

Reviewing for Exams: Do Crossword Puzzles Help in the Success of Student Learning?

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Abstract

The goal of this project was to further our understanding of how students learn. Does reviewing for exams using certain teaching methods actually enhance students' learning of course material? Through a comparative analysis of two sections of the same class the researchers tested to see if using crossword puzzles as a 'fun' review technique actually affects students' exam scores as evidence of successful learning. The results revealed that some classes benefited while others did not.

Keywords: Games, teaching methods, learning, exam review.

All students, at some point in their academic career, must review for an exam. There are several different study techniques that can be employed, including flash cards, rote practice, practice tests or quizzes, and games to review the material. Because of the potential for these methods to impact student learning and exam outcomes, it is important that research is done to look at the effectiveness of these methods. Not only might they positively impact grades, but the ways in which students choose to study may negatively impact their grades as well.

It is first helpful to identify why employing different study techniques in classroom teaching is important. Krätzig and Arbuthnott (2006) found that varied learning techniques aid in retaining complicated information, and Klepper's (2003) study found that a multi-approach in vocabulary was more effective than using a single approach. Because individuals differ in the type of stimuli from which they best retain and process information, such as verbal or visual (Krätzig & Arbuthnott, 2006), it is best to have a variety of resources available to students to aid in the learning process (Franklin, Peat, & Lewis, 2003). Not only can this accommodate a range of learning styles, but it can also minimize repetition and boredom in the classroom (Franklin et al., 2003). This is more important now than ever, as research has found that today's students have more diversity in learning styles (Moore & Dettlaff, 2005).

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In response to different styles of learning, the use of games in the classroom can be an effective tool, especially at the college level. Gifted and talented students, who are the most likely to attend college, have been found to prefer games and other alternative teaching methods (Moore & Dettlaff, 2005). For some teachers, implementing alternative methods of teaching may be difficult, as many teachers prefer to use the traditional methods they are comfortable with, but games can be used as a supplement to traditional methods, not as a replacement (Moore & Dettlaff, 2005). Finally, it is important to note that games can add flexibility to the classroom, allowing students to adjust to the way in which they learn best (Moore & Dettlaff, 2005). Games allow students to work in groups or alone, to be competitive or not, to be creative, and to have fun while learning.

Games have been a widely utilized form of study by students and teachers alike, across all age groups and areas of study. These methods are a desirable learning method, as they can make studying more enjoyable (Franklin et al., 2003; Weisskirch, 2006; Crossman & Crossman, 1983). Haun (1985) reports a number of benefits to using games in the classroom, including teaching students alternative techniques to studying, impacting cognitive development, motivating students to learn instead of simply memorizing, and boosting students' confidence when they get a correct response.

Due to the fact that games are a useful tool, it is not surprising how many different types of games are used for test review and classroom teaching at the university level. BINGO (Klepper, 2003), simulation games and role playing (Childers, 1996), games formatted like the Olympics (Clark, 1997), Jeopardy-type games (Rotter, 2004), web-based quizzing (Gurung & Daniel, 2006), discussion games (Franklin et al., 2003), and crossword puzzles (Weisskirch, 2006; Franklin et al., 2003; Crossman & Crossman, 1983; Childers, 1996) have all been used by instructors to review course material. Using these different approaches to learning can be helpful in several ways. Games can relieve the tedium of lecture and traditional teaching methods, as well as create a more relaxed and friendly classroom atmosphere (Dorn, 1989). Reinforcement of critical information can be done through the novel use of games instead of rote practice (Rotter, 2004). This can increase the amount of attention students give to the material, thus increasing retention (Klepper, 2003). Another positive outcome of using games in the classroom is that participation in them makes learning a matter of direct experience (Dorn, 1989), and research has shown that students prefer hands-on learning such as this (Moore & Dettlaff, 2005). Making students' interaction with material active rather than passive is important as "the mind is an instrument to develop rather than a receptacle to be filled" (Dorn, 1989, p. 5).

With these benefits in mind, the crossword puzzle stands out from the rest as a classroom tool. Crosswords have been used successfully in many different disciplines (Childers, 1996), showing their versatility and flexibility. They are also a useful tool as most people are already familiar with them, which reduces the need to explain directions, saving class time (Crossman & Crossman, 1983; Weisskirch, 2006). Additionally, these puzzles are often perceived as being a recreational activity, therefore making them more enjoyable and less threatening than traditional teaching techniques (Crossman & Crossman, 1983; Childers, 1996).

Crossword puzzles have been shown to be effective teaching tools of terminology, definitions, spelling, and pairing key concepts with related names, resulting in greater retention and memorization of facts (Childers, 1996; Franklin et al., 2003; Crossman & Crossman, 1983; Moore, 2005). Because of the need to spell items correctly to complete the puzzle, their use results in increased care in studying as well, and when completed, can be used further as a study device (Crossman & Crossman, 1983; Childers, 1996).

