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Effective Note Taking Strategies in the Secondary Mathematics Classroom

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EFFECTIVE NOTE TAKING STRATEGIES IN THE SECONDARY MATHEMATICS CLASSROOM

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05/07/17

Effectiveness of the Cornell Method, Guided Notes, and Graphic Organizers on Student Achievement in the Mathematics Classroom

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Abstract

Note taking is an essential part for student success in the classroom. Students that struggle recording notes benefit from having a note taking method with a set format or design. The Cornell method, guided notes, and graphic organizers are all structured note taking methods that each have their own benefits. This quantitative research study focuses on whether the Cornell method, guided notes, or graphic organizers are effective in a secondary mathematics classroom based on students' academic achievement.

Keywords: Cornell method, guided notes, graphic organizers, mathematics

There are many key factors that benefit students' success in the classroom. One main influence in the classroom is the teacher and their preferred instructional methods. However, some students have difficulties understanding the content because of the struggle of note taking. When students do not use effective note taking skills during lectures, they end up missing out on important concepts and content (Boyle, 2010). Note taking is an essential skill that all students must have in order for them to be successful in the classroom.

Students are commonly expected to record notes during their classes. A necessary skill to learn in core classes is the ability to listen to lectures and record notes (Boyle, 2010). Note taking is a complex activity that requires comprehension and selection of information and written production processes (Piolat, Olive, & Kellogg, 2004). Note taking is a difficult skill in which students must not only have good listening skills, but also be able to pick out the important points from a lecture, record the information in an understandable manner, and write quickly enough in order to stay on pace with the lecturer (Boyle, 2010). Students that have a reliable system or format of notes can increase learning and achievement (Quintus, Borr, Duffield, Napoleon, & Welch, 2012). The Cornell method, guided notes, and graphic organizers are all consistent and structured in a way that is easy for students to follow when taking notes.

There are a number of students who have a particular difficulty in mathematics (Ives, 2007). As Ives (2007) states, "teachers and researchers have begun to explore instructional methods that are less dependent on reading and language comprehension than traditional mathematics instruction." Therefore, structured notes are more beneficial in a secondary mathematics classroom. As the year moves on, the new mathematics material builds off previous material taught. With structured notes, students are able to use their notes to add the new material to the previous material taught.

Most research is on note taking strategies and students with disabilities, there is a lack of research on the effectiveness of note taking in the secondary mathematics classroom. Therefore, this action research focused on students in a secondary mathematics classroom and their academic achievement over the course of three units using three different note taking strategies. Measuring students' academic achievement was done: analyzing pretest and posttest results over the course of three units in the mathematics classroom. After the research study, students will complete a survey to determine their preferred note taking strategy. After the research is completed and all the data is collected, I will be able to understand whether the Cornell method, guided notes, or graphic organizers are more effective in my secondary mathematics classroom.

Literature Review

This literature review focuses on the effect of the Cornell method, guided notes, and graphic organizers on student achievement and the research that has been conducted on this matter. This review has been organized into six sections. The first section details the procedures used during the researching and gathering of the literature analyzed in this review. The next section is on the three note taking strategies being studied. This section includes the Cornell method, guided notes, and graphic organizers. After discussing the three different note taking strategies, the benefits of note taking in the classroom are explained. Then the disadvantages of researching the effectiveness of various note taking strategies in the classroom are discussed. Afterwards, the gaps in the research on the effectiveness of different note taking strategies will be examined and discussion of further research on note taking strategies will take place. The final section of this literature review is a conclusion that will review the literature review in its entirety.

Research Methods

Research studies were retrieved from two online databases, Education Research and Education Research Complete. The search terms used to find the research studies comprised of "note taking AND strategies", "Cornell method AND note taking method", "guided notes AND note taking", and "graphic organizers AND secondary mathematics". As well as accessing the literature through the two online databases, I used the reference page of Dexter and Hughes (2011) to find the research study of Ives (2007). I also used Google Scholar to acquire the Jacobs (2008) study after finding it in the reference page of Belson, Hartmann, and Sherman (2013). The search was limited to articles published after 2000, with the exception of Lazarus (1991), which allows the use of newly developed studies that show recent and relevant note taking

strategies in the classroom. Additionally, the search narrowed down to only include literature based in a middle or high school setting. Furthermore, the literature being synthesized in this literature review incorporates general education students as well as students with learning disabilities.

Note Taking Strategies

Ives (2007) emphasizes the fact that mathematical instruction is changing by asserting, "Teachers and researchers have begun to explore instructional methods that are less dependent on reading and language comprehension than traditional mathematics instruction" (p. 110). As well as mathematical instruction changing, note taking strategies are being developed and incorporated in today's classrooms. For learning to be successful, students must record notes and then study them. Nevertheless, students' notes must be organized in a way that is useful so that maximum studying can occur. There exists many different types of note taking strategies; however, studies and literature exploring the Cornell method, guided notes, and graphic organizers are the three note taking strategies that will be analyzed in the following.

Cornell method. Faber, Morris, and Lieberman (2000) defines the Cornell method as a two-column format in which a paper is folded length wise with approximately one third on the left of the fold for the recording of main ideas, and the remaining two thirds of the space on the right of the fold for recording details. The Cornell method is a learner-directed note taking strategy used in classrooms to help students organize their notes in a way that benefits them when studying the notes at a later time. However, if students are not taught the appropriate way to record notes using the Cornell method, then this note taking strategy is not useful for the students. Faber et al. (2000) conducted a study involving the Cornell method. They studied the academic gains between two classes: one class was taught how to correctly record notes using

the Cornell method and the other class did not receive any note taking instruction. Their results determined that there was not a significant difference between academic achievement between the two groups.

Quintus et al. (2012) studied the academic success of high school students when using the Cornell method versus student-choice note taking. Their research study consisted of two groups, one using the Cornell method and the other using a method of their choice. Quantitative analysis of three unit tests indicated no significant difference in the test scores. They concluded that there is no statistical difference in student-choice note taking and the Cornell method on student academic performance.

Belson et al. (2013) linked digital note taking with the Cornell method. After performing t-tests, they discovered that students' note taking with notes taken with the digital pen indicated that there was a significant positive difference in some areas of note quality with the use of the pen when added to the Cornell note taking system (Belson et al., 2013). Regarding mathematics, this study emphasizes the positives of digital note taking in which the students could listen to the instructor describe a formula or a procedure instead of copying down the notes and not understanding. Digital note taking also has its disadvantages. One being, the need for technology and whether every classroom is equipped with the technology of digital pens, another being that digital pens are useful for recording and listening to mathematical lectures over again for later study. They may not be useful for some students with hearing impairments.

Although the majority of the research (Faber et al., 2000; Quintus et al., 2012) suggests that the Cornell method had no effect on student academic achievement, none of their research was in the mathematics field, but nonetheless their findings cannot be overlooked. Jacobs (2008) studied the effectiveness of the Cornell method compared to guided notes in the secondary

English classroom. She found both methods to be effective and have different advantages. In regards to which method is more effective when measured with a pretest and a posttest, she discovered that the guided notes method had the highest increase in scores. Her observations led her to make the conclusion that guided notes are more beneficial than the Cornell method when learning information that can be memorized, such as names and places. On the other hand, the Cornell method is more useful when students need to synthesize, apply, or evaluate information (Jacobs, 2008).

