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 we tested to see if using crossword puzzles as a ‘fun’ review technique actually affects students’ exam scores as evidence of successful learning.

Review of the Literature
• Crossword puzzles have not been largely examined to evaluate success for students learning.
• Crossword puzzles are shown to increase retention among students (Crossman & Crossman 1983) and clarify concepts (Childers 1996). But do they help when used as an exam review aid?
• Many types of games are used as test review including: board games (Clark & Farland 1992), simulations games (Dorn 1989), jeopardy (Rotter 2004), bingo (Klepper 2003), and crossword puzzles (Childers 1996; Crossman & Crossman 1983).

Research Questions
• Does using crossword puzzles as an exam review aid affect student exam scores?

Methodology
Participants
Eighty-seven students in two sections of an introductory sociology class 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 were sophomores (Class A, 11.6%; Class B, 36.4%) and juniors (Class A, 2.3%; Class B, 4.5%).

Procedure
Key terms were chosen to give 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 puzzles 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 group given the crossword puzzle was alternated throughout the semester with the four tests:

<table>
<thead>
<tr>
<th>Test Number</th>
<th>Class A</th>
<th>Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crossword puzzle review</td>
<td>No crossword puzzle review</td>
</tr>
<tr>
<td>2</td>
<td>No crossword puzzle review</td>
<td>Crossword puzzle review</td>
</tr>
<tr>
<td>3</td>
<td>Crossword puzzle review</td>
<td>No crossword puzzle review</td>
</tr>
<tr>
<td>4</td>
<td>No crossword puzzle review</td>
<td>Crossword puzzle review</td>
</tr>
</tbody>
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Results
Repeated Measure ANOVAs
Results found that there was a significant effect over time in student scores on their exams 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 better 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 mean 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 significantly 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 each class period to see if there were significant differences between the same conditions for exam review. In both class periods, 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 = .995; Class B, p = .474). For the crossword puzzle reviews, the results also found in both class periods 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.

Conclusions
The results were mixed when looking at the use of crossword puzzles as tools for the increase of student success of learning. One class had improvement in student exam scores when using the crossword puzzle, but only one pair was found significant. On the other hand, the second class’ results were significant in both exam pairs, but the crossword puzzle as a review tool negatively affected student’s exam scores.

What does this mean? The fact that one class did do better on exams when given the crossword puzzle indicates that further research on this topic needs to be done. Why did students’ scores decrease when using the crossword puzzle as review? Learning theory suggests that if students only used the crossword puzzle as their study technique, they are less able to retain information than if they used multiple techniques (Krätzig & Arbuthnott 2006). Perhaps when given the crossword puzzle, rather than just the key terms, the students in the second class did not take the initiative to go beyond the crossword puzzle and explore the terms more thoroughly; whereas when they were only given the key terms, they were ‘forced’ to look things up. As Gurung & Daniel (2006) point out, “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). This supports the fact that the students did worse on exams when given the crossword puzzle as a test review and study aid.

This study provides a glimpse at the use of a review technique in helping students learn material for exams. Future research should be focused upon the use of such review aids, how the instructor informs students about using the aid, as well as how exactly students utilize the aid for studying for exams.

Bibliography:
Available upon request from authors.