As a study tool, crossword puzzles are helpful in identifying areas of understanding as well as lack of comprehension and areas of weakness (Weisskirch, 2006; Franklin et al., 2003; Childers, 1996). When students identify answers correctly, they may have an increase in confidence (Weisskirch, 2006; Crossman & Crossman, 1983; Franklin et al., 2003; Childers, 2003). This can have a positive effect on grades, as self-efficacy has been shown to be connected to performance (Cassidy, 2004), and satisfaction has been shown to reinforce learning (Childers, 1996). When students have difficulty with the puzzles, they are prompted to ask questions and research to find the correct answers (Franklin et al., 2003). Overall, students found this method of study to be helpful (Childers, 1996), and research has shown crosswords to have a positive effect on learning (Weisskirch, 2006). Research has also shown that these puzzles increase motivation and students' interest in the topic at hand (Franklin et al., 2003; Crossman & Crossman, 1983).

In contrast with all the research showing that crossword puzzles are a positive tool to use in the classroom, there has been little to examine and evaluate the success they provide in student learning. Most studies look more closely at teachers' and students' attitudes toward the puzzles (Crossman & Crossman, 1983; Franklin et al., 2003; Childers, 1996; Weisskirch, 2006), rather than the actual effect using them has on students' grades. Crossman and Crossman's (1983) study did compare pretest scores to final exam scores after crosswords were used in the classroom, but there was no control group in which students did not use the crosswords to see if the increase in scores was actually due to the puzzles and not some other factor. Although there are some holes in earlier studies, they provide a foundation for the analysis of crosswords as effective study tools.

The current study advances the literature to show whether crossword puzzles do enhance student learning and therefore student grades. This is accomplished through a comparative analysis of two sections of an introductory sociology class. The research question to be studied is: Does the use of crossword puzzles as test review enhance students' test scores?

Methods

Participants

Eighty-seven college students in two sections of an Introduction to Sociology course participated in this study (Class A, $N = 43$; Class B, $N = 44$). The majority of students were freshmen (Class A, 86%; Class B, 59.1%); the remainder of the classes consisted of sophomores (Class A, 11.6%; Class B, 36.4%) and juniors (Class A, 2.3%; Class B, 4.5%).

Procedure

Key terms were chosen and presented to the students to review for the exams. Using a crossword creator software program, the review terms, along with their clues, were generated into a crossword puzzle. The crossword puzzle review aid was given to one group and a review of just the key terms used on the crossword were given to the other group. The class that received the puzzle was given time to complete it in class, they were allowed to work in groups or individually, and the answers to the puzzle were reviewed at the end of the class period. The class that did not receive the puzzle was given the key terms, and the students were able to ask questions about the terms prior to leaving class. The exams were multiple choice based on both definitions and applications of the key terms. Table 1 shows that the class given the crossword puzzle was alternated throughout the semester for each of the four tests.

Table 1.

Test Number	Class A	Class B
1	Crossword puzzle review	No crossword puzzle review
2	No crossword puzzle review	Crossword puzzle review
3	Crossword puzzle review	No crossword puzzle review
4	No crossword puzzle review	Crossword puzzle review

Results

Repeated Measure ANOVAs

The results demonstrate that the crossword puzzles had a significant effect on students' exam scores for both class periods (Class A: $F = 5.617$, $p = .001$; Class B: $F = 8.850$, $p = .000$). Specifically, it was found that students' exam scores in Class A were higher when they were given the crossword puzzle as exam review (Exam 1 $M = 73.30$; Exam 3 $M = 76.075$) than when they were given a list of terms for exam review (Exam 2 $M = 71.463$; Exam 4 $M = 68.575$). However, in Class B students' scores on exams were lower when they were given the crossword puzzle as the exam review (Exam 2 $M = 73.605$ and Exam 4 $M = 70.744$) than when they were just given a list of terms for exam review (Exam 1 $M = 77.512$ and Exam 3 $M = 75.860$). This indicates that there is a possible difference between the classes on the exams.

Independent t-tests

In order to examine the possible difference in scores between the two classes, an independent t-test was conducted on all four exams. Results found that the means for each of the four exams did not differ significantly between the two classes ($p = .310$; $p = .321$; $p = .933$; $p = .456$, respectively). Levene's test for equality of variances also indicates that the variances for Class A and Class B for each of the four exam times did not differ sig-

nificantly from each other ($p = .230$; $p = .208$; $p = .427$; $p = .712$, respectively). Thus, there is no significant difference between the two classes in terms of their scores for each of the exams.

