Using Geometer’s Sketchpad to Improve Student Attitude in the Mathematics Classroom

A Capstone Project
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Abstract

This study determined whether using Geometer’s Sketchpad as a teaching tool improved student attitudes toward mathematics. Geometer’s Sketchpad is a computer program that allows the user to design, manipulate, and measure geometric figures. The researcher taught 31 high school geometry students two units only using Geometer’s Sketchpad as a teaching tool to determine whether the students’ attitudes toward mathematics improved. Students’ attitudes at the beginning and the end of research project were measured using a Modified Fennema-Sherman Attitude Survey. Student interviews and the researcher’s journal were also used for data of the project. After an eight-week project, student interviews and my observations indicate students’ attitudes toward mathematics improved, while pre-survey and post-survey results indicate no significant improvement in attitudes toward mathematics.
Acknowledgements

I would like to thank my husband for all of his love and support through this process, as well as my family and friends. Thank you to my students and their parents for being a part of the research project. If it wasn’t for you all, this would have been a much more difficult journey.
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Chapter One

Introduction

“It's so hard when I have to, and so easy when I want to.” ~Annie Gottlier.

Attitude truly reflects how well students do in the mathematics classroom. If students want to learn the math, they are more likely to understand and succeed. However, some students dislike mathematics and it shows in their attitudes. How can math teachers improve students’ attitudes toward mathematics? Geometer’s Sketchpad is a computer program allowing the user to design, manipulate, and measure geometric figures. Teaching everyday lessons using Geometer’s Sketchpad might improve students’ attitude toward mathematics.

Motivation for the Project

Mathematics is a powerful and interesting subject to math teachers. However, the attitude of the majority of my students toward mathematics can be negative or neutral. I started using Geometer’s Sketchpad in my mathematics classroom and saw a spark of interest from some students. I wanted to see if using Geometer’s Sketchpad on a continuous basis would improve students’ attitudes toward mathematics.

Background on the Problem

Why do some of my students have a negative attitude toward mathematics? For me, when I am struggling with an activity, my attitude tends to become more negative instead of positive. Attitudes can make or break student
achievement. A positive attitude can make a world of difference in the learning of mathematics. Students who are extremely smart, but put little or no effort into their studies, can find themselves failing subject matter which should be interesting and fun for them. Their attitudes toward mathematics can be dismal. However, these are not the only students who find mathematics uninteresting. Many of my students struggle with the material, which turns their attitude toward mathematics ugly. It is frustrating as a teacher to hear a student state, “I like you as a teacher, but I hate math.” I want students to enjoy what they are learning and to see the benefits of learning it. As a teacher, I have tried many things to engage these students, and have struggled to find a niche for attitude adjustments. Geometer’s Sketchpad just might be the niche. If Geometer’s Sketchpad improves half of my class’s attitude toward mathematics; it’s a success for me as a teacher.

Statement of the Problem

Negative student attitudes in the classroom reduce students’ ability to be successful in school. The majority of my students’ attitudes toward mathematics were low and unappreciative of what they were learning. In my classroom, I could probably have counted on one hand the number of students who truly enjoyed learning about mathematics and could see its importance.

Statement of Purpose

To improve student attitudes toward mathematics, I implemented two units using Geometer’s Sketchpad as my only teaching tool to determine whether
its use contributes to improved attitudes toward mathematics. Students took a pre-
survey before the unit and a post-survey after the unit to measure attitudes toward
mathematics. During the units, students had access to Geometer’s Sketchpad on
their computers every day. They were able to follow what I did and discover the
material covered. Not only did I hope to spark an interest in mathematics, but I
hoped the students would get so involved in what they are doing, they would
teach me new ideas about how to use Sketchpad.

Research Questions/Hypotheses

The question answered in this study is as follows: In what ways do
students’ attitudes toward mathematics improve while using Geometer’s
Sketchpad? It was interesting to see the students’ answers to this question and my
own answers after I implemented this project.

Definitions

*Geometer’s Sketchpad* — A computer program allowing the user to design,
manipulate, and measure geometrical figures.

Summary

Eagerness to learn seems to be slipping away from my mathematics
classroom. Teaching everyday lessons using Geometer’s Sketchpad might
improve students’ attitudes toward mathematics. I want students to enjoy the math
they are learning and not just who is teaching it. To understand whether use of
this learning tool might be a solution to negative attitudes, the literature pertaining
to this problem was reviewed and then summarized in Chapter Two.
Chapter Two

Review of Literature

This study determined whether using Geometer’s Sketchpad as a teaching tool improved student attitudes toward mathematics. There has been research done on enjoyment and student attitude toward mathematics as well as the effects of Geometer’s Sketchpad on student achievement. However, in the research found, a direct relationship between student attitudes toward mathematics and use of Geometer’s Sketchpad was not found. The research found related to enjoyment of mathematics, student attitude, Geometer’s Sketchpad, and academic results of studies using Geometer’s Sketchpad as a teaching tool.

Enjoyment of Mathematics

“Why do we need to know this?” Most mathematics teachers have heard this question before. Some students do not enjoy learning mathematics which can bring down their attitudes toward mathematics along with their success levels. The students then find themselves enrolled in a low level math class, dislike it, and don’t understand why they need math in their lives. According to Bryk and Triesman (2010), “Recent studies report that between 60 and 70 percent of students placed into remedial math either do not successfully complete the sequence of required courses or avoid taking math altogether and therefore never graduate” (p. 19). Some students do not pass math classes because they don’t
enjoy what they are learning and can’t see the reason for learning it. Loss of interest and enjoyment turns into a bad attitude toward mathematics.

