THE EFFECTS OF A STRUCTURED NOTE-TAKING

STRATEGY IN VIRTUAL SCHOOL MATHEMATICS

by

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DEDICATION

I would like to dedicate the following research paper to my wife, Acacia. She inspires and encourages me every day to be a better student, husband, and citizen of the world. Without her continued support, I would not be where I am or who I am today.

I would also like to acknowledge all others that have contributed and supported me through this process including my family, the Agora Cyber Charter School Learning Center staff and the Montana State University MSSE professors and staff.

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ABSTRACT

For this action research investigation, the strategic note-taking strategy, Cornell Notes, was implemented with a group of middle school students from a cyber school to increase their math skills and improve their perception of note-taking. The quality and organization of class notes was a major concern among teaching staff at Agora Cyber Charter School. Students attending the Agora Learning Center were provided with note-taking workshops to teach and encourage them to take and organize notes during virtual classes. After workshops and follow-up, the treatment showed minimal impact on student perception of note-taking and no significant impact on math performance as displayed in data from math assessments and online surveys.

INTRODUCTION AND BACKGROUND

The purpose of this study is to investigate the effects of a specific note-taking strategy, Cornell Notes, when implemented in a math intervention class. The school in focus is Agora Cyber Charter School, based out of King of Prussia, Pennsylvania. Agora is one of the largest cyber schools in Pennsylvania and the nation. Agora enrolls 8,420 students from Kindergarten to 12th Grade. Although the students come from every corner of Pennsylvania, the majority of Agora's students are located around the major urban areas such as Philadelphia and Pittsburgh. Of the students currently enrolled, 72% are considered economically disadvantaged and 24% are special education students (Pennsylvania Department of Education, 2015). We are also a diverse school with a population of 61% Caucasian, 27% African American, 9% Hispanic students. Based on the Pennsylvania statewide assessments, Agora is consistently considered a low-performing school in all tested subjects.

At Agora, middle school students log into live class sessions with an online teacher through a classroom platform named Elluminate BlackBoard and work through an online curriculum provided by the company, Fishtree. During these live sessions, students can receive core content, electives and intervention classes based on need. Engagement is a major concern at Agora, as teachers cannot see how the students are absorbing the information during the direct instruction. Different tools are available through the platform such as chat, polling tools and the microphone, but little is known about how the students are storing the information received during class.

I first became concerned about this while working at Agora's Learning Center in Philadelphia. At the Learning Center, students come to a physical location to attend their online lessons in computer labs and receive extra support from in-person staff. Here, one can witness the extent to which students store the information from their online classes. The majority of students at the Learning Center merely interact with the online platform by viewing the lesson and by providing responses using the different tools. Very few students keep organized and detailed notes of the lessons. While the lack of note-taking is only visible at the Learning Center, it is a major concern of the online teaching staff as well.

This lack of note-taking is of particular concern in my department, Response to Intervention. My department, through universal assessments, identifies which students may have major deficiencies in either their mathematics or reading skills. Those students who show the need for interventions through benchmark and diagnostic assessments are designated as Tier 2 or 3 in our Response to Intervention system. These tiers signify the intensity of interventions needed for a group of students with Tier 3 being the students who need the most additional academic support. The amount of students in Tier 2 or 3 math far outnumbers the amount of students in Tier 2 or 3 reading. This is especially true in our middle school population at the Learning Center. The ability to process and store the skills provided in their math and math intervention classes is crucial for these students to bridge their academic gaps.

Currently, there are no strategies or initiatives within Agora to increase and enhance the level of note-taking among the students. In order to be followed with fidelity,

any strategy must be simple enough for each student to consistently recreate and implement on a daily basis. A good example of such a strategy is Cornell Notes.

The concerns about student note-taking practices and the middle school's low performance in mathematics has led me to develop the following focus question for my research: *How can incorporating a specific note-taking strategy, Cornell Notes, affect students in a virtual middle school math class?*
The following subquestions were examined:

- What are the effects of a structured note-taking strategy on a cyber student's math performance?

- What are the effects of a structured note-taking strategy on a cyber student's perception of note-taking?

CONCEPTUAL FRAMEWORK

As schools evolve and adapt to new teaching methods and technology, note-taking remains an essential study skill for students (Boyle, 2011). The purpose of notes is to record the ideas presented in a way your short-term memory cannot (Pauk, 1997). Students are expected to take notes in classes across all curricula from mathematics to language arts (Boch & Piolat, 2005). Note-taking may occur in many different scenarios such as lectures, independent readings, or while making simple observations. In classrooms, with or without lectures, students have used note-taking to enhance their learning experience. As students move onto post-secondary education, note-taking will become even more essential as it is reported that 98% of college-level classes are in the form of lectures (Eades & Moore, 2007; Boyle, 2011).

Through note-taking, the student interprets and encodes the information presented (Howe, 1970). This process of interpretation and encoding is not an easy task, as students must listen to all verbal information, discern between important and unimportant points, connect to prior knowledge, and rephrase statements, all while writing notes in an organized fashion (Boyle, 2011). Contributing to this difficulty is the writing speed of students, which averages between 0.3 and 0.4 words per second, while the words in a lecture are conveyed at a much higher rate (Boch & Piolat, 2005). Although new developments in technology have provided alternative forms of note-taking, which can increase the amount of information students record and retain (Bui, Myerson, & Hale, 2013) cost, accessibility, and practicality are still prohibitive factors. Therefore, written note-taking is still an effective means of learning skills and content (Boyle, 2011).

Researchers generally study note-taking as two different, although not separate, functions: encoding and external storage (Kiewra, DuBois, Christian, McShane, Meyerhoffer & Roskelley, 1991). Essentially, these two functions are the processes of taking and reviewing notes. The majority of research supports the idea that, in itself, the process of note-taking increases student encoding (Kiewra, 1985). Howe (1970) found that students who had written down a specific piece of information was about seven times more likely to recall the information than student who did not take notes. Although note-taking varies from student to student and classroom to classroom, the evidence generally suggests that students should have higher achievement when they take notes (Titsworth, 2001). Similar increases in achievement have been seen even with respect to a student's long-term memory. In a study by Titsworth (2001), delayed assessments illustrated that

note-taking helped to encode information into long-term memory even without the opportunity for review.