Guided notes. As defined by Haydon, Mancil, Kroeger, McLeskey, and Lin (2011), guided notes is a note taking strategy in which the teacher provides students with a handout containing a map or outline of the lecture, and he or she leaves some critical information blank requiring a student response. This critical information ranges from key facts, to important concepts. The following three research studies have concluded that guided notes are an effective note taking strategy in which guided notes consistently produced better academic outcomes than traditional note taking strategies. Haydon et al. (2011) examined thirteen studies in a meta-analysis study and determined that guided notes allowed students to retain more information from lectures. This meta-analysis study also showed that guided notes benefited the students academically by improving students' test scores.

Hamilton, Seibert, Gardner, and Talbert-Johnson (2000) also measured the effects of guided notes on academic performance. They used a single-subject ABAB reversal design across experimental conditions to conclude that students demonstrated an improved academic performance when guided notes were implemented. The two studies previously described emphasize on the positives of applying the guided notes strategy and the effect it has on students' academic performance. As Haydon et al. (2011) states, guided notes are designed to increase

student listening, active participation, and convert verbal behavior during classroom lectures and discussions.

Lazarus (1991) came to similar conclusions, as did Haydon et al. (2011) and Hamilton et al. (2000) in his own study about the effectiveness of guided notes. In this single-subject reversal design research study, it was concluded that the use of guided notes produced greater academic gains for students with learning disabilities. Much of the research regarding guided notes has focused on students with learning and behavior problems (Hamilton et al., 2000), learning disabilities (Lazarus, 1991), and students who struggle with learning in general (Haydon, 2011). Although the research regarding guided notes (Haydon et al., 2011; Hamilton et al., 2000; Lazarus, 1991) does not take place in a mathematics classroom, it is nonetheless pertinent in the effectiveness of guided notes and student achievement in a content classroom.

Graphic organizers. Graphic organizers are a note taking strategy that visually represent material that is difficult to understand and make the text more meaningful and accessible to students (Gajria, Jitendra, Sood, & Sacks, 2007). The literature being analyzed on the graphic organizer strategy is directly related to students with learning disabilities. However, the following studies are still relevant in all educational classrooms. Dexter and Hughes (2011) conducted a meta-analysis of sixteen articles and found that overall, graphic organizers showed the highest achievement on posttest results. As Dexter and Hughes (2011) examined graphic organizers in each subject area, the small posttest effects for mathematics could be explained by the fact that the content was more abstract than the other subjects in the meta-analysis.

Ives (2007) performed a two-group comparison experimental design study to investigate the effectiveness of graphic organizers in the mathematics classroom with students who have learning difficulties. To measure students' academic performance, Ives (2007) had the students

complete a prerequisite skill test and a two-question posttest. Based on the students' performance on the two tests, Ives (2007) determined that the results of his studies showed that the students who worked with graphic organizers had a stronger understanding of the content than the students who did not work with the graphic organizers. Furthermore, the use of graphic organizers to teach higher-level mathematics to students with language and attention problems leads to improved conceptual understanding of that mathematics content (Ives, 2007).

Dicecco and Gleason (2002) determined that graphic organizers help students with recall of relational knowledge, particularly when apply this knowledge to writing an essay. However, Dicecco and Gleason (2002) found no statistical difference when assessing the students on general content knowledge among the group that used graphic organizers and the group that did not use graphic organizers.

Benefits

Titsworth (2001) found that note taking has positive effects on students' cognitive learning in his research study. Note taking requires a complex set of skills in order to be effective including, but not limited to, selective hearing, fast writing, organization, understanding as you record, and many more. Allowing students to acquire those skills through the process of note taking can greatly benefit their academic success. Teaching students the proper skill set for note taking can make students who are overwhelmed with the idea of note taking become more comfortable. Likewise, students who are hesitant of the idea of note taking in class may also benefit from a set note taking strategy that contains an organized structure to make them feel less uneasy about note taking. Note taking aids the recollection of factual knowledge and the synthesis, evaluation, and application of new knowledge. Another benefit of various note taking strategies is that the Cornell method, guided notes, or graphic organizers might be the one

strategy that motivates the students to record notes. In research done by Hamilton et al. (2000), a student questionnaire was completed and resulted in six of the seven students preferring the use of guided notes and all of the students reported that they earned better grades and learned more when they used guided notes. Similarly, Haydon et al. (2011) found students were more satisfied with the use of guided notes when compared to traditional note taking. Graphic organizers visually represent relationships between multiple items and help interpret text to be easier comprehended. Therefore graphic organizers could benefit students who understand information more when using visuals rather than students who benefit more writing in lists or sentence, such as guided notes.

Disadvantages

The main limitation of researching and studying the effectiveness of different note taking strategies is considering if the participants being studied were taught how to properly record notes with each strategy. Results can be invalid if each note taking strategy was assessed on its effectiveness without being formally taught to the participants. Another difficulty of measuring the effectiveness of the different note taking strategies is the difference in content area. One of the note taking strategies may be more useful in one content area than another. Also, the process in which the effectiveness of a note taking strategy is measured can be a limitation. The use of pretest and posttest has many disadvantages in itself such as, the structure of the test whether it be multiple choice or short answer based. Lastly, a big limitation to the results is the participants, the students. Self-regulated learners also prefer certain formats and vary their note taking to meet the demands of specific tasks (Brown, 2005). Thus some students may not find a particular note taking strategy being studied beneficial and vary their notes from the research study. As Quintus et al. (2012) indicated in their study, some students showed resistance to the Cornell method,

with negative comments regarding the work, the format, and the overall strategy of the Cornell method.

Gaps in the Research

There is an abundance of literature on note taking strategies, however most of the literature analyzed is on students with learning disabilities. The rise in research studies on students with learning disabilities could stem from the idea of Lynch et al. (2007), in which they indicate there is an increase in the number of students being included in general education classes, however most students with mild disabilities have difficulty learning the content in those classes.

Furthermore, there are very few studies that focus on various types of note taking strategies in the mathematics classroom. While there are many different levels of mathematics, for example conceptual and abstract, there are various beneficial methods of note taking for each level. The Cornell method, guided notes, and graphic organizers are all beneficial in the mathematics classroom; however one of those methods may not be as helpful as the other in an abstract mathematics course, but it may be more helpful in a conceptual mathematics course. Further research studies should be conducted in the secondary mathematics classroom in order to agree on which note taking strategy is most effective on student achievement in the secondary mathematics classroom.

Conclusion

Note taking is an important strategy all students must learn in order to be successful in school. Using the learner-directed note taking strategy, the Cornell method, almost all of the found research concluded that the Cornell method did not have any effects on student achievement. However, student achievement was measured through factual recall on tests, and as

Jacobs (2008) believes the Cornell method is more beneficial when synthesizing, applying or evaluating information rather than factual recall. The second method discussed, guided notes, proved to be valuable for students with learning disabilities and produced greater academic gains. Again, Jacobs (2008) shows that guided notes are more useful when recording notes on factual items, such as places or names for later recall on tests. Lastly, graphic organizers were examined. The research studies involving graphic organizers determined that this strategy was helpful for students with recall of relational knowledge in writing an essay. For mathematics, graphic organizers proved to be a better strategy for students learning conceptual mathematics rather than abstract mathematics. For a note taking strategy to be effective on student achievement in the secondary mathematics classroom, the instructor must differentiate the note taking method to best fit the mathematics being taught during that lesson.