Are students losing interest in mathematics because they are bored with the continuous routine and never changing atmosphere? Classroom activities, such as using Geometer’s Sketchpad, might bring that enjoyment back into mathematics. According to Curtain-Phillips (2010):

The Third International Mathematics and Science Study (TIMSS) tested the students of 41 nations. Children in the United States were among the leaders in the fourth grade assessments, but by high school graduation, they were almost last…Full 88% of Bill and Melinda Gates Foundations’ survey respondents said they had passing grades in high school. Asked to name the reasons they had left school, more respondents named boredom than struggles with coursework. (para. 1-2)

Some high school math teachers tend to teach with paper and pencil only, without any manipulatives, which makes some mathematics very abstract and hard to master. Students start to get bored and lose interest which can take the enjoyment out of what they are learning. Using hands-on activities can bring the enjoyment back into the mathematical classroom and take the term “boredom” out of the student’s thoughts (Curtain-Phillips).
**Student Attitude**

Students’ attitudes toward mathematics can either make or break their personal achievement in the subject. Some students find mathematics irrelevant and unrelated to their personal lives. At St. Joseph’s College New York, a survey was done with 49 pre-service high school math teachers on their experience of teaching styles. The results of the survey showed the majority taught in a lecture style manner. In this research, there was a correlation between teaching styles and student achievement. According to White-Clark, DiCarlo, and Gilchriest (2008), “Many high school students feel disconnected from their math instruction and perceive it as irrelevant in their lives, impacting their levels of interest and mathematics achievement” (p. 40). If students do not have a positive outlook on the concepts they are learning, finding importance can be a challenge. The White-Clark et al. study showed how constructivism-based learning produced positive achievement results for the students. An example of constructivism-based learning is hands-on learning, such as using Geometer’s Sketchpad. Learning the same material but in a different way might change students’ attitudes and increase their enjoyment of what they learn.

In Queensland primary school, a study was undertaken to implement a string of games and activities on probability, specifically chance, in a year 7 classroom. The study investigated whether use of games and activities improved student attitudes toward chance. Fifty-eight students participated in this research,
consisting of 31 boys and 27 girls. According to Nisbet and Williams (2009), “In the positive attitude cycle, a student with positive attitudes to mathematics has the intention to do well, hence exhibits positive behavior, and then experiences success. The success in turn improves attitudes even more, and the cycle continues” (p. 26). Over an eight day period, students had six activities on probability. The students took pre- and post-surveys on their attitudes toward mathematics. At the end of the study, the researcher found students’ attitudes improved greatly, and the teachers noted the students’ enjoyment of and motivation for mathematics was present during the study as well. According to Nisbet and Williams, “Teachers should therefore use such activities to address attitude problems” (p. 36). Attitude is so crucial to student achievement and success. Can Geometer’s Sketchpad improve student attitudes toward mathematics so students enjoy what they learn? Improving the attitude of students in the secondary school system may change the entire learning environment.

**Geometer’s Sketchpad**

Geometer’s Sketchpad is a computer program that allows students hands-on experience with geometrical figures and measurements. According to Hannafin, Truxaw, Vermillion, and Liu (2008):

Dynamic geometry programs are tools that one can use to create and support student-centered learning environments. To use dynamic geometry programs to foster student-directed inquiry, instruction needs to be
structured to guide students to the point at which conjectures are possible.

(p. 148)

Geometer’s Sketchpad does not replace the classroom teacher. The teacher needs to develop lessons using Geometer’s Sketchpad as the teaching tool to allow students to design and manipulate figures. Hannafin, Burruss, and Little (2001) stated, “Proponents of OELEs (dynamic geometry programs) believe that by identifying goals and constructing meanings, learners become active managers, rather than passive receptacles, of information” (p. 132). The students are in control of their learning with Sketchpad while the teacher keeps them on the right path. Geometer’s Sketchpad can engage students’ higher-order thinking and challenge them into deeper thinking. The use of Geometer’s Sketchpad can provide hands-on experiences, and it might also improve the attitudes of those who do not enjoy mathematics.

Geometer’s Sketchpad allows students to design figures using circles, lines, segments, arcs, and other geometric shapes. Once students design an object, they can measure angles, arcs, segment lengths, find midpoints and other measurements. The student can then grab a point on the figure, move it, and watch the measurements change with the change in the object. For example, if a geometry teacher is teaching the students about parallel lines and angles, then the students can design two or more parallel lines and a transversal using Sketchpad. The student can measure alternate interior, alternate exterior, corresponding, same
side interior, and same side exterior angles also using Sketchpad. Once the student measures all of these angles, he or she should see the pairs of matching angles. The student can move the lines and watch the measurements change, but stay equal to the measurement of the matching angle. This fast-paced manipulation of a figure cannot be done using paper and pencil. This computer program allows students to change or move figures very quickly and get clear results. Once students become comfortable using Geometer’s Sketchpad, lessons typically proceed at a much faster pace.

Sketchpad can help students learn geometry and history too. Students learning about the Pythagorean Theorem can recreate the square foundation of the Ancient Pyramids in Giza. The students can make a perfect square using three different methods. The students first make a square like the ancient Egyptians did with string and knots, then with a protractor, paper and pencil, and finally using Geometer’s Sketchpad. According to Smith, Stump, and Lazaros (2010), “(Students will) draw a circle with a radius and then draw lines perpendicular to the radius. (Students will) draw intersection points and complete the square by connecting the points with the line segments” (p. 24). After students finish with the three methods, they can write a paper comparing the similarities and differences of the three methods. Geometer’s Sketchpad can give students the tools necessary to create a perfect square, but the students’ need sufficient understanding of the use of Geometer’s Sketchpad to create the perfect square.
Results of Using Geometer’s Sketchpad

Geometer’s Sketchpad is used as a teaching tool in many classrooms throughout the country. Whether the teacher uses it for demonstration or the students conduct their own discovery experiments in a lab, studies have been conducted on the effect Geometer’s Sketchpad has on student achievement. Students seem to enjoy figuring out mathematics through hands-on activities, rather than having a teacher show them how to do the math and move on.