The external storage or review function of note-taking is also an important component in student learning. It is widely believed that the external storage function of notes is more important than the process of note-taking (Kiewra et al., 1991). Students who review their notes generally outperform peers who do not review their notes (Kiewra, 1985). Like the method of note-taking itself, review can take many forms. One can choose to review immediately after a lecture or reading, delay reviewing notes until studying for an assessment or even during a lecture with gaps meant for review. Review could also include rewriting or reorganizing the previously written notes. In an investigation of studies pertaining to effective review, found support for both delayed and immediate review of notes. He also found more time spent reviewing notes translated to higher achievement. In another study, Kiewra et al. (1991) demonstrated that even when a student had not attended the class, reviewing notes provided by someone else had a greater benefit than encoding alone. This study found students performed best when given the opportunity to utilize both functions of note-taking, encoding and external storage.

The benefits of note-taking have been widely demonstrated through different studies and one would be hard pressed to find a teacher or school that would disagree. The question then becomes, how should students most effectively take and review their notes (Kiewra, 1985)? This is an incredibly important question because, although many students take notes, they may lack the knowledge of how to take effective notes for

encoding and review (Boyle, 2011). The use of specific techniques can help students

increase the amount and quality of notes. As it is best described by Boyle (2010):

> Effective note-taking techniques should help students capture the majority of the
>
> critical ideas in a lecture, portray the nature of the relationships among those
>
> ideas, and identify appropriate connections between these ideas and a student's
>
> prior knowledge of the lecture topic (p. 537).

Various techniques are available to guide teachers and students in the process of note-

taking. Among these various techniques, one can find common key components.

Effective note-taking strategies encourage summarization rather than simple

dictation. In fact, verbatim notes, in which one tries to record everything heard, tend to be

the least effective means of taking notes (Marzano, Pickering, & Pollock, 2001).

Verbatim notes tend to stress students working memory and distract students from the

key points of a lecture (Akintunde, 2013; Marzano et al., 2001). Thus, summarizing or

outlining the information presented will be of more value to a student.

The review function of notes is just as important as the process of taking the

notes. Effective notes should be organized in a manner that allows and encourages

students to add to or revise their notes after class (Marzano et al., 2001). Note organizers,

which include sections for student reflection and summaries, promote these positive

behaviors in the students. Marzano et al. (2001), even suggest teachers incorporate time

for revision and review into their regular teaching practices.

The spatial organization of the notes is a key component of effective note-taking

as well. Conventional note-taking tends to follow the organization of the lecture, which

may lead to incomplete and unorganized notes (Kiewra et al., 1991). Through

conscientious spatial organization, students create more conceptual links to the material

presented in class (Boch & Piolat, 2005). When students organize notes in a structured

non-linear or non-conventional fashion, there is less cognitive demand on the students

(Makany, Kemp, & Dror, 2009). Examples of nonconventional note-taking organization

include but are not limited to matrix notes, Cornell Notes (hereafter, CN) and concept

mapping.

Developed by Walter Pauk from Cornell University, CN is a note-taking system

that incorporates many key components of effective note-taking. To set up CN, one

divides up a page into three distinct sections. The largest right-hand section is reserved

for what one would consider standard class notes. Typical CN templates involve a narrow

left-hand column called the cue column, a summary area at the bottom of the page, and a

large remaining area for in-class notes (Pauk, 1997). In the cue column, students are to

write in questions, keywords or key ideas upon reviewing their notes (Donohoo, 2010;

Pauk, 1997). In the summary area, students write a brief summary or reflection of the

notes taken. The inclusion of the cue column and the summary area encourages students

to perform immediate or delayed review of their notes. Students who have been taught to

use the CN method have shown a significant advantage in scores when compared to

students not using the CN method (Faber, Morris, & Lieberman, 2000). When comparing

three different note-taking methods, Akintunde (2013) found that CN were most effective

in promoting information retrieval. Beyond the studies, different educational

organizations such as the Advancement Via Individual Determination encourage the use

of CN due to its benefits (Nickerson, 2012).

No matter the note-taking method used, one essential element that may be overlooked is the training provided by a teacher. Some studies have found that note-taking increases student achievement regardless of teacher behavior and communication, yet the process of teaching note-taking is still important and effective (Titsworth, 2001). Many students do not even receive basic training in this skill, although they are constantly expected to take notes (Boch & Piolat, 2005). Studies have suggested teachers should specifically train students to perform automatic operations when taking and reviewing notes like those found in concept mapping or CN (Boch & Piolat, 2005). Without guidance, students' notes tend to vary greatly as it is skill developed individually and over time. Due to this, adjustments of a students' note-taking process should require some form of re-teaching or training (Kiewra, 1985). Donohoo (2010) suggests gradually releasing responsibility of the note-taking process when training students. This involves four different phases of release: "modeling, guided instruction, collaboration, and independent practice" (Donohoo, 2010, p. 225). Research has shown that once students are well versed in a note-taking process through training, the quality of notes and comprehension increase (Boyle, 2010).

METHODOLOGY

In order to gauge the effects of a structured note-taking strategy in a virtual environment, the treatment and data collection was conducted over a two-month period from late November 2015 to late January 2016. The treatment involved two note-taking workshops provided by instructional staff and regular follow-up support and note-taking

checks. Montana State University's Institutional Review Board approved this research project and compliance for working with human subjects was maintained (Appendix A).

The students selected for this research consisted of sixth to eighth grade middle school students who regularly attended Agora Cyber Charter School's in-person Learning Center in Philadelphia, PA. This study involved two separate groups of students. The first met with the Learning Center Math Specialist for interventions each day, and the other was a group identified by other Learning Center staff as in need of note-taking guidance.