Methods

The purpose of this research was to measure the effectiveness of the Cornell method, guided notes, and graphic organizers on student achievement in the secondary mathematics classroom and to understand which note taking method students preferred. Note taking is an essential skill all students must have in order to be successful. A good system or format of notes can increase learning and achievement (Quintus, Borr, Duffield, Napoleon, & Welch, 2012). Therefore, this research compared three note taking methods in relation to student achievement.

School and Participants

This study took place at a suburban middle school located in Central Virginia. This middle school implemented a new class schedule this year to maximize mathematics instruction by having mathematics class meet daily for 90 minutes. This county, according to the 2015 Census, has a population of over 130,000 residents with nearly 30 public schools. This study was conducted in two inclusion Math 8 classes. There were two teachers inside the classroom, the general education teacher and the collaborative teacher, who has a mathematical background.

The two classes contain a total of 54 students. However, only 22 students returned a completed consent and assent form. Of the 22 students who participated in the study, 11 were male and 11 were female. The 22 students included 7 Caucasian students, 6 African American students, 7 Hispanic students, and 2 Asian American students. Also included in this study were 2 English language learners, 3 students with an IEP, and 1 student with a 504 plan.

Data Collection

The data for this study was collected during the spring semester of the school year. Data were collected daily because math classes meet every day for ninety minutes. This research focused on the effectiveness of note taking strategies and student achievement. Data consisted of

pretest and posttest results from both units and surveys on student preferences of their preferred note taking method using a Likert-style survey.

Procedure

Data for this action research study began in January and finished in early April. Two units were taught: plane geometry and solid geometry. Both units were taught using the Cornell Method, guided notes, and graphic organizers. In order for all of the units to be measured the same, both units contained a pretest at the start of the unit and concluded with a posttest that measured student academic growth. The pretest and posttest consisted of questions created by my mentor teacher and myself. Additionally, before each unit began the students received proper instruction on how to correctly take notes in the three different note taking methods. At the end of both units, the students were given a Likert-style survey to complete.

Data Analysis

The pretest and posttest were graded in the same manner in both classes based on accuracy. The scores were not statistically analyzed, however they were studied in depth. I examined the pretest and posttest scores for each individual student and compared the scores with the class as a whole. The scores were also separated into subgroups and I compared the subgroups. The subgroups consist of males, females, race, general education students, self-contained students, and English language learners. The student surveys were evaluated and studied to consider students' note taking preferences. The student surveys were used to see if the students' preferred note taking strategy had an effect on my results. Additionally, since there is little research on effective note taking strategies in the secondary mathematics classroom, this survey could be of use to future research performed in the mathematics classroom.

Results

The following results represent the data concluded from the study. The study consisted of 22 eighth graders in an inclusion Math 8 class. Of the 22 students, 11 were male and 11 were female. To protect the students identities the following graphs were coded so that a number represents each student. That number remained the same throughout this entire study. Table 1 below was used as a guide.

Table 1. Code for Each Individual Student.

1	Female	Asian American		12	Male	Hispanic	
2	Female	Hispanic		13	Male	African American	IEP
3	Female	African American		14	Male	Hispanic	
4	Female	African American		15	Male	African American	IEP
5	Female	Caucasian		16	Male	African American	504
6	Female	Hispanic		17	Male	Caucasian	
7	Female	Asian American	ELL	18	Male	Caucasian	
8	Female	Hispanic		19	Male	Hispanic	IEP and ELL
9	Female	Caucasian		20	Male	Caucasian	
10	Female	Caucasian		21	Male	African American	
11	Female	Caucasian		22	Male	Hispanic	

Unit One: Plane Geometry

The first unit taught was plane geometry. This unit was broken up into three sections: angles and the Pythagorean Theorem, composite figures, and transformations. Students took notes using graphic organizers for angles and Pythagorean Theorem. The Cornell Method was

used during the composite figures section and transformations used guided notes. The students took a pretest on plane geometry. According to Figure 1, the students scored slightly better on their posttest involving angles and the Pythagorean Theorem, which used graphic organizers.

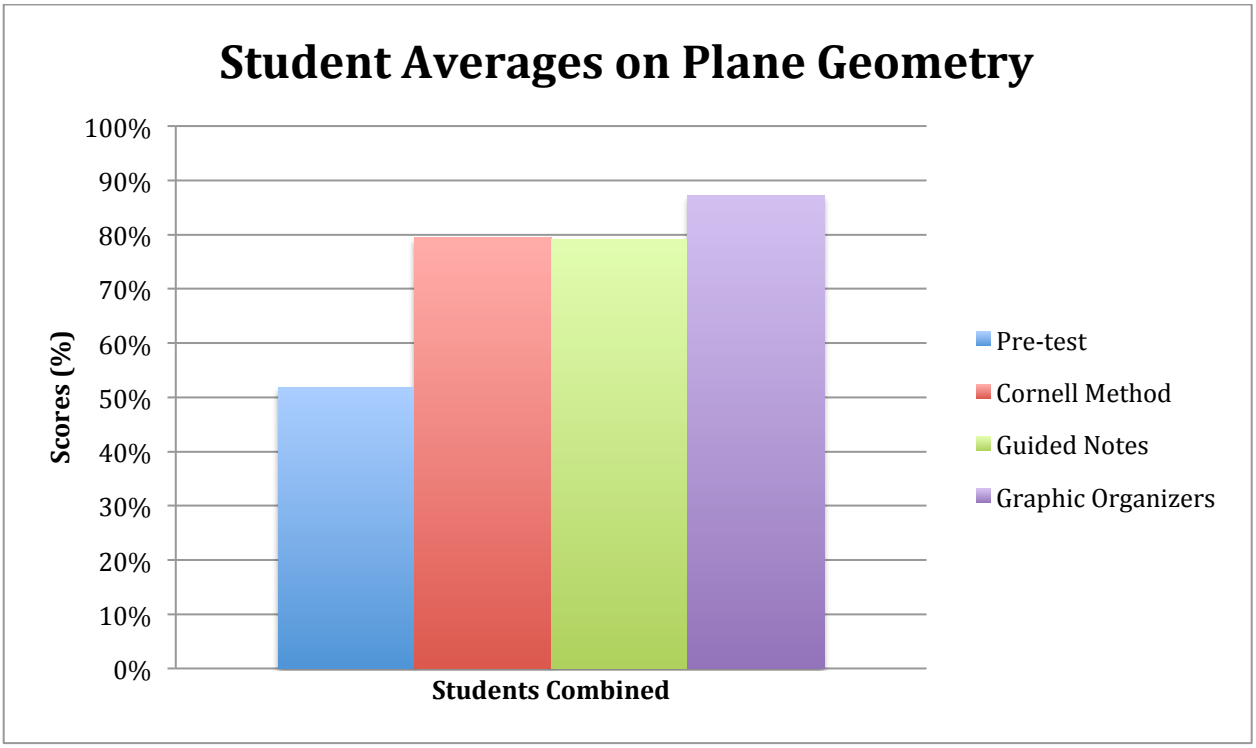

Figure 1. Bar graph of student averages. This graph displays the students combined averages on the pre-test and posttest on plane geometry involving three note taking strategies.

Figure 1 shows that average pre-test score of 52%, the average posttest score using the Cornell method at 80%, the average posttest score using guided notes at 79%, and the average posttest score using graphic organizers at 87%. However, not every student showed the greatest academic achievement using graphic organizers. Figure 2 shows all of the scores for each individual student.

