quiz was intentional in the last class covering new material to ensure that students would always think it was a possibility to have a written quiz. Students were informed that the reading for that day and the following day would appear on the next quiz to ensure that they would be prepared. Although only one of the hypothesized differences in exam grades was found, we can be relatively sure that the difference was not due to pre-existing differences between the sections. Future research on the impact of quizzing methodology should evaluate the groups for potentially important pre-existing differences to ensure results are due to the manipulation only.

One major strength of the current study is the fact that there were minimal differences in the sections other than the quizzing methodology because both sections were taught the same semester, by the same professor, only one hour apart with identical assessments. Furthermore, the sections had identical class plans for all but the eight classes in which one section received the written quiz at the start of class. During these classes the class plan was identical for the time that the written quiz was written but that section experienced a more rushed version of the class plan. One potential important difference between the sections and a limitation of the study which could not be prevented (or even evaluated) was that I was likely able to provide better feedback to the students on the written quizzes. Overall, the study included a majority that would favor the additional grading time and additional content that was added to the course.
indicated they received the e-mail or were concerned the e-mail had been intended for them, nor did they indicate they remembered it when I announced the changed policy in their section.

ACKNOWLEDGEMENTS

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REFERENCES


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