In a computer lab project at a college, pre-service teachers created two-dimensional nets to build three-dimensional objects using Geometer’s Sketchpad (Maida, 2005). The professor who taught the course first tried teaching the students how to make nets without Geometer’s Sketchpad by using hands-on plastic polygon manipulatives. This method achieved proficient results but not enough to assure all students understood the concept. The teacher then decided to have the students make nets on Geometer’s Sketchpad, print them off, cut them out and fold them into three-dimensional figures. The students made nets of right hexagonal pyramids, right octagonal prisms, and the five platonic solids. According to Maida, “Many students stated that the lab was time consuming but worth it and much more meaningful than simply being told results from a teacher” (p. 5). Using Geometer’s Sketchpad, all of the students achieved success and reinforced the concept on how to make nets of any 3D figure.
A study was done with two seventh-grade math classes on learning basic geometry concepts in a two week unit using only Geometer’s Sketchpad as their learning tool. The students received 14 Sketchpad lessons they were to complete individually at their own pace. The lessons had students manipulate, measure, and design figures to answer the guided questions. During the two-week period, the teacher did answer Sketchpad or mathematical questions provided by the students. Those students who finished earlier than the two week period worked on enrichment Sketchpad activities until the others were finished. Once all of the students were finished, they took a multiple choice exam on the basis of the material covered in the Sketchpad activities. According to Hannafin at al. (2001):

Students said that they felt they had learned a lot of geometry by using the computer and the specialized materials: “I thought it (geometry) was boring before, but when we got to play with making them, it was fun.” “I thought it would be really hard, now it’s not.” (p. 139)

Students seem to really enjoy using Geometer’s Sketchpad. “Most of the students interviewed were in agreement on the usefulness of the visual and active aspects of the program….‘I think I learned better using the Sketchpad than a normal class - - - because it was hands-on’” (Hannafin et al., p. 139). Even though the teacher had a difficult time relinquishing control of the classroom to individual guided learning, the teacher saw improvement in student learning with this study. Geometer’s Sketchpad allowed students to control what they were learning and
focus on trial and error. Many lecture-style teachers would have a difficult time letting go; however, the impact of the results might ease the pain or discomfort.

At Gartree High School in Leicestershire, a study was done by Sue Forsythe (2007) with year 7 students using Geometer’s Sketchpad and pencil/paper as the teaching method to a target group. The control group was taught the same material but without Geometer’s Sketchpad. The teacher tested both groups before the lessons started and found their mathematics achievement level to be the same. The objective of the study was to determine whether use of computer-generated geometry improved achievement significantly more than use of paper-based geometry. The content of the unit was rotation, reflection, and transformations. The target group students had to draw figures, mark vectors, and mirror images all on Sketchpad. According to Forsythe, “The students were intrigued…and seemed to enjoy the task” (p. 202). At the end of the project, both the control and target groups were given the same test to determine their knowledge of rotation, reflection, and transformations. The results showed after the first section no significant difference in achievement, but after the second section, the target group outscored the control group tremendously. Forsythe stated the following:

The value for the students of using Sketchpad was that, sitting in pairs at a computer, they interacted with the software and learned how to get the computer to produce the desired geometrical objects….They engaged in
discussing and explaining geometrical concepts. During lessons with the computer, the pupils’ conversations tended to involve more mathematics and less inconsequential chatter. (p. 35)

While Geometer’s Sketchpad helped these students understand the concept of rotation, reflection, and transformations, it also gave them an opportunity to enjoy what they were learning.

Not only does Geometer’s Sketchpad improve student achievement or at least produce the same results as paper and pencil, it also is a hands-on program students enjoy working with. Will the use of Geometer’s Sketchpad help improve students’ attitudes toward mathematics? Even though time can be an issue with covering math material, it seems more important to have students succeed and enjoy what they are doing than cover a lot of material with negative attitudes and lower achievement.

**Summary**

Enjoyment of mathematics seems like an impossible dream for some students. Negative attitudes toward mathematics create a cycle of poor achievement, which can lead to more attitude problems. The use of Geometer’s Sketchpad could be a solution to the attitude problems in the mathematical classroom. Attitudes might be improved with the use of Geometer’s Sketchpad. Enjoyment of and positive attitude toward mathematics might have a positive correlation with the use of Geometer’s Sketchpad in the classroom. The following
chapter is a discussion of the methods used to determine whether student attitudes improved while using Geometer’s Sketchpad.
Chapter Three
Research Design and Method

This study determined whether using Geometer’s Sketchpad as a teaching tool improved student attitudes toward mathematics. During this study, geometry students learned about right triangles and area using Geometer’s Sketchpad. Surveys, given to the students before and after the units, determined whether their attitudes toward mathematics changed. Student interviews and a teacher journal were also used to get a qualitative look at student attitudes toward mathematics.

Setting

The classes chosen for the research were two regular high school geometry classes. There were 31 students in this study representing all grade levels, freshman through senior. The school was in a rural setting in the north central part of the United States, with a public school population of 140 students. Circumstances affecting the study were as follows: student attendance during the research, technological difficulties with Geometer’s Sketchpad or the computers, and time issues with lessons planned and the implementation of the lesson. Student attendance for the research was vital because the students needed experience using Geometer’s Sketchpad in order for it to have any impact on their attitudes toward mathematics. When implemented correctly, technology can be a valuable learning tool. However, when the software or hardware does not function properly, it can be detrimental to the research of this study. When lessons were
planned using technology, it was hard to judge how much time should be allotted for the optimal experience. Some classes worked faster than others; therefore, there were other lessons for exploring more on the same topic. Notes about these issues and any changes made during the study were noted in my journal.