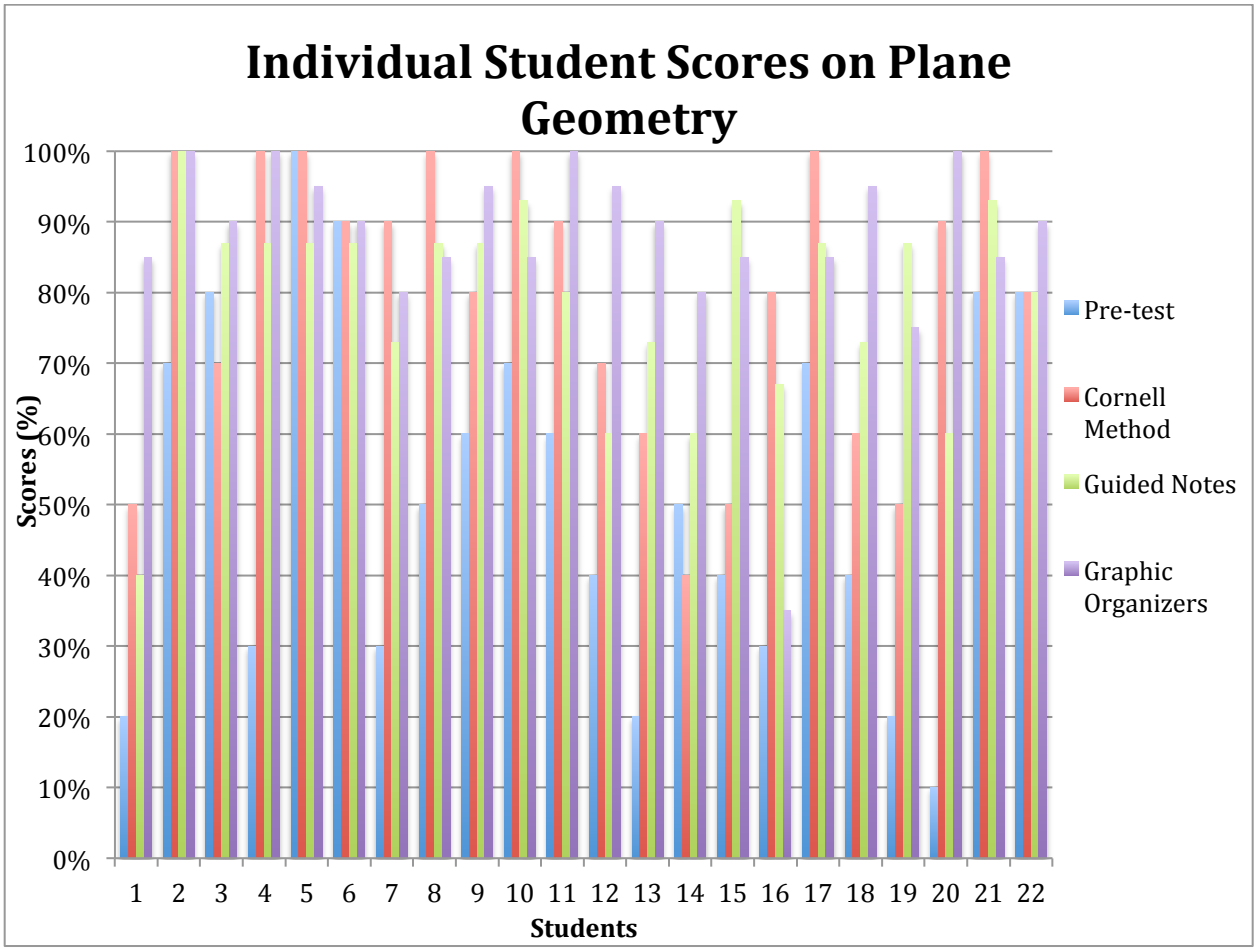

Figure 2. Bar graph of individual student scores. This graph displays individual student scores on the pre-test and posttest on plane geometry involving three note taking strategies.

Statistically, graphic organizers proved to be the most successful note taking strategy for plane geometry, although Student Sixteen had the lowest academic growth with graphic organizers only scoring a 35% on the posttest. Student Sixteen scored 80% on the posttest regarding the material using the Cornell method and 67% on the material using guided notes. Student Two scored a 100% on the posttest relating to all three note taking strategies. Likewise, students Five, Seven, Eight, Ten, Sixteen, Seventeen, and Twenty-one all had the highest academic growth with the Cornell method. Students Fifteen and Nineteen both scored highest on the material using guided notes. Also Student Fifteen and Student Nineteen are two of the three

students with an IEP. Lastly, Student Four and Student Six both scored the same with the Cornell method and graphic organizers.

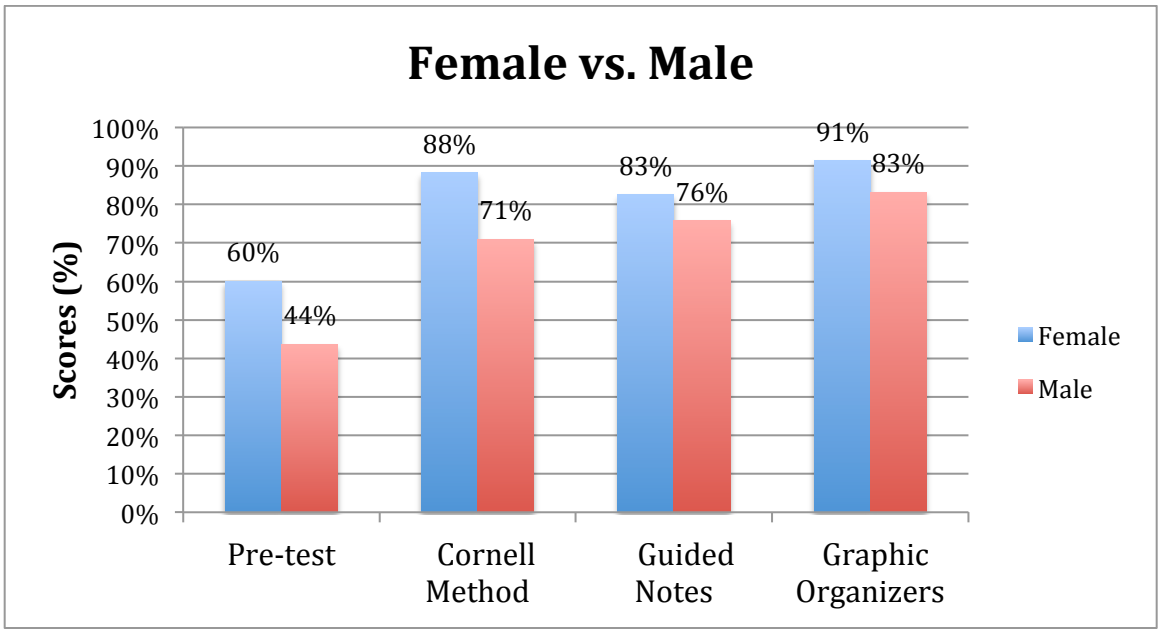

Figure 3. Bar graph of female and male scores. This graph displays student scores on the pre-test and posttest on plane geometry involving three note taking strategies.