Pair-sample t-tests

Pair-sample t-tests were conducted to compare both non-crossword puzzle review times and the crossword puzzle review times within both class sections to see if there were significant differences between the same conditions for exam review. In both class sections, the results for the non-crossword puzzle exam review times found that the mean scores were not significantly different from one another (Class A, $p = .095$; Class B, $p = .474$). For the crossword puzzle reviews, the results also found in both class sections that the mean scores were not significantly different from one another (Class A, $p = .316$; Class B, $p = .060$). Thus, there was no difference between the scores on the students' exams under the same test condition.

Pair-sample t-tests were then conducted to compare the exams scores between the crossword puzzle reviews and the non-crossword puzzle reviews within each of the classes separately. For Class A, the results were mixed. When comparing the first pair (Exam 1 & Exam 2) it was found that the mean score on the exam with the crossword puzzle review ($M = 73.000$) was not significantly different ($p = .125$) from the mean score on the exam with the non-crossword puzzle review ($M = 71.463$). However, when analyzing the second pair of exams (Exam 3 & Exam 4), the mean score for the crossword puzzle review ($M = 76.075$) was significantly different ($p = .000$) from the mean scores on the exam with the non-crossword puzzle review ($M = 68.575$). Thus, having an exam review using crossword puzzles did affect students' exam scores in Class A, but only for one of the exam pairs. For the pair that was significant, students did better on the exam when they were given the crossword puzzle as review. The results also found that a significant correlation exists between each of the exam pairs ($r = .573$, $p = .000$; $r = .623$, $p = .000$), indicating that those who scored high on one exam tended to score high on the other.

For Class B, the results for both tested pairs found that the mean score on the exams with the non-crossword puzzle review were significantly different from mean scores on the exams with the crossword puzzle review (respectively, $M = 77.512$ to $M = 73.605$, $p = .017$; and respectively, $M = 75.860$ to $M = 70.744$, $p = .001$). Thus, having an exam review using crossword puzzles as a review technique did affect students' exam scores in Class B, but in the opposite direction; the mean scores show that students did *worse* on the exams when they were given the crossword puzzle as review. The results also found a significant correlation exists between each of the test pairs ($r = .711$, $p = .000$; $r = .671$, $p = .000$), indicating that those who scored high on one exam tended to score high on the other.

Conclusions

The results of this study varied in how the use of crossword puzzles, when used as an exam review, affected the success of student learning. The students in one class showed

improvement in their exam scores when given crossword puzzles to use for review, but only one exam pair out of two was shown to have significant difference. On the other hand, the second class' results showed a decrease in exam scores with use of crossword puzzles, with the difference being significant in both exam pairs.

What does this mean?

The differing results between the two classes used in this study suggest that further research on this topic needs to be done. The procedures that were followed in administering the crossword puzzles for exam review have been shown to be effective ways to increase student learning. Weisskirch (2006) found that students were more likely to complete the puzzles when given time to do them in class, and when given the chance to work collaboratively with others, students found the puzzles to be more useful and enjoyable than when doing them on their own. In addition to these findings, allowing students to complete the crosswords in class can provide the opportunity for them to ask questions or review answers orally with the instructor (Weisskirch, 2006).

In contrast to the positive aspects of crossword puzzles, past literature and research offers a few reasons as to why student grades may have been negatively impacted by the use of this study method. As stated earlier, a multi-approach to learning is more effective than a single approach (Klepper, 2003), so the addition of crossword puzzles to the use of a standard review technique may have been more effective than providing students with only one or the other. Because of the recreational connotation associated with crossword puzzles, some students may have not taken the task of completing the puzzles seriously, as they were perceived to be unimportant (Rotter, 2004). On the other hand, students may have done the puzzles given to them at the cost of spending time studying the material in other ways. As Gurung and Daniel (2006) found, "many students spend too much time on some aids...at the expense of studying important material or working on elaboration and understanding of material" (p. 53). Because students tend to gravitate towards study techniques that require less time and effort (Gurung & Daniel, 2006), students may have assumed that completing the crossword puzzles was sufficient for studying for the exams. One way in which the use of crosswords might be made more effective is to allow students to develop puzzles for their fellow classmates to complete (Moore & Detlaff, 2005). In this way, students are forced to research and understand the material so that they are able to write meaningful clues for the puzzle.

This study provides a glimpse at the use of crossword puzzles for exam review and the impact they have on student learning. Future research is needed to further explore how these puzzles might be used to more positively impact students' exam scores, and items such as what study methods students report using, how study aids are used, and the length of time students spend using these methods and aids should be looked at. Demographics could also be researched in future studies. Level of study in college (freshman, sophomore, junior, senior), sex, academic skill (measured by SAT scores or GPA) could be looked at further to see if they have differing impacts on student learning. Instructors may also have an impact on how students study and use study aids, and future research should look at how instructors inform their classes to use study aids, and how this impacts the way in which students use the aids. Finally, future research may want to explore learning

styles, and whether a particular learning style will lend itself to the use of crossword puzzles with positive, negative or neutral results.

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