Prior to the treatment, participating students were asked to complete the online Learning Center Math Survey (Appendix B). The survey focused on student perceptions of note-taking in general and the frequency with which they take and/or use class notes. This data was collected to compare with a later post-treatment survey with the same questions utilizing a Wilcoxon rank sum test for a statistically significant difference between medians and frequency charts for display. Prior to the treatment, student math performance data was collected from the student grade book and the STAR online assessment database. Final math grades for the first quarter were collected as a letter grade. From the school's November STAR Math benchmark, each student scaled test score and percentile rank was collected for post-treatment comparison.

To compare the treatment students to the general student population, comparison students were selected based on a specific set of criteria. In order to ensure a reasonable match, comparison students selected had to be in the same grade, work with the same team of middle school teachers, and had to have the same Special Education status. Once a preliminary list of matching students was compiled following the criteria listed above,

STAR math assessment scores and Pennsylvania state assessment scores were reviewed to find the two closest matches to each treatment student. Due to the student turnover at Agora, two comparison students were selected with one being the primary and the other being the secondary or back-up comparison.

During the first week of treatment, the instructors ran one note-taking workshop for the participating students. The initial workshop was 40 minutes in length and occurred during the students' regularly scheduled afternoon hours at the Learning Center. The workshop consisted of 12 total students, of which seven were female and five male. The students ranged from 6th to 8th grade as there were two 6th graders, five 7th graders, and five 8th graders. The goal of this workshop was to introduce the general Learning Center note-taking initiative while providing the students with a specific strategy, Cornell Notes (CN), to use. Students were provided with a premade CN Template (Appendix C).

The workshop followed an *I Do, We Do, You Do* approach with two instructors, modeling the CN strategy for a math lesson. The content of the lesson was basic order of operations, which all students had already been exposed to, so that students could focus on the note-taking rather than the math concept. To initially model the CN strategy, the instructors used two separate boards, a whiteboard and a touch-screen SmartBoard that were side by side. On the whiteboard, the first instructor acted as the teacher, modeling how to find the solution to an expression using order of operations. This was delivered in a slow pace with a verbal explanation and written out steps. While this occurred, the second instructor acted as the student on the interactive SmartBoard. Projected on the

screen was the CN template which the second instructor copied notes onto based on what the first instructor was writing and saying.

During this example, students were asked to watch and listen rather than take notes of their own. At the end of this example, the instructors reviewed the example student notes on the SmartBoard. The Reasons / Questions column notes were emphasized by the instructors. The second instructor explained their additions to this column, which included one question mark that signified a step that was not understood. For the *We Do* portion of the workshop, a similar math problem was used. While the one instructor worked through the problem on the whiteboard, students were asked to copy down the example in the Notes section of the CN template. Upon completion, the instructors asked for student volunteers to fill in the Reasons / Questions column displayed on the whiteboard. An example of student notes for this part of the workshop can be seen in Figure 1.

Figure 1. Example of student workshop CN.

Once the reasons were listed based on student and instructor input, the students

copied these down. For the *You Do* portion of the workshop, the instructor taught two

problems. While the teaching occurred, students took notes in both columns of the CN

Template. The first problem involved basic order of operations while the second problem

was a two-step equation in order to apply this strategy on a different type of problem.

At the end of the workshop, the instructors focused on the Big Ideas / Big

Questions section of the CN template. The instructors discussed how the students could

summarize the main idea or strategies from the lesson. They reflected on their notes as to

include any lingering questions the student may have about the content. Between the two

initial workshops, students were asked to use the CN strategy at least once during their

virtual math classes. They were told that they would need to produce this example at the

following week's workshop.

The second set of workshops followed the same format in terms of time of day

and length. Only seven of the original workshop students were in attendance on this day.

At the beginning of this workshop, the instructors reviewed the students' notes from the

past week. This review acted as the first note-taking check for the students. The

instructors made note if a student made a reasonable attempt at the CN strategy.

After the note review, students were asked to recreate the CN structure on note

paper. An example was displayed on the SmartBoard for student reference. Once

completed, I introduced the goal for the workshop that day. The goal was to mimic a

virtual math class by viewing a Khan Academy video on the SmartBoard while both the

students and instructors took notes using the CN method (Appendix D). After this

activity, the students and instructors shared their notes in a round-table format. Each

member of the discussion was to provide one of the reasons or questions they listed in the

left-hand column or what they wrote in the section labeled, Big Ideas / Big Questions.

The instructors also discussed the struggles with this method and how to make it work for

each individual.

After the second workshop, students were asked to try the CN strategy at least

once each week during their virtual math classes. Regular note-taking checks occurred

over the course of the following five weeks of school. These regular checks were typically formatted as a one-on-one follow-up conversation with the students on their note-taking process and encouragement to continue the CN method. Students were not penalized when they forgot to bring in examples or follow the expectations.

Two months after the initial workshop, the remaining treatment students were asked to complete the Math Notes Survey (Appendix E). At the time of the survey, only eight students remained of the original treatment group. Although the title and design of the survey was different, the questions and choices remained the same as the Learning Center Math Survey pre-survey. To analyze the data on student perception and attitude towards notes, the Learning Center Math Survey and Math Notes Survey results were analyzed question by question. The results of this data were used to gauge any shift in as a whole as well as any shift in individual responses. To display shifts in responses to each question, either box plots or percentage tables were created to display the frequency of each level on the Likert scale for both pre and post-results for each question. To verify the statistical significance of the data in the charts, the Wilcoxon ranked sum test to compare medians was utilized with a pre-determined α level of 0.05 for analysis purposes. The data were also analyzed in terms of individual increases or decreases in student responses to each question. An increase was considered a shift towards a higher value on the Likert scale for each question. For example, *neutral* to *strongly agree* would be a higher level shift. A graph was created to display the frequency of higher level shift, lower level shift or no change for each question.

At the beginning of February, student grades and STAR Math benchmark data were collected for the participating students. This data was used to calculate growth in terms of course grade in percentage, STAR percentile ranks and STAR student growth percentiles (SGP). Each student's percentile rank from November to January was used to calculated percentages of students that fall under four different reporting categories as determined by STAR. These categories range from Urgent Intervention (1st to 10th percentile) to At/Above Benchmark (40th percentile or above) and represent a student's current math performance level. For example, those students designated as Urgent Intervention are most likely two grade levels behind in terms of their math skills.

