

Observations on a High-School Mathematics Class: Issues and Implications

Destiny Coslett

In this paper, I present my views and observations about one high school mathematics class. Before I went to observe the mathematics class, there were several issues I was interested in learning about, and several questions I wanted answered.

Based on the recommendations of the National Council of Teachers of Mathematics [NCTM] (1989, 2000), a reform movement in mathematics education is occurring. In the mathematics classrooms envisioned by reformers, students develop competency not only with appropriate computation skills but with mathematical reasoning and application (Battista, 1994, p. 463). In fact, Kramarski and Mevarech (2003) also state: “To help students meet the standards, the NCTM emphasizes the importance of mathematical discourse in the classroom. Students not only should discuss their reasoning on a regular basis with the teacher and with one another but also should explain the basis for their mathematical reasoning, both in writing and in their mathematical discourse” (p. 281). If a teacher believes in a reform-based method of teaching over the traditional method, is she accurately focusing on these goals the NCTM lays out the classroom? The teacher whose class I went to observe stated that she believed that a traditional way of teaching students was not as effective as a reform-based method, but how closely does she follow the reform-oriented visions of classroom discourse and mathematical understanding?

“Educational practice is necessarily based on the assumption that students are willing to engage in educational activities – that they will lend their cooperation and support to the process of their education. Students who do not offer such cooperation – who are ‘unmotivated’- present significant challenges” (Williams and Ivey, 2