**Intervention/Innovation**

My students were used to a lecture-style classroom with Geometer’s Sketchpad used as a teaching tool every once in awhile. For the most part, students were not used to having the freedom to learn through discovery. During this study, Geometer’s Sketchpad was the only teaching tool for the students. Every day during the units, the students worked on their own computers using Geometer’s Sketchpad. The students either worked through a lesson on their own with a guided worksheet on Sketchpad, or the teacher guided the lesson using Sketchpad with the students following suit.

**Design**

To determine whether using Geometer’s Sketchpad as a teaching tool improved student attitudes toward mathematics, I determined student attitudes toward mathematics before and after the study to see if there was any significant change. I also had the students explain the reasons for their attitudes. The design best fitted to this type of research is mixed-methods. The mixed-method design enabled me to use data from a pre-survey to get a good idea of where the students’ attitudes were at the beginning of the study. At the end of the study, I used a post-
survey to determine student attitudes. I compared the two results to determine whether there was a significant difference. Also, the mixed-method design permitted me to not only determine student attitudes, but why they have those particular attitudes. I had students rate their attitudes toward mathematics in a survey and then explain why they felt this way in interviews.

**Description of Methods**

Before the research study began, the principal consented to the study. See Appendix A for the principal consent form. The students first took home a consent letter approved by MSU’s Institutional Review Board (IRB) to their parents/guardians asking permission to collect data on the students’ behalf. See Appendix B for the consent form. Students also needed to assent to the study. See Appendix C for the student assent form. If a student or parent/guardian of the student chose not to participate, the student was not part of the study. Those students still learned the same material using Geometer’s Sketchpad; they just didn’t take pre- and post-surveys and weren’t involved in any interviews. Once the letters were collected and approved, the students took the pre-survey to determine their attitudes toward mathematics. See Appendix D for the pre-survey. The students then began the unit of area and continued with a unit of right triangles in geometry using Geometer’s Sketchpad as the teaching tool.

During the units, I kept an active journal recording the reactions of students using Geometer’s Sketchpad. The student’s had activities on Geometer’s
Sketchpad, took quizzes, and took a summative test to determine whether the students understood the units. Throughout the units, some students were interviewed about their attitudes toward using Sketchpad and how it was affecting their attitudes toward mathematics. See Appendix E for interview questions. At the end of the study, I gave a post-survey to determine whether their attitudes toward mathematics changed after using Sketchpad as a teaching tool. See Appendix D for the post-survey. The MSU IRB approval letter is in Appendix F.

There was one research question answered in this research project: In what ways do students’ attitudes toward mathematics improve while using Geometer’s Sketchpad? The question was answered by surveys, interviews, and my journal. The pre- and post-surveys were created using a Modified Fennema-Sherman attitude scale that had students answer questions about their attitudes toward mathematics. The pre-survey was given during class before the first unit began. The post-survey was given during class at the end of the second unit. Some students were interviewed and asked to explain in detail their attitudes toward mathematics. I chose who to interview based on the pre-survey results. I picked two students who had a high positive attitude, two students who had a neutral attitude, and two students who had a low attitude toward mathematics from their survey results. The interviews were conducted before school, during lunch, or after school depending on students’ schedules. Interview questions were asked in my classroom without others in the room to avoid distractions. The interviews
were not done during class time to prevent loss of learning. I kept a daily journal on my reactions toward students’ attitudes during this unit. The journal allowed me to document my thoughts about the use of Geometer’s Sketchpad as a tool for improving student attitudes toward mathematics.

**Expected Results**

During this study, I expected to see a positive correlation between student attitude and Geometer’s Sketchpad. I anticipated time would be a potential obstacle. It took longer than planned to get through the units, and some students went through the lessons quicker than others. I also worried about using technology everyday due to the fact it might not work properly as needed.

**Timeline for the Study**

This particular study took about eight weeks to complete. Due to student understanding and discovery learning using Geometer’s Sketchpad, it took longer to teach these two units using Geometer’s Sketchpad than it had in previous years.

**Summary**

This study determined if using Geometer’s Sketchpad as a teaching tool improved student attitude toward mathematics. Surveys, interviews, and journals were used to determine whether student attitudes improved while using Geometer’s Sketchpad in my high school geometry classes. In the next chapter, I interpreted the results of study.
Chapter Four

Data Analysis and Interpretation of Results

This study determined whether using Geometer’s Sketchpad as a teaching tool improved student attitudes toward mathematics. This chapter includes the data analysis of the surveys, interviews, and journal, as well the interpretation of the results.

Data Analysis

A Modified Fennema-Sherman attitude survey was given to two Geometry classes with a total of 31 students at the beginning and at the end of the Sketchpad research project to determine any significant attitude change toward mathematics. The survey consisted of 36 statements that measured student attitudes toward mathematics. The students answered each question with strongly agree, agree, neutral, disagree, or strongly disagree. The 36 statements were each given a certain amount of points, depending on the type of questions. For example, in a positive attitude question, a strongly agree would get 5 points, agree 4 points, neutral 3 points, disagree 2 points, and strongly disagree would get 1 point. Whereas a negative attitude question would give 1 point to a strongly agree, agree 2 points, neutral 3 points, disagree 4 points, and strongly disagree would get 5 points. Refer to Appendix D for more clarification of the Student Survey. The highest score any student could get on the survey was 180, and the lowest was 36. Once the students finished the surveys, I added up their total score out of 180. To
calculate the averages of the pre-survey and post-survey, I added all the students’ scores and divided by the total number of students. If a student scored 90/180 then that student’s attitude toward mathematics was at 50%, suggesting that this student’s attitude was neutral toward mathematics.