January STAR percentile ranks and SGPs were collected and their distribution was analyzed and displayed in a box and whisker plot. The same data was collected for each identified comparison student and included in this analysis. A box and whisker display was used to visualize any differences between January percentile ranks and SGPs for treatment and non-treatment comparison students. To determine statistical significance, a Welch Two-Sample t-test was utilized with a pre-determined α level of 0.05 for analysis purposes.

To analyze the students' course grades from quarter one and quarter two, each student was categorized as an increase, decrease, or no change in grade. The percentages were collected in a table. The same data was then collected for the appropriate comparison students to provide a non-treatment comparison data set. Quarter Two grades were compared between these two groups in a frequency chart as well. To further compare the two different groups, a number scale for the letter grades was created where

1 = F and 5 = A. This allowed for a comparison of grade change (moving from a C to a B would equal positive one) between the treatment students and their matched comparison students. To determine statistical significance, a Welch Two-Sample t-test was utilized with a pre-determined α level of 0.05 for analysis purposes.

Student responses from the Post Treatment Student Interview (Appendix F) were used as qualitative data to illustrate or further elaborate on the data found in the other data collection tools. A data triangulation matrix was created to summarize the use of data for this study (Table 1).

Table 1
Data Triangulation Matrix

Focus Questions	Data Source 1	Data Source 2	Data Source 3
1. What are the effects of a structured note-taking strategy on a cyber student's math performance?	STAR Math Assessment Percentile Rank and Scaled Scores (from November to January)	STAR Math Student Growth Percentile	Student Math report card grades in Quarter 1 and Quarter 2
2. What are the effects of a structured note-taking strategy on a cyber student's perception of note-taking?	Comparison between Learning Center Math Survey (pre) and Post Treatment Google Survey	Post-Treatment Student Interviews (based on survey questions)	Researcher observations throughout treatment period

DATA AND ANALYSIS

On the STAR Math assessments, 43% or three of the students demonstrated positive growth in regards to the nationally normed percentile rank, while 14% or one of

the students showed no change in percentile (*N=7*). Fifty-seven percent or five of the

students increased their overall scaled score on the assessment (Table 2).

Table 2
Percentage of Students in STAR Reporting Categories

Category	Urgent Intervention: 1st to 10th (%)	Intervention: 10th to 25th (%)	On Watch: 25th to 40th (%)	At Benchmark: 40th and Above (%)
November	71	0	29	0
January	57	14	0	29

Note: (N=7).

The median January percentile rank for treatment students was the 5th percentile,

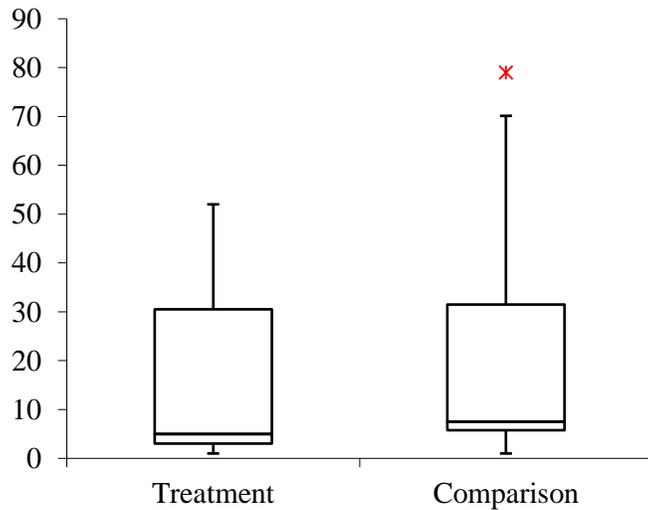while the median for the comparison was the 7.5th percentile (Figure 1).

Figure 2. January STAR percentile rank comparison, (*N=7*).

When considering the growth from November to January as the STAR Student

Growth Percentile (SGP), the treatment group had a median SGP of 38 while the

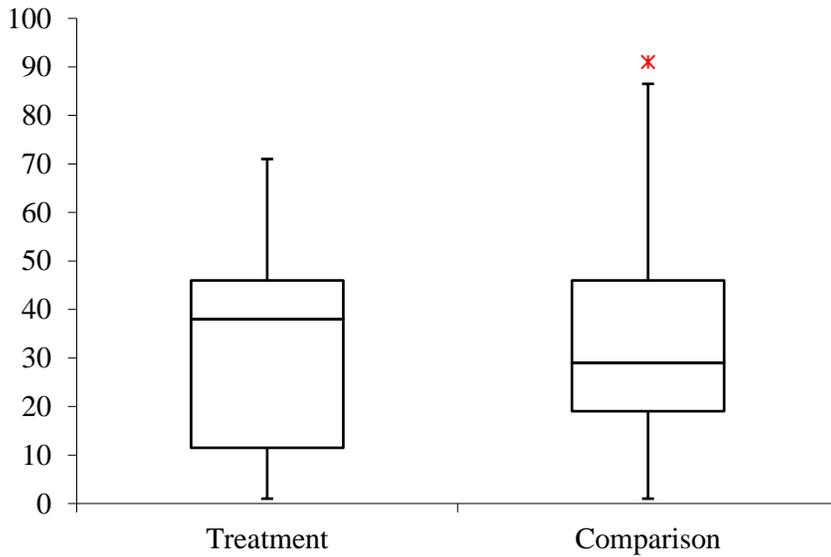comparison group had a median SGP of 29 (Figure 2).

Figure 3. Student growth percentile rank comparison, (*N*=7).

For both the percentile rank and SGPs, a Welch Two Sample t test was utilized on the matching pairs of treatment and comparison students. Neither sets of data demonstrated statistically significant differences between the treatment and comparison means with p-values well above the pre-determined α level (*p = 0.68* and *p = 0.61*).