Figure 3 shows that both female and male scored better on the posttest using graphic organizers as a note taking method. Figure 4 below shows the comparison between special education students and general education students. The Cornell method showed to be ineffective for students with IEPs during the plane geometry unit. Overall, graphic organizers revealed to be the most effective note taking strategy in plane geometry.

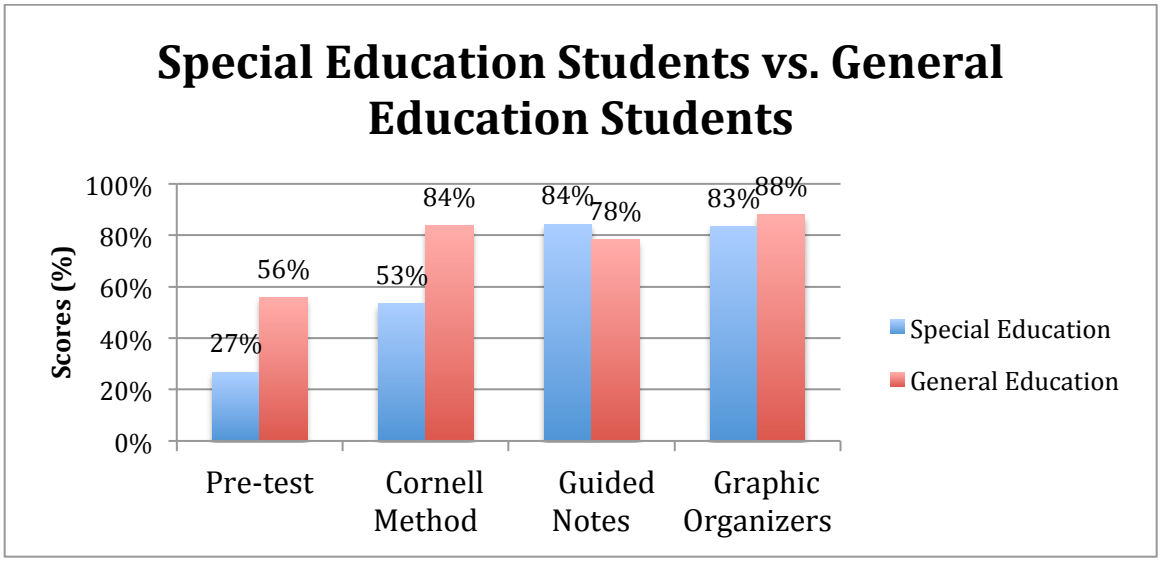

Figure 4. Bar graph of special education and general education student scores. This graph displays student scores on the pre-test and posttest on plane geometry involving three note taking strategies.

Unit Two: Solid Geometry

The second unit taught was solid geometry. This unit was broken up into three sections: three-dimensional figures, surface area and volume, and changing attributes. Students took notes using the Cornell Method for three-dimensional figures. Graphic organizers were used during surface area and volume section and changing attributes used guided notes. Just like the first unit, the students took a pretest on solid geometry.

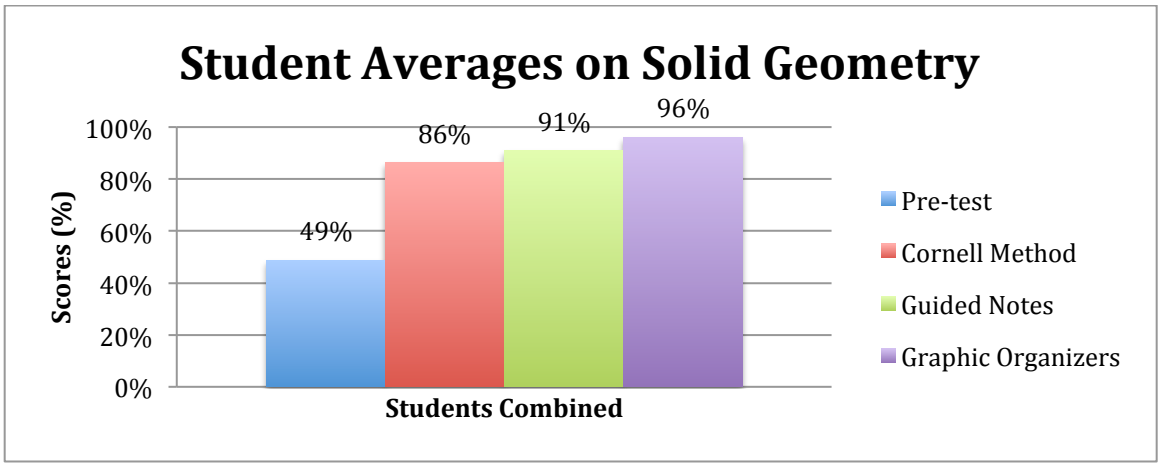

Figure 5. Bar graph of student averages. This graph displays the students combined averages on the pre-test and posttest on solid geometry involving three note taking strategies.

Figure 5 shows the average pre-test score of 49%, the average posttest score using the Cornell method at 86%, the average posttest score using guided notes at 91%, and the average posttest score using graphic organizers at 96%. Although graphic organizers showed the greatest academic gain for the students, not every student proved to be the most successful with graphic organizers as a note taking method. Figure 4 shows all the scores for each individual student.

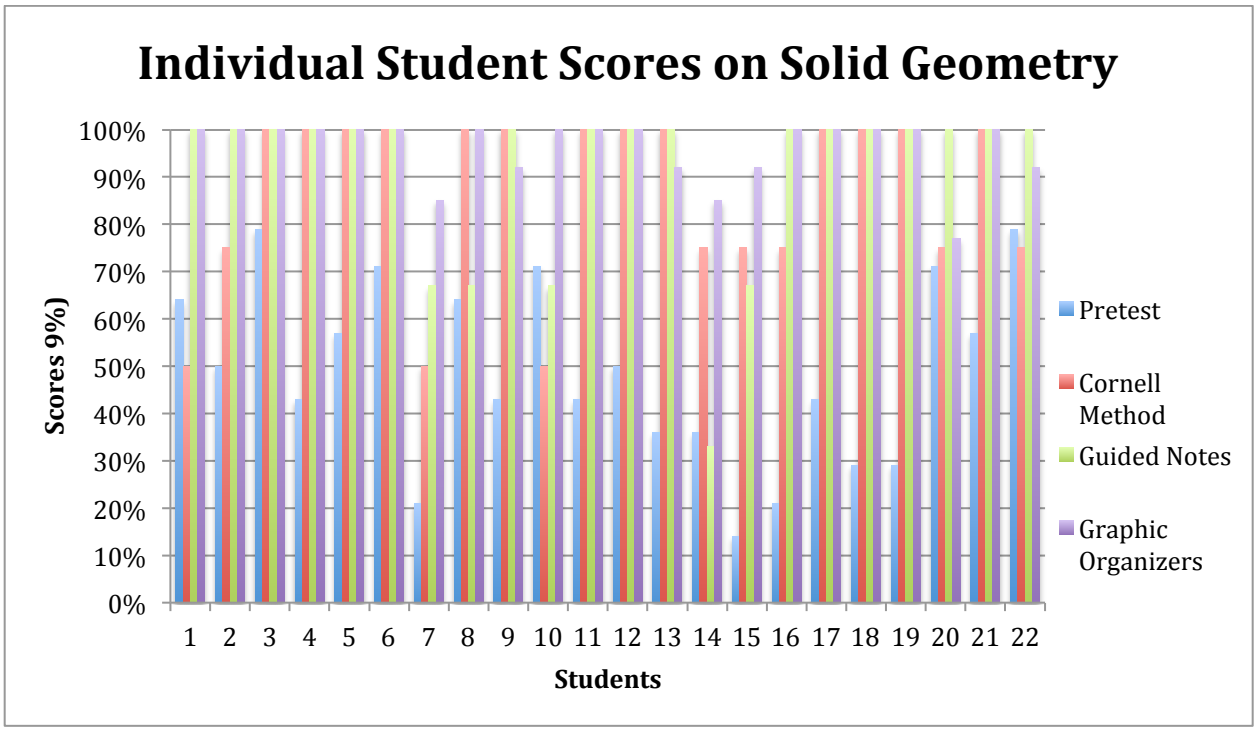

Figure 6. Bar graph of individual student scores. This graph displays individual student scores on the pre-test and posttest on solid geometry involving three note taking strategies.