The pre-survey was given toward the end of January. The pre-survey resulted in an average student’s attitude toward mathematics of 141/180. This suggests that most students landed in the 78% area, implying that the majority of students had a high positive attitude toward mathematics at the beginning of the project. After eight weeks of using Sketchpad every day to teach two units, the post-survey was given to the same students in the middle of March. After the Sketchpad research project, the post-survey resulted in an average student’s attitude toward mathematics of 137/180. This figure shows that students landed in the 76% area, a high positive attitude toward mathematics. Figure 1 shows the difference in the average student’s attitude toward mathematics in the pre and post surveys.

Other descriptive statistics found were the mode, which is the score that occurred most frequently, and the median, which is the score in the middle of the survey data results. For the pre-survey results, the mode was 121 and the median was 139. For the post-survey results, the mode was 126 and the median was 130. The first and third quartiles were also figured with the student data of the surveys by finding the medians of the lower and upper halves. The first quartile was 121.5
and the third quartile was 157 for the pre-survey results. The first quartile was 120 and the third quartile was 159 for the post-survey results. Figure 2 is a box plot comparing the first quartiles, medians, and third quartiles of the pre-survey and post-survey results.

![Figure 1. Modified Fennema-Sherman Attitude Survey Results.](image)

The last statistic calculated was standard deviation. Standard deviation measures the variation of the survey results from the mean or how far the data points are spread out around the mean. A small standard deviation shows that the data points are very close to the mean, whereas a large standard deviation shows that the data points are further from the mean. The standard deviation for the pre-survey was 18 and for the post-survey was 21. Due to the standard deviation and mean numbers being very close to one another, it shows that the pre- and post-
surveys’ results did not change dramatically enough for the student attitude to change. About 99% of the data results are within three standard deviations of the mean.

**Figure 2.** Box Plot Data of the Survey Results.

The survey indicates using Geometer’s Sketchpad resulted in no major attitude change toward mathematics. However, the average student’s attitude toward mathematics did not notably decrease due to the use of Geometer’s Sketchpad.

Throughout the Sketchpad research project, six interviews were conducted. After the pre-survey results were finished, I picked two students whose attitudes toward mathematics were very high, two students with average
attitudes toward mathematics, and two students with low attitudes toward mathematics. The interview went through a series of questions about their attitude toward mathematics while using Geometer’s Sketchpad, found in Appendix E.

The two students who had low attitudes toward mathematics were students who had very poor math grades and struggled in other classes as well. During each interview, both of them liked using Geometer’s Sketchpad, but not enough to enjoy mathematics. They both liked Geometer’s Sketchpad because it was different than what they normally did in class, and it made math more interesting to learn. Note-taking was a problem for both of them as they both said they take better notes in a normal class setting. The poor notes led to not understanding their homework. One of the students stated, “My attitude toward mathematics is worse because I don’t take very good notes while using Geometer’s Sketchpad, so my homework grade goes down.” The other student stated, “My attitude hasn’t changed toward mathematics because Geometer’s Sketchpad is still doing math, which I don’t like.”

The two students with average attitudes toward mathematics who were interviewed both have B averages in Geometry class. Both students really enjoyed using Geometer’s Sketchpad due to the hands-on aspect Sketchpad offered. Both stated that their attitude toward mathematics was better because Geometer’s Sketchpad helped them understand math better and was more fun. One stated, “I enjoy learning about mathematics more using Geometer’s Sketchpad because it is
easier to understand when I have to do it myself on the computer.” When asked if Geometer’s Sketchpad made them want to explore more about mathematics, one of the students said, “If you (teacher) weren’t there to help me after school, I would go into the computer lab and see if Sketchpad could help me figure out the problem.”

The last two interviews were with students who had high attitude toward mathematics. They both enjoyed using Geometer’s Sketchpad because of the hands-on applications. One student stated, “I like how you can discover and see relationships on Sketchpad that you can’t measure on paper.” Their attitudes toward mathematics were already high, but both explained that their attitudes were even better due to Geometer’s Sketchpad. “I like Geometry better because of Geometer’s Sketchpad.”

Overall, most of the interviews showed that attitudes toward mathematics were improved due to the use of Geometer’s Sketchpad. Even the students who had low attitudes toward mathematics enjoyed using Geometer’s Sketchpad, yet it didn’t improve their attitude toward mathematics. However, had this project gone on longer than eight weeks, I believe that the low attitude students would start seeing improvements in their attitude toward mathematics due to the use of Geometer’s Sketchpad.

I kept a journal throughout the entire period of using Sketchpad as a teaching tool. Every day that the students went to the computer lab to use
Geometer’s Sketchpad, they really seemed to enjoy using the program. The first week we used Geometer’s Sketchpad, students were amazed at how quickly class went by because they were so absorbed in what they were doing. One student stated to me at the end of the first day using Geometer’s Sketchpad, “Can we take your post-surveys at the end of the year? Because I want to use Sketchpad every day.” The students would come into class and ask if they were going to the computer lab today. They actually looked forward to learning about geometry while using Geometer’s Sketchpad. However, it was a struggle on my part to be able to create Sketchpad units that fit every lesson. Classroom observations verified that students’ attitudes toward mathematics were positive when using Geometer’s Sketchpad.