On the second quarter report cards, none of the students increased their letter grade in their math classes (*N = 8*). While the majority of the students received the same grade in the first and second quarter, 25% or two of them received a lower letter grade (Table 3).

Table 3
Percentage of Letter Grades in Math by Quarter

	F (%)	D (%)	C (%)	B (%)	A (%)
1st Quarter	62.5	0	0	25	12.5
2nd Quarter	62.5	12.5	0	25	0

Note: (N=8).

In comparison, 37.5% or 3 of the matching non-treatment students received a failing grade in the second quarter ($N = 8$). Half of the non-treatment students received a C or better while only a quarter of treatment students earned such grades (Figure 3).
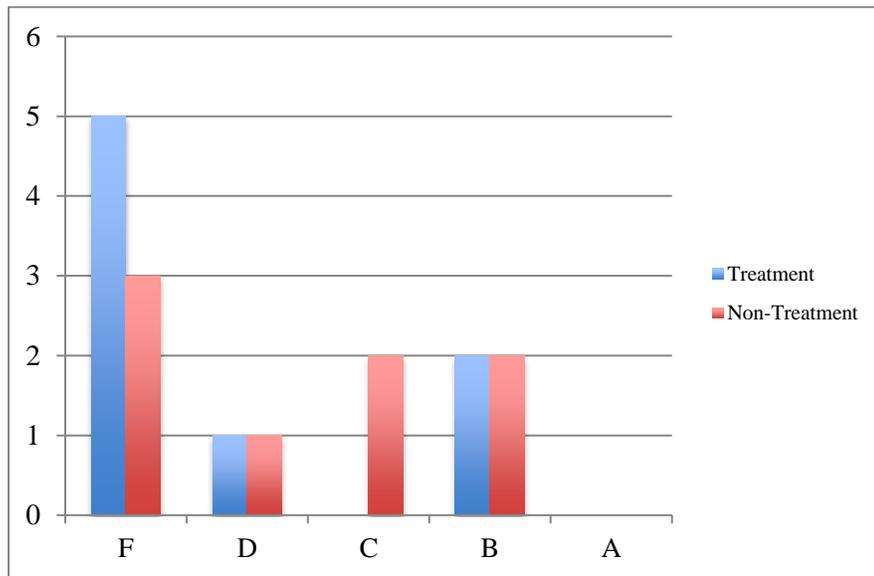
Figure 4. Frequency of second quarter letter grades, (N=8).

For both the second quarter grades, a Welch Two Sample t test was utilized on the matching pairs of treatment and non-treatment comparison students. This set of data did not demonstrate statistically significant differences between the treatment and comparison with p-values well above the pre-determined α level ($p = 0.46$).

Although the student math performance indicators did not demonstrate any effects that could stem from the Cornell Note (CN) treatment, the survey results were analyzed to determine any changes in student perception. When asked about the importance of note-taking, the majority of the responses were either *important* or *very important* on both the pre and post-surveys (N = 7). When asked about the importance of note-taking as a cyber student (Question One), both surveys had 71% or five *important* or *very*

important responses yet the post-survey showed a 28% increase in *very important*

responses (Table 4). When asked specifically about the importance of note-taking in

Math class (Question Two), a similar 28% increase of *very important* responses occurred

while one response dropped to *slightly important* (Table 5).

Table 4
Percentage of Responses for Survey Question One

	Not Important (%)	Slightly Important (%)	Moderately Important (%)	Important (%)	Very Important (%)
Pre	0	29	0	43	29
Post	0	14	14	14	57

Note: (N=7).

Table 5
Percentage of Responses for Survey Question Two

	Not Important (%)	Slightly Important (%)	Moderately Important (%)	Important (%)	Very Important (%)
Pre	0	0	0	71	29
Post	0	14	0	29	57

Note: (N=7).

Even with similar levels of importance on each survey, there was a shift in the

students' perception of the importance of note-taking. The median for both questions

shifted from *important* to *very important*. A Wilcoxon rank sum test was utilized to check

for statistical significance for both Question One and Two. With p-values ($p = 0.457$ and

$p = 0.567$) well above the α level, neither question showed a difference in responses that

was statistically significant. Both students in the final interview agreed that note-taking

was very important as a cyber and specifically in math class. They both also focused on

the idea of note-taking as a way to not "forget about things."

When students were asked how frequently they write notes in math class, the median response pre-treatment was *often* while the median response for the same group of students after the treatment was *sometimes* thus showing a decrease in frequency. Upon utilizing a Wilcoxon rank sum test on the pre and post responses, a p-value of 0.599 demonstrated that there is no significant statistical difference in the responses. While a decrease was shown in the survey, both interviewed students shared that they consistently take notes in Math class to help remember what was covered that day. Another student during an impromptu check-in, noted that she specifically used CN for every math class as it "helps to organize (my) notes" (Figure 6).

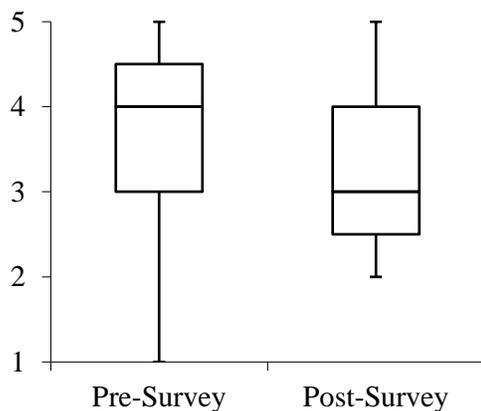*Figure 5.* Note-taking survey – analysis question three (*N* = 7)
Note. 5 = Always, 4 = Often, 3 = Sometimes, 2 = Rarely, 1 = Never

When asked how frequently students looked back at or reviewed notes (Question 4), 43% or three of the students originally responded *often* or *always* (N = 7). On the post-survey, 71% or five of the students responded *often* or *always,* a 28% increase (Table 6).

Table 6
Percentage of Responses for Survey Question Four

	Never (%)	Rarely (%)	Sometimes (%)	Often (%)	Always (%)
Pre	0	14	43	29	14
Post	0	0	29	57	14

Note: (N=7).