Graphic organizers proved to be the most successful note taking strategy for solid geometry, but multiple students scored the same with graphic organizers and the other note taking strategies. Students Three, Four, Five, Six, Eleven, Twelve, Seventeen Eighteen, Nineteen, and Twenty-one scored a 100% on the posttest regarding material using the Cornell

method, guided notes, and graphic organizers. Students One, Two, and Sixteen scored a 100% on graphic organizers and guided notes. Students Nine and Thirteen both scored better on the Cornell method and guided notes by scoring a 100% on the posttest. Student Eight scored a 100% on both the Cornell method and graphic organizers. Two students, Twenty and Twenty-two, showed guided notes to be the most successful out of the three note taking strategies. Students Seven, Ten, Fourteen, and Fifteen all scored greater with graphic organizers indicating that was the most effective note taking strategy for those four students.

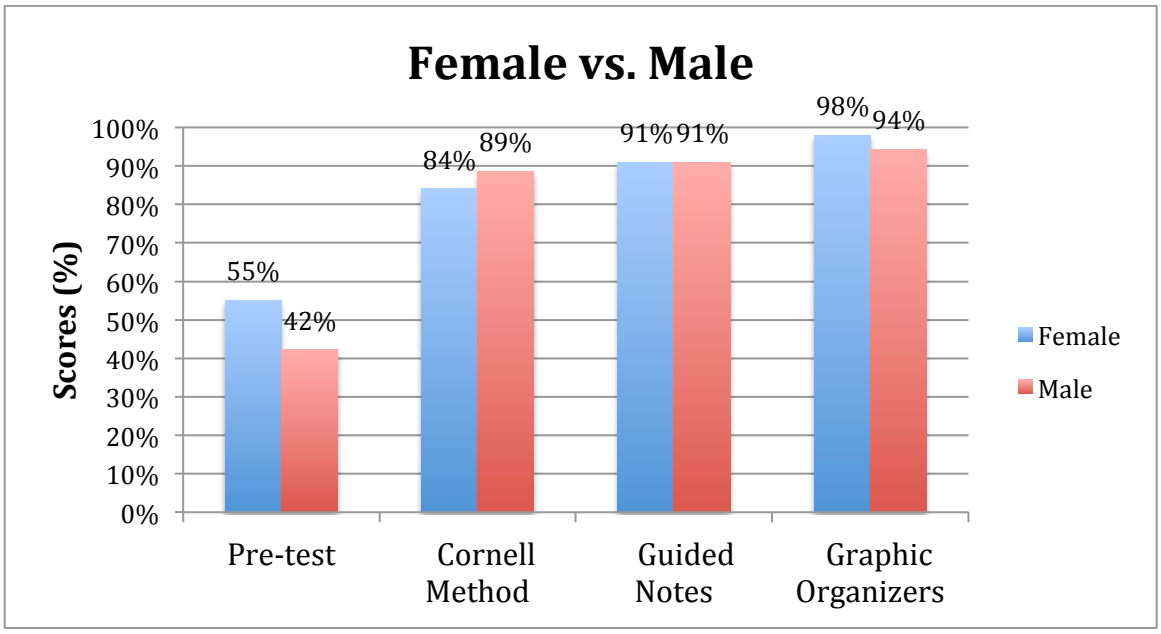

Figure 7. Bar graph of female and male scores. This graph displays student scores on the pre-test and posttest on solid geometry involving three note taking strategies.

Figure 7 shows that graphic organizers were the most effective note taking strategy for both females and males in solid geometry. Guided notes were equally effective for both females and males in solid geometry. Lastly, the Cornell method was the least effective note taking strategy for females and males in solid geometry. Figure 8 below shows the difference between special education students and general education students. Overall both special education and

general education students performed better academically when using graphic organizers on solid geometry.

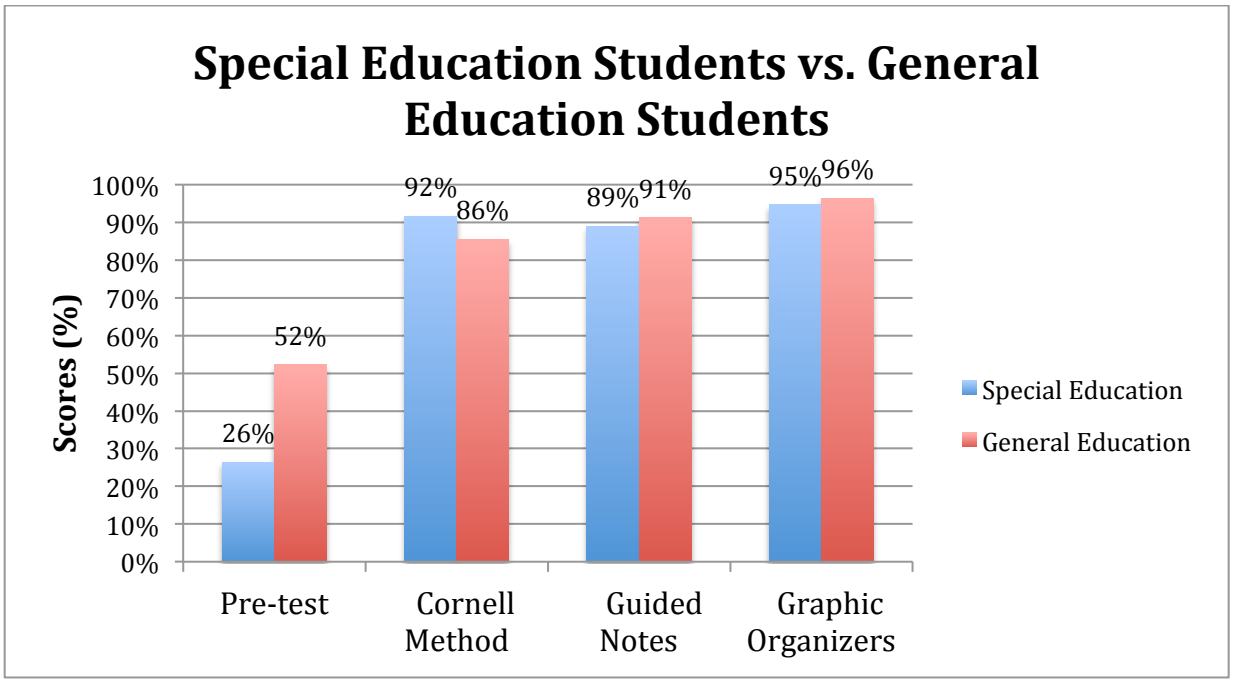

Figure 8. Bar graph of special education and general education student scores. This graph displays student scores on the pre-test and posttest on solid geometry involving three note taking strategies.