**Interpretation of Results**

The research question, “In what ways do students’ attitudes toward mathematics improve while using Geometer’s Sketchpad?,” was answered by surveys, interviews, and my journal. The interviews and journal showed that Geometer’s Sketchpad improved students’ attitudes toward mathematics. However, the survey showed that Geometer’s Sketchpad did not improve students’ attitudes toward mathematics.

I expected the survey to show better results. Part of the reason why the survey showed basically no change in attitude was the statements on the survey. The survey was geared for students’ current attitude toward mathematics. If the
survey would have had questions such as. “Did your attitude toward mathematics improve because of the use of Geometer’s Sketchpad?” I think the results might have looked different. However, the survey did its purpose. Geometer’s Sketchpad did not dramatically change students’ attitudes toward mathematics according to the survey. Another circumstance that may have affected the survey results was the timing of the post-survey. I gave the post survey the day before spring break when students wanted to get out of school and were showing minimal effort all week toward mathematics. It would be interesting to see the results of the survey if it had been given after spring break.

**Summary**

After the data analysis, the surveys showed no major change in student attitudes toward mathematics due to the use of Geometer’s Sketchpad. However, the interviews and journal showed improvement in student attitudes toward mathematics due to the use of Geometer’s Sketchpad. The next chapter is the conclusion to whether Geometer’s Sketchpad improved student attitude toward mathematics in my high school Geometry classes.
Chapter Five
Conclusions, Action Plan, Reflections, and Recommendations

This study was conducted to determine whether using Geometer’s Sketchpad as a teaching tool improved student attitudes toward mathematics in my high school Geometry classes. This chapter includes the conclusion of the project, an action plan for the results of the research, and reflections and recommendations for teachers who plan to use the Geometer’s Sketchpad in their classrooms and for other researchers.

Conclusions

This study was conducted to determine whether using Geometer’s Sketchpad as a teaching tool improved student attitudes toward mathematics. After reviewing the surveys, interviews, and journal, Geometer’s Sketchpad improved student attitudes toward mathematics but not enough to show dramatic change. The results from the pre- and post-surveys showed no overall change in student attitudes toward mathematics. Nevertheless, the interviews and my journal indicate positive increases in attitudes toward mathematics.

Action Plan

I plan to continue using Geometer’s Sketchpad as a teaching tool for mathematics. Even though I won’t use it every day, it will still be an active tool throughout a week’s worth of lessons. While using Geometer’s Sketchpad, I saw student interest in concepts they were learning grow; whereas in the past, I hadn’t
seen such high interest in previous teachings of the same unit. For this reason, I plan to still use Geometer’s Sketchpad as a learning tool for my students.

**Reflections and Recommendations for Other Teachers**

Overall, I really enjoyed using Geometer’s Sketchpad as a teaching tool. I never knew how the trapezoid formula came about until I used Geometer’s Sketchpad to figure it out. I loved watching and hearing students get excited about what they were learning. My biggest frustration was trying to use Geometer’s Sketchpad for every lesson. If I was to do this differently, I would not try to adapt every lesson to Geometer’s Sketchpad. It was really hard to teach surface area using Sketchpad, because it took half the period just to draw one figure to find its surface area. A highlight for my project was figuring out all of the area formulas using Geometer’s Sketchpad. It was a really cool moment watching the kids actually understanding where the formulas came from and how they were calculated.

Teachers who plan to use this particular intervention should plan to double the amount of time needed for the lessons. Geometer’s Sketchpad is time consuming but worth it. Geometer’s Sketchpad worked really well on finding area of figures and Pythagorean triples. Also, using books with ideas on how to use Geometer’s Sketchpad in geometry really helped.

Advice to teachers about action research, it is well worth it. It is really a neat experience to do something with your own students and see if it truly works.
It helped having a good research design. Implementing the project wasn’t so stressful because I knew exactly how I was going to do it.

**Summary**

The survey determined that Geometer’s Sketchpad did not improve my high school Geometry students’ attitudes toward mathematics. However, the interviews and journal showed the use of Geometer’s Sketchpad having positive increases in attitude toward mathematics. Geometer’s Sketchpad impacted the lessons in such a positive way that I plan to still implement it as much as possible in the future. Overall, Geometer’s Sketchpad is a great program to implement in any math class and might improve student attitudes toward mathematics.
References


Appendices
Appendix A

Principal Consent Form

I. Research Background (to be completed by researcher)

Title of the Study: Using Geometer’s Sketchpad to improve Student Attitude in the Mathematics Classroom

Name of Researcher: Ashley O’Donnell Phone: (307) 461-7068

Street address: Box 34 City: Dayton State: Wyoming

Zip: 82836

E-mail: ashley.odonnell@sheridan.k12.wy.us

II. Description of Research Proposal

I am planning to implement two units only using Geometer’s Sketchpad as my teaching tool to determine if it improves student attitude toward mathematics. The unit will take place in January and February and will last five to seven weeks. Before the units begin, I will send home consent forms for parents to sign allowing their student to participate in the research. During the research study, the students will take a pre and post surveys and some will be involved in interviews. At the end of the units, I will look at the data of the surveys, interviews, and my journal to determine the results.

III. Agreement (to be completed by principal)

I, ____________________________, principal of __________________________school, understand

- the study and what it requires of the staff, students, and/or parents in my school,
• that the privacy and confidentiality of any staff or student will be protected,
• that I have the right to allow or reject this research study to take place at my school,
• that I have the right to terminate the research study at any time,
• that I have the right to review all consent forms and research documents at any time during the study and up to three years after the completion of the study.

☐ I grant permission to the researcher to conduct the above named research in my school as described in the proposal.

☐ I DO NOT grant permission to the researcher to conduct the above named research in my school as described in the proposal.