The data distribution also demonstrated a shift as the median response pre-treatment was *sometimes* while the median response for the same group of students after the treatment was *often*. Upon utilizing a Wilcoxon rank sum test on the pre and post responses, a p-value of 0.375 demonstrated that there is no significant statistical difference in the responses. Although the data may not have shown statistically significant differences, both students stated that being able to review notes was one of the reasons for their importance. One student shared that on a regular basis she will, "go back over them with my brother or mom."

When asked to rate the quality or helpfulness of their personal notes (Question 5), there was a minimal shift in student responses from pre to post-survey (Figure 8).

Table 7
Percentage of Responses for Survey Question Five

	Very Poor (%)	Poor (%)	Average (%)	Above Average (%)	Excellent (%)
Pre	14	14	29	14	14
Post	29	0	14	29	14

Note: (N=7).

The median response was *average* on both surveys. While the *above average* responses increased so too did the *very poor* responses. Upon utilizing a Wilcoxon rank sum test on the pre and post responses, a p-value of 0.845 demonstrated that there is no

significant statistical difference in the responses. During the interviews, the two students had mixed responses, which supports the lack of change shown in survey data. One student stated that her notes are "sometimes" helpful but she can "forget to write down everything" that was important. The other student found her notes to be very helpful in that it allows her to "break it (math problem) down to a way I understand it." This student also shared that she will continue to use CN as this strategy was helpful to her.

The sixth and final question on the survey asked the student if they agreed that note-taking helps them to better understand skills learned in class. For this question there was a minimal shift in student responses from pre to post responses (Figure 9).
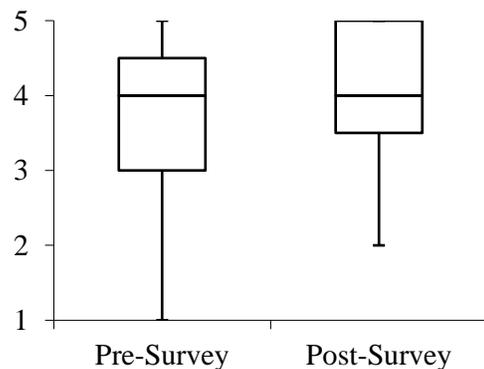
Figure 6. Note-taking survey – analysis question six (*N*=7)
Note. 5 = Strongly Agree, 4 = Agree, 3 = Undecided, 2 = Disagree, 1 = Strongly Disagree

The median response was *agree* on both surveys while the minimum, first and third quartiles had a change to higher levels of agreement as seen in Figure 9. Upon utilizing a Wilcoxon rank sum test on the pre and post responses, a p-value of 0.595 demonstrated that there is no significant statistical difference in the responses. Interview data did not address this topic specifically although, one student stated that note-taking helps her understand "how to properly do it (math)."

To see the overall shift from pre to post survey, the number of students that had a higher level shift, lower level shift, or no change can be considered (Figure 10). The survey questions were all created to such that the higher the response on the Likert scale, the more positive the response. For example, when discussing note-taking frequency a student that selected *sometimes* on the pre-survey and *often* on the post-survey would count as a higher level shift. Students demonstrated the greatest higher level shift in regards to the frequency at which they review their notes (Question Four). On the other hand, students had the greatest lower level shift in responses to how frequently they take notes, with one student going from *often* taking notes to only *sometimes*.

Q1: "How important is note-taking to you as a cyber student?"
Q2: "How important is note-taking to you in Math class?"
Q3: "How frequently would you say you take notes in Math class?"
Q4: "When you do take notes, how frequently do you look back at or review your notes later on?"
Q5: "When you do take notes, how would you rate the quality or helpfulness of your notes?"
Q6: "How do you feel about the statement below? '*Taking notes helps me better understand the skills I learn in class.*'"
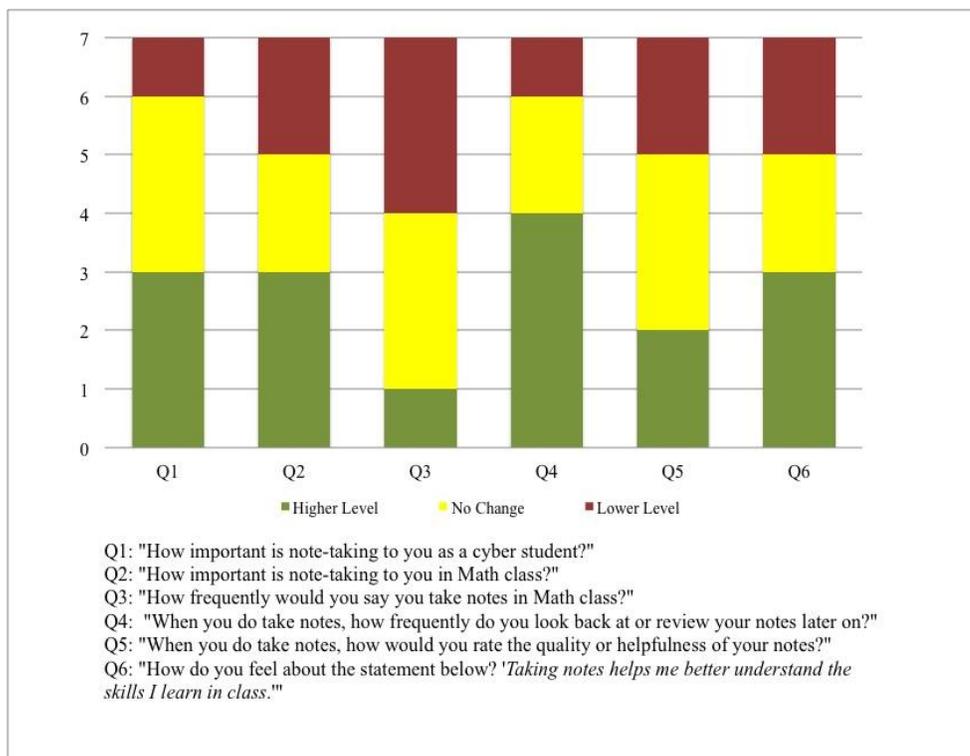
Figure 7. Frequency of individual changes of agreement in survey responses, (*N*=7).