Student Survey

At the end of both units every student was given a Likert-style survey to understand the students' preferred note taking method. The survey consisted of 10 questions with five answer options. The answer options consisted of really agree, agree, I'm not sure, disagree, and really disagree. The questions for this survey are located in Appendix A. Table 2 shows the results from the surveys.

Table 2. Student Responses to the Likert- Style Survey.

Question	Really Agree	Agree	I'm Not Sure	Disagree	Really Disagree
1	15	6		1	
2		10	1	10	1
3	6	8	3	3	2
4	6	6	5	5	
5	10	7	2	3	
6	8	7	2	4	1
7	6	10		5	1
8	5	10	4	2	1
9	8	5	7	2	
10	5	5	4	4	4

Based on the student responses to the survey, slightly more students prefer taking notes using guided notes rather than using the Cornell Method and graphic organizers. Almost all of the students responded that they complete all their notes during class. However the class was divided on whether or not they study their notes outside of class. Students preferred taking notes using the Cornell Method rather than using graphic organizers. However, the class was split on agree and disagree for the use of graphic organizers during the two units.

The data collected from the pretest and posttest showed that graphic organizers as a note taking strategy showed the greatest increase in student achievement. However, based on the student survey, the students prefer guided notes as their note taking method. These results show a negative correlation between their academic achievement and preferred note taking method.

Discussion

The statistical data shows that for plane geometry and solid geometry graphic organizers proved to be the most effective note taking strategy. However, graphic organizers revealed to be the least preferred note taking strategy according to the student surveys taken at the end of both units.

For plane geometry, students took notes using graphic organizers for angles and the Pythagorean Theorem. Both angles and the Pythagorean Theorem were new topic for the students. However transformations and composite figures were both review topics. The students were responsible for four types of transformations and three of the transformations were a review from last year. Transformations were studied with guided notes as a note taking method and proved to be the lowest in student academic achievement, although students preferred guided notes as their form of note taking. Composite figures are a review topic as well, as it reviews area and perimeter of two-dimensional figures. Students learned area and perimeter of two-dimensional figures in previous years and have built on their knowledge the past year. Composite figures were studied with the Cornell method and proved to be the second best note taking strategy for plane geometry.

The section of surface area and volume was studied using graphic organizers for solid geometry. The students were taught to find the surface area and volume for five three-dimensional figures and two of the figures were review from the previous year. Three-dimensional views, constructing and interpreting, were taught using the Cornell method and that was a new topic for the students. Likewise, changing attributes of three-dimensional figures and finding the surface area and volume of those new figures was also a new topic. Graphic organizers proved again to be the most successful note taking strategy based on student academic

achievement. Next, guided notes showed to be the next effective note taking strategy. Lastly, the Cornell method proved to be the least effective note taking strategy. Though the percent differences between the three note taking strategies are very close for solid geometry, graphic organizers proved to be slightly better than the Cornell method and guided notes.

The student preference survey indicated that the students preferred to take notes using guided notes the most. Next, the students preferred using the Cornell method as a note taking strategy. Students did not prefer to take notes using graphic organizers though it statistically proved to be the most effective regarding student academic scores. Students preferred note taking strategy of the Cornell method proved to be the least beneficial academically for students during the plane geometry unit and the second effective note taking strategy academically for solid geometry.

Conclusion

Note taking is a necessary skill needed for all students in the classroom. Providing students with different note taking strategies can benefit them in their future educational career. Based on the results from this study, all three note taking strategies showed to be helpful, however graphic organizers proved to be more beneficial for the students academically in both plane geometry and solid geometry.

There were some limitations during this study. First, there were some days when students were absent and they missed an instructional day and thus did not get the full benefit of that particular note taking strategy. Secondly, the small sample size in this study was also a limitation. If more students had participated then there would have been more data to analyze and compare throughout the study. The results may have varied had there been more students who participated in this study.

In conclusion, all three note taking strategies proved to help each student academically and provided them with different strategies to use later in their education. For future research, it would be beneficial to study the effectiveness between two note taking strategies rather than three and run a statistical analysis between the two studied note taking strategies. Also, future studies would be more statistically accurate if researchers kept the topic consistent and changed the note taking strategy. Note taking strategies are an essential key to student success in the classroom and offering students varying note taking strategies can greatly increase student academic performance.

References

Belson, S. I., Hartmann, D., & Sherman, J. (2013). Digital note taking: The use of electronic pens with students with specific learning disabilities. *Journal Of Special Education Technology*, *28*(2), 13-24. doi: 10.1177/016264341302800202

Boyle, J. R. (2010). Note-taking skills of middle school students with and without learning disabilities. *Journal of Learning Disabilities, 43*(6), 530-540. doi: 10.1177/0022219410371679

Brown, R. (2005). Seventh-graders' self- regulatory note-taking from text: Perceptions, preferences, and practices. *Reading Research & Instruction*, *44*(4), 1-26. Retrieved from http://web.a.ebscohost.com.ezproxy.umw.edu/ehost/pdfviewer/pdfviewer?sid=e62dc2af-fe97-452c-a34d-ff6f074465fe%40sessionmgr4006&vid=4&hid=4207

Dexter, D. D., & Hughes, C. A. (2011). Graphic organizers and students with learning disabilities: A meta-analysis. *Learning Disability Quarterly*, *34*(1), 51-72. doi: 10.1177/073194871103400104

Dicecco, V., & Gleason, M. (2002). Using graphic organizers to attain relational knowledge from expository text. *Journal of Learning Disabilities, 35*(4), 306-20. Retrieved from http://ldx.sagepub.com.ezproxy.umw.edu/content/35/4/306.full.pdf

Faber, J. E., Morris, J. D., & Lieberman, M. G. (2000). The effect of note taking on ninth grade students' comprehension. *Reading Psychology*, *21*(3), 257-270. doi:10.1080/02702710050144377

Gajria, M., Jitendra, A. K., Sood, S., & Sacks, G. (2007). Improving comprehension of expository text in students with LD: A research synthesis. *Journal Of Learning Disabilities*, *40*(3), 210-225. Retrieved from

http://web.b.ebscohost.com.ezproxy.umw.edu/ehost/detail/detail?vid=3&sid=2a6dfbce-68fa-461e-be06-4f8232fc96e1%40sessionmgr102&hid=128&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=24993390&db=ehh

Hamilton, S. L., Seibert, M. A., Gardner, R., & Talbert-Johnson, C. (2000). Using guided notes to improve the academic achievement of incarcerated adolescents with learning and behavior problems. *Remedial & Special Education*, *21*(3), 133. doi: 10.1177/074193250002100302

Haydon, T., Mancil, G. R., Kroeger, S. D., McLeskey, J., & Lin, W. J. (2011). A review of the effectiveness of guided notes for students who struggle learning academic content. *Preventing School Failure*, *55*(4), 226-231. doi:10.1080/1045988X.2010.548415

Ives, B. (2007). Graphic organizers applied to secondary algebra instruction for students with learning disorders. *Learning Disabilities Research & Practice*, *22*, 110 – 118. doi: 10.1111/j.1540-5826.2007.00235.x