☐ I understand that data should be released only by the departments that own them. My staff and I shall not release data to the researcher without approval from the IRB.

________________________________
Signature of Principal
Appendix B

Research Participant Consent Form

Using Geometer’s Sketchpad to improve Student Attitude in the Mathematics Classroom

Ashley O’Donnell

Purpose of the Research
I am completing work toward my Masters of Arts of Teaching: Mathematics degree through Minot State University. For my final degree requirement, I am conducting an action research project for five to seven weeks in January and February to determine whether student attitudes toward mathematics improve while using Geometer’s Sketchpad as a teaching tool.

Specific Procedures
Students in two geometry classes will be learning about right triangles and area using Geometer’s Sketchpad. At the beginning of the study, your student will take a pre-survey to assess his/her attitude toward mathematics. Throughout the units, some students will be interviewed about the process of learning math using Geometer’s Sketchpad and their attitudes toward mathematics. At the end of the study, your student will take a post-survey to again assess his/her attitude toward mathematics. Survey responses, interviews, and my observations will be analyzed to determine whether attitude improved over the course of the study and will be included in my research paper. Mr. White, principal of Tongue River High School has approved this research study.

Duration of Participation
Your student will participate in a five to seven week unit on area and a unit on right triangles. They will be expected to take two surveys and possibly be involved in interviews during the duration of the units.

Benefits to the Individual
There are no direct benefits to participating in this study. The study may show the benefits of using Geometer’s Sketchpad as a teaching tool to improve student attitude toward mathematics.
Alternatives to Participation
If you decide to not allow your child to participate, he/she will still do the units using Geometer’s Sketchpad with the entire class, but will not do the pre/post surveys and will not be involved in any interviews.

Confidentiality
All data will be treated confidentially by the researcher. Names of participants and their data sets will be kept in a locked filing cabinet in the researcher’s office and will be destroyed once the paper has been defended and approved. The researcher agrees to maintain strict confidentiality, which means your student’s name will not be discussed or divulged with anyone outside of this research project. The researcher will also make sure confidential information will not be discussed in an area that can be overheard that would allow an unauthorized person to associate or identify the student with such information.

Voluntary Nature of Participation
During this study, your student may choose to revoke his/her survey and interview results. However, I hope you approve of your student being involved in this study because a large sample size improves the accuracy of the results of my study.

Human Subject Statement
The Institutional Review Board of Minot State University has given me permission to conduct this research. If you have questions regarding the right of research subjects, please contact the Chairperson of the MSU Institutional Review Board (IRB), Brent Askvig at 701-858-3051 or Brent.Askvig@minotstateu.edu.

Offer to Answer Questions
If you have any questions or concerns now or during the study, feel free to contact me at 461-7068 or email me at ashley.odonnell@sheridan.k12.wy.us, or Mr. Don White at 655-2236. Thank you for your consideration.

Consent Statement
You are voluntarily making a decision whether or not to participate in this study. With your signature below, you are indicating that upon reading and understanding the above information, you agree to allow your student’s survey and interview results to be used in this study. You will be given a copy of the consent form to keep.
Appendix C

Student Assent Form

Using Geometer’s Sketchpad to improve Student Attitude in the Mathematics Classroom

Ashley O’Donnell

Purpose of the Research
I am completing work toward my Masters of Arts of Teaching: Mathematics degree through Minot State University. For my final degree requirement, I am conducting an action research project for five to seven weeks at the beginning of the second semester to determine whether student attitudes toward mathematics improve while using Geometer’s Sketchpad as a teaching tool.

Specific Procedures
Students in two geometry classes will be learning about right triangles and area using Geometer’s Sketchpad. At the beginning of the study, you will take a pre-survey to assess your attitude toward mathematics. Throughout the units, you may be interviewed about the process of learning math using Geometer’s Sketchpad and your attitudes toward mathematics. At the end of the study, you will take a post-survey to again assess your attitude toward mathematics. Survey responses, interviews, and my observations will be analyzed to determine whether attitude improved over the course of the study and will be included in my research paper. Mr. White, principal of Tongue River High School has approved this research study.

Duration of Participation
You will participate in a five to seven week unit on area and a unit on right triangles. You will be expected to take two surveys and possibly be involved in interviews during the duration of the units.

Benefits to the Individual
There are no direct benefits to participating in this study. The study may show the benefits of using Geometer’s Sketchpad as a teaching tool to improve student attitude toward mathematics.
Alternatives to Participation
If you decide to not participate, you will still do the units using Geometer’s Sketchpad with the entire class, but will not do the pre/post surveys and will not be involved in any interviews.

Confidentiality
All data will be treated confidentially by the researcher. Names of participants and their data sets will be kept in a locked filing cabinet in the researcher’s office and will be destroyed once the paper has been defended and approved. The researcher agrees to maintain strict confidentiality, which means your name will not be discussed or divulged with anyone outside of this research project. The researcher will also make sure confidential information will not be discussed in an area that can be overheard that would allow an unauthorized person to associate or identify the student with such information.

Voluntary Nature of Participation
During this study, you may choose to revoke your survey and interview results. However, I hope you approve of being involved in this study because a large sample size improves the accuracy of the results of my study.

Human Subject Statement
The Institutional Review Board of Minot State University has given me permission to conduct this research. If you have questions regarding the right of research subjects, please contact the Chairperson of the MSU Institutional Review Board (IRB), Brent Askvig at 701-858-3051 or Brent.Askvig@minotstateu.edu.

Offer to Answer Questions
If you have any questions or concerns now or during the study, feel free to contact me at 461-7068 or email me at ashley.odonnell@sheridan.k12.wy.us, or Mr. Don White at 655-2236. Thank you for your consideration.