INTERPRETATION AND CONCLUSION

As stated in the focus subquestions, the data were analyzed to gauge any changes in math academic performance and student perception of note-taking. The data collected do not demonstrate a consistent positive shift in student math performance after the treatment period. Although minimal, positives gains can be seen in student perception of note-taking as seen in survey responses and student feedback throughout the process. Looking at the data triangulation further demonstrates these trends.

The STAR Math assessment results showed some positive results as the percentage of Urgent Intervention students dropped by 14% or one student and the At/Above Benchmark students increased by 29% or two students. The Student Growth Percentile (SGP), which compares the growth between assessments against national norms, also showed positive results. The median SGP of the treatment students was the 38th percentile which is approaching the school's goal of 40th and above. This median SGP outpaced the median of the comparison group by 9 percentile points. When analyzing the January benchmark results though, the comparison group did outpace the treatment group when it came to the median percentile rank for that particular score. With a median percentile rank of 5, the treatment group still demonstrated that they are on the very low end of the math spectrum even if they did demonstrate some growth. When analyzing the STAR data points, cannot conclusively say that the treatment had a measurable effect on their academic performance. One must also consider that the treatment students attend the in-person Learning Center for extra supports while the comparison students did not. With extra support and resources, one should expect to see a

difference in performance merely from that. To truly say the treatment had an effect, one would need to see a more statistically significant difference between the treatment and comparison students.

   Academic performance was also viewed through student report card grades in Math. One should expect that a consistently used note-taking strategy should help to increase student performance on homework, quizzes and tests. Based on the report card data, there seems to be no evidence that this was the case. No treatment students received a higher letter grade in the second quarter and that 25% or two students actually dropped a letter grade or more. Being that over 50% or four of the treatment students were failing in the first quarter, this was not a positive data point. At Agora Cyber Charter School, one can find a drop in grades during quarter two or three across the board, but this was generally worse than the average grade fluctuations. The comparison group data displayed less students failing their math course and 50% or four of them had a C or higher as compared to the treatment group which was only at 25%. So although STAR scores showed some gains, student grades seemed to be effected very little through the use of CN on a regular basis. As students can many times use notes for homework, quizzes and tests, this can particularly show that the quality of their CN may be low. During the second workshop, I observed students struggling with the Reasons/Questions column which helps students break down examples or identify areas they need to review. Upon analyzing this data, I believe that this struggle continued to occur throughout the treatment period. Of the few examples that I could gather during impromptu check-ins, the depth of the notes was lacking for some of the students.

In regards to student perceptions of note-taking, there are some positives to take away from the survey data even if it is not statistically significant. On both questions (Question One and Two) that asked about the importance of taking notes, a positive shift to higher levels of agreement were seen. In Question Two, which asked specifically about the importance of notes in Math class, all students selected *agree* or *strongly agree* in the pre-survey yet the median still shifted as 43% or three of the students changed their selection to *strongly agree* after the treatment. So although many students came into this treatment believing that note-taking was important, it was very positive to see that the treatment may have made the importance even more clear to the students involved.

Another positive change in student perception as seen on the surveys, was in the student responses to the question, "how frequently do you look back at or review your notes" (Question Four). The students shifted from *sometimes* to *often* on the post-treatment survey. Although not statistically significant, the majority of the students stated that they review their notes more frequently since the beginning of the treatment. As noted earlier, the act of reviewing one's notes is a very important part of the learning process. Being able to encourage more frequent review of notes is a step in the right direction for these students following the treatment.

The aspect of note-taking that the CN treatment may not have helped is the overall quality of student notes and the frequency with which they take notes. There was very minimal change in the students' perception of their own personal notes. When asked to "rate the quality of your notes" (Question Five), the students responses showed little to no change in the assessment of their own notes. Question Six showed very little change in

regards to the quality and helpfulness of their notes. When asked how frequently the students take Math notes (Question Three), there was actually a decrease in the selected frequency. The process of teaching a specific note-taking strategy may have increased the student's perception of importance and encouraged them to review their notes, but it did not seem to address the frequency and quality of these notes.

I believe that a similar approach with workshops and follow-up protocol would be beneficial for the students in a virtual setting even without a clear picture of the benefits. The small sample size of treatment students must be considered as a factor in the results but I believe the focus on CN may not have been the key to changing student attitudes towards note-taking and their math performance. So although some positives can be taken from this treatment, the final outcome of improved math performance and quality of notes were not apparent in the data collected.

VALUES

The process of action research has been an extremely valuable experience to me as an educator and as I move more into the realm of program management and policy. It allowed me to take a systematic approach to a specific issue that I had experienced during my time at Agora Cyber Charter School. Although the overall CN treatment may have not proven to be successful, I believe that I am better and that my students have taken at least some positives away from it.

One very positive thing to stem from this action research-based project was a specific focus on teaching note-taking as a virtual student. From my experience at Agora Cyber Charter School, I do not believe there ever had been note-taking workshops

offered to the students. Being a virtual student can be a very daunting task especially for those students who struggled at standard brick-and-mortar schools prior to attending a cyber school. Note-taking and note organization is a skill that is specifically practiced in standard schools from elementary to secondary. While I have seen virtual teachers who do an excellent job of supporting student note-taking, it is quite difficult to give the same level of support when your student is behind the screen and not in your physical classroom. Upon doing this research, I found myself thinking even more strongly that we need to find ways to provide extra note-taking support for virtual students. Providing specific workshops beyond normal classes was an excellent way to get students thinking about note-taking as a virtual student. Although I had an in-person treatment group at the Learning Center, I feel like this should be available to all students at Agora to help meet their needs. I have encouraged administration to include note-taking as an orientation course during the first week of classes or during new student orientation. Even though my treatment group did not show large gains in terms of perception or skills, the extra emphasis on note-taking pushed them to think about their notes more and encouraged them to figure out the best way to take notes for themselves.