Jacobs, K. (2008). A comparison of two note taking methods in a secondary English classroom. *Proceedings of the 4th Annual Symposium on Graduate Research and Scholarly Projects (GRASP).* Retrieved from http://soar.wichita.edu/handle/10057/1388

Lazarus, B. D. (1991). Guided notes, review, and achievement of secondary students with learning disabilities in mainstream content courses. *Education & Treatment Of Children (ETC)*, *14*, 112-127.Retrieved from http://web.a.ebscohost.com.ezproxy.umw.edu/ehost/detail/detail?vid=9&sid=feb8e24d-f4b2-4b69-abcd-d9d1c6adf3bb%40sessionmgr4006&hid=4212&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=9609042237&db=ehh

Lynch, S., Taymans, J., Watson, W. A., Ochsendorf, R. J., Pyke, C., & Szesze, M. J. (2007). Effectiveness of a highly rated science curriculum unit for students with disabilities in general education classrooms. *Exceptional Children*, *73*(2), 202-223. Retrieved from http://web.a.ebscohost.com/ehost/pdfviewer/pdfviewer?sid=97f7aaf2-7ff0-4579-ae02-78d6716740db%40sessionmgr4006&vid=1&hid=4201

Piolat, A., Olive, T., & Kellogg, R. T. (2004). Cognitive effort during note taking. *Applied Cognitive Psychology, 19*, 291-312. doi: 10.1002/acp.1086

Quintus, L., Borr, M., Duffield, S., Napoleon, L., & Welch, A. (2012). The impact of the Cornell note-taking method on students' performance in a high school family and consumer sciences class. *Journal Of Family & Consumer Sciences Education*, *30*(1), 27-38. Retrieved from http://web.b.ebscohost.com/ehost/detail/detail?sid=5e27991d-b6c8-4089-9935 e35c407190a2%40sessionmgr103&vid=0&hid=115&bdata= JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=89472604&db=ehh

Titsworth, S. B. (2001). The effects of teacher immediacy, use of organizational lecture cues, and students' note taking on cognitive learning. *Communication Education, 50*(4), 283-297. doi:10.108010363452010937925 6

Appendix A

Student Preference Survey

The following survey will help me understand which note taking strategy you benefited from the most. Please circle the answer that you agree with most. You may choose to skip any of these questions, or withdraw from the study at any time, for any reason. Your answers will NOT be graded.

1. I complete all my notes during class.

Really Agree **Agree** **I'm not sure** **Disagree** **Really Disagree**

2. I study my mathematics notes outside of class.

Really Agree **Agree** **I'm not sure** **Disagree** **Really Disagree**

3. I prefer taking notes using the Cornell method.

Really Agree **Agree** **I'm not sure** **Disagree** **Really Disagree**

4. I learn more with the organized format of the Cornell method.

Really Agree **Agree** **I'm not sure** **Disagree** **Really Disagree**

5. I learn better watching the teacher perform an example first.

Really Agree **Agree** **I'm not sure** **Disagree** **Really Disagree**

6. I pay attention to the lesson more when I already have completed notes and I can watch the teacher explain how to solve the problem.

Really Agree **Agree** **I'm not sure** **Disagree** **Really Disagree**

7. I understand the material more when using guided notes.

Really Agree **Agree** **I'm not sure** **Disagree** **Really Disagree**

8. In our class, guided notes help me understand mathematics more.

Really Agree **Agree** **I'm not sure** **Disagree** **Really Disagree**

9. I like to take notes with visuals.

Really Agree **Agree** **I'm not sure** **Disagree** **Really Disagree**

10. I understand the material more when I take notes with a graphic organizer.

Really Agree **Agree** **I'm not sure** **Disagree** **Really Disagree**

Appendix B

Consent Letter

Dear Parent or Guardian,

Hello, my name is Stefannie Asselanis, and I am a student teacher in your child's classroom. I am currently a graduate student at the University of Mary Washington working towards my Master's degree in Secondary Education. A requirement of our program is to conduct an action research study. *I am inviting your child to participate in a research study I am doing. Involvement in the study is voluntary, so you may choose to have your child participate or not. I am now going to explain the study to you.*

I am interested in learning about the effectiveness of three different note taking strategies: the Cornell method, guided notes, and graphic organizers in the mathematics classroom.

Note taking is an essential skill all students must have in order to be successful in their educational career. For about six to seven weeks, your child will participate in a variety of different note taking strategies. *I am requesting permission to give your child a survey to complete about his or her note taking preferences. I am also requesting permission to use your child's scores on mathematics tests to determine the effectiveness of each note taking strategy.* ***This project will be part of your child's work for class. It will in no way require extra work for him or her.***

Your child's work will be kept confidential. All names will be changed to protect his or her privacy, and thus his or her name will not appear on any work needed for this study. Following the project, all samples I collect will be destroyed. Participation in this project will not affect your child's grade in any way. His or her participation in the study is voluntary, and you have the right to keep your child out of the study. Also, your child is free to stop participating in the study at any time. Your child would still participate in the classroom project, but data for the research study would not be collected from him or her.

The benefit of this research is that you will be helping me understand the most effective way to have students record notes in the mathematics classroom, as well as allowing me to assist your child in developing their note taking strategies, which will benefit them in all of their classes.

If you have any further questions or concerns, please do not hesitate to contact my research supervisor, Dr. Marie Sheckels (msheckel@umw.edu), or myself (sasselan@mail.umw.edu). Please return this form by February 17, 2017. I look forward to working with you and your student!

This research has been approved by the University of Mary Washington Institutional Review Board, which is a committee responsible for ensuring that research is being conducted safely and that risks to participants are minimized. For more information about the IRB review of this research, contact Dr. Jo Tyler, at jtyler@umw.edu.

Thank you,

Stefannie Asselanis

I have read the above letter and give my child, _____, permission to participate in this project. I certify that I am 18 years of age or older.

_____ _____
(Parent/Guardian Signature) Date

I, _____ agree to keep all information and data collected during this research project confidential.

_____ _____
(Researcher Signature) Date

Appendix C

Student Assent Letter

Dear Student,

I am very excited to be your student teacher throughout the spring! For our upcoming math units, I will be teaching you three different ways to take notes, which will not only help you in math class but all your classes.

While working with these different note taking methods, I will be collecting information for a research project that I am doing to see which note taking strategy is most effective in the math classroom. At the end of my study, you will complete a survey to let me know which note taking method you liked best. You will not be graded for your help in my study, and this study will not require you to have extra work.

Your parents were given a letter about taking part in this study. If your parents did not allow you to participate in this study, you will not be asked to sign this form. However, if your parents did allow you to participate, I encourage you to participate in this study.

You do not have to be in this study. No one will be mad at you if you decide not to do this study. Nothing bad will happen if you take part in the study and nothing bad will happen if you do not. However, if you decide not to participate you still will use the same note taking strategies as your peers and do all of the work that they will do; I will just not use your work in my research. Even if you start, you can stop later if you want. You may ask questions about the study.

If you decide to be in the study, I will keep your information confidential. This means that I will not use your name or the name of the school in anything I write and I will not reveal any personal, identifying information about you.

Signing this form means that you have read it and that you are willing to be in this study. If at any point you have any questions, please ask me!

Thanks,

Ms. Asselanis

I have been read the above letter, all my questions have been answered, and I agree to participate in the project.

_____ _____

(Student Signature) (Date)

I, _____ will keep your names confidential.

_____ _____

(Student Teacher/Researcher Signature) (Date)