Assent Statement
You are voluntarily making a decision whether or not to participate in this study. With your signature below, you are indicating that upon reading and understanding the above information, you agree to allow your survey and interview results to be used in this study. You will be given a copy of the assent form to keep.
Appendix D

Student Attitude Survey

Developed from the Modified Fennema-Sherman Attitude Scales

Name:_________________________ Date:____________________

This survey will help me determine how you feel about mathematics. Please answer each question honestly and to the best of your ability. There is no “right” or “wrong” answers. The following key will help you determine your best choice. Circle one of the five.

SD - Strongly Disagree
D - Disagree
N - Neutral
A - Agree
SA - Strongly Agree

<table>
<thead>
<tr>
<th>Question</th>
<th>SD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am sure that I can learn math.</td>
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<td>2. My teachers have been interested in my progress in math.</td>
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<td>3. Knowing mathematics will help me earn a living.</td>
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<td>4. I don’t think I could do advanced math.</td>
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<td>5. Math will not be important to me in my life’s work.</td>
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<td>6. Getting a teacher to take me seriously in math is a problem.</td>
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<td>7. Math is hard for me.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>8. I’ll need mathematics for my future work.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>9. I am sure of myself when I do math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>10. I don’t expect to use much math when I get out of school.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>11. I would talk to my math teachers about a career that uses math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
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<td>12. It’s hard to get math teachers to respect me.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>13. Math is a worthwhile, necessary subject.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>14. I’m not the type to do well in math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>15. My teachers have encouraged me to study more math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>16. Taking math is a waste of time.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>17. I have a hard time getting teachers to talk seriously to me about math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>18. Math has been my worst subject.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>19. I think I could handle more difficult math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
</tr>
<tr>
<td>20. My teachers think advanced math will be a waste of time for me.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>21. I will use mathematics in many ways as an adult.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
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<tr>
<td>22. I see mathematics as something I won’t use very often when I get out of high school.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>23. I feel that math teachers ignore me when I try to talk about something serious.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
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<tr>
<td>24. Most subjects I can handle OK, but I just can’t do a good job with math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
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<td>SA</td>
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<td>25. I can get good grades in math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
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<tr>
<td>26. I’ll need a good understanding of math for my future work.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>27. My teachers want me to take all the math I can.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>28. I know I can do well in math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<tr>
<td>29. Doing well in math is not important for my future.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<td>30. My teachers would not take me seriously if I told them I am interested in a career in science and mathematics.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<td>31. I am sure I could do advanced work in math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
<td>SA</td>
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<td>32. Math is not important for my life.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
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<td>33. I’m no good in math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
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<td>SA</td>
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<td>34. I study math because I know how useful it is.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
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<td>SA</td>
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<td>35. Math teachers have made me feel I have the ability to go on in mathematics.</td>
<td>SD</td>
<td>D</td>
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<td>A</td>
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<td>36. My teachers think I’m the kind of person who could do well in math.</td>
<td>SD</td>
<td>D</td>
<td>N</td>
<td>A</td>
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</table>

Thank you for taking this survey!
Key

C = Personal Confidence about the subject matter

U = Usefulness of the subject’s content

T = Perception of teacher’s attitude

+ = Question reflects positive attitude

_= Question reflects negative attitude

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<td>22</td>
<td>U</td>
<td>_</td>
</tr>
</tbody>
</table>
Scoring Directions

Each positive item receives the score based on points

\[
\begin{align*}
\text{SA} &= 5 \\
\text{A} &= 4 \\
\text{N} &= 3 \\
\text{D} &= 2 \\
\text{SD} &= 1
\end{align*}
\]

Each negative item receives the reverse amount of points

\[
\begin{align*}
\text{SA} &= 1 \\
\text{A} &= 2 \\
\text{N} &= 3 \\
\text{D} &= 4 \\
\text{SD} &= 5
\end{align*}
\]

Add the scores for each group, T, C, U to get a total for that attitude.

The highest possible score for each group of statements is 60 points.
Appendix E

Interview Protocol of Students

1. What is your name and grade thus far in your math class?

2. Do you think your understanding of mathematics is improving by using Geometer’s Sketchpad?
   a. Why?

3. What was your attitude toward mathematics at the beginning of the unit?
   a. Why?

4. Do you enjoy using Geometer’s Sketchpad?
   a. Why?

5. Are you enjoying learning about mathematics more using Geometer’s Sketchpad?
   a. Why?

6. Describe any problems you have while using Geometer’s Sketchpad?
   a. What would improve your experience?

7. Does Geometer’s Sketchpad make you want to explore more about mathematics?
   a. Why?

8. Do you think your attitude toward mathematics has changed due to the use of Geometer’s Sketchpad?
   a. Why?
Appendix F

IRB Approval Letter

Notice of IRB Approval

Name of Principal Investigator: Ashley O'Connor O'Donnell

University Address: Math & Computer Science

Title of Project: Using Geometer's Sketchpad to Improve Student Attitude in the Mathematics Classroom

January 13, 2011

The above project has been reviewed and approved by the IRB under the provisions of Federal Regulations 45 CFR 46.

This approval is based on the following conditions:

1. The materials you submitted to the IRB provide a complete and accurate account of how human subjects are involved in your project.

2. You will carry on your research strictly according to the procedures as described in materials presented to the IRB.

3. You will report to the chair of the Institutional Review Board any changes in procedures that may have a bearing on this approval and require another IRB review.

4. If any changes are made, you will submit the modified project for IRB review.

5. You will immediately report to the IRB Chair any problems that you encounter while using human subjects in your research.

[Signature]

Dr. Brent A. Adieig
Chair, Minot State University's IRB