I have already begun to think about ways to expand or build upon this action research. If similar note-taking workshops and follow-ups could be implemented with a larger, more representative group of students, I would be highly interested in collecting similar data. I mentioned earlier having a note-taking orientation course for students which would cover students across the state. This would allow for a greater and more random sample of students to analyze. Working with specifically the Learning Center

students, I was only looking at a small portion of the student population at Agora. Instead of strictly urban Philadelphia students, we could work with students across the economic and geographic map to encourage note-taking. The population at the Learning Center was also quite transient as it was not necessarily a requirement for students to attend as they could always go strictly virtual. I would want to investigate a note-taking treatment that did not specifically focus on CN. Expanding to different styles of notes allows the students to find one that suits them best and thus creates more buy-in. While using strictly CN allowed my workshops to focus for the time I could spend at the Learning Center, I feel now that this is not the best approach to the treatment in the future.

Through this process, I also found that the follow-up was extremely important when it came to note-taking. As I did not work at the Learning Center during the treatment period, I was not able to visit as frequently as I wanted to. For those students that I was able to check in with during my times at the Learning Center, I found a follow-up conversation on their notes after the workshops gave them a chance to share positives, struggles and encouraged them to keep it going. I wish that I had the opportunity to go back and set up a more formal method for follow-up. This would have allowed me to collect student notes and provide feedback myself which in turn could affect the quality of student notes. If a similar treatment was to ever be implemented, I would like to see it done in a way that cyber teachers could see student notes. This project has motivated me to explore possible options in terms of virtual notebooks or Google Apps for Education that are easy for the students to use and for teachers to check in on their class' notes.

I found this type of research extremely valuable for me as I look to further my career in education. I have moved into more program coordination since starting as a math teacher and I am always hearing to back up proposals with "research." What better way to back up different proposals with research that came directly from our own school? This rings especially true for working in a cyber school setting. Most of the research literature available is focused on research done in brick-and-mortar schools. While we share similarities, there are many struggles unique to cyber schools. For example, at a cyber school, behavioral issues may be fewer but engagement issues can be overwhelming as students can log into class and leave the computer. Having organized research from our particular situation is undeniably valuable to our decision-making process. Encouraging action research to be done in cyber schools can greatly address this research gap and help strengthen virtual education as an option for future students.

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APPENDICES

APPENDIX A

IRB EXEMPTION APPROVAL LETTER

INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

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MEMORANDUM

TO: Andrew Senkowski and John Graves

FROM: Mark Quinn, Chair *Mark Quinn CQ*

DATE: November 16, 2015

RE: *"The Effects of a Structured Note-Taking Strategy in a Virtual Classroom"* [AS111615-EX]

The above research, described in your submission of November 11, 2015, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

__X__ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

__X__ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

_____ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

_____ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

_____ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

_____ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

LEARNING CENTER MATH SURVEY

Learning Center Math Survey

Your participation on this survey is voluntary. Please be completely honest on this survey. Your responses will not affect your grade or status as a Learning Center student.

How important is note-taking to you as a cyber school student?
○ Not Important
○ Slightly Important
○ Moderately Important
○ Important
○ Very Important

How important is note-taking to you in Math class?
○ Not Important
○ Slightly Important
○ Moderately Important
○ Important
○ Very Important

How frequently would you say that you take notes in Math class?
○ Never
○ Rarely
○ Sometimes
○ Often
○ Always

When you do take notes, how frequently do you look back at or review your notes later on?
○ Never
○ Rarely
○ Sometimes
○ Often
○ Always

When you do take notes, how would you rate the quality or helpfulness of your notes?
○ Very Poor
○ Below Average
○ Average
○ Above Average
○ Excellent

How do you feel about the statement below?
"Taking notes helps me better understand the skills I learn in class"
○ Strongly Disagree
○ Disagree
○ Undecided
○ Agree
○ Strongly Agree

APPENDIX C

CN TEMPLATE

Topic: **Date:**

Reasons / Questions	Notes

Big Ideas / Big Questions

APPENDIX D

KHAN ACADEMY EXAMPLE LESSONS

"Adding fractions with unlike denominators"

https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-fractions-topic/cc-5th-add-sub-fractions/v/adding-small-fractions-with-unlike-denominators

"Subtracting fractions with unlike denominators"

https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-fractions-topic/cc-5th-add-sub-fractions/v/subtracting-small-fractions-with-unlike-denominators

APPENDIX E

MATH NOTES SURVEY

Math Notes Survey

Your participation on this survey is voluntary. Please be completely honest on this survey. Your responses will not affect your Math grade or status as a Learning Center student.

Your username (asenkowski@agora.org) will be recorded when you submit this form. Not asenkowski? Sign out

How important is note-taking to you as a cyber school student?

- ○ Not Important
- ○ Slightly Important
- ○ Moderately Important
- ○ Important
- ○ Very Important

How important is note-taking to you in Math class?

- ○ Not Important
- ○ Slightly Important
- ○ Moderately Important
- ○ Important
- ○ Very Important

How frequently would you say that you take notes in Math class?

- ○ Never
- ○ Rarely
- ○ Sometimes
- ○ Often
- ○ Always

When you do take notes, how frequently do you look back at or review your notes later on?

- ○ Never
- ○ Rarely
- ○ Sometimes
- ○ Often
- ○ Always

When you do take notes, how would you rate the quality or helpfulness of your notes?

- ○ Very Poor
- ○ Below Average
- ○ Average
- ○ Above Average
- ○ Excellent

How do you feel about the statement below?
"Taking notes helps me better understand the skills I learn in class"

- ○ Strongly Disagree
- ○ Disagree
- ○ Undecided
- ○ Agree

APPENDIX F
POST TREATMENT STUDENT INTERVIEW

Note: Prior to the interview, interviewer will state that "this interview is voluntary and you will not be graded or judged on your responses"

1. Do you find that taking notes is important to you as a cyber student? Please explain.

2. Do you find your notes to be helpful? Why or why not?

3. Will you continue to use the Cornell Note method for your math classes?

4. Do you think you will continue to regularly take notes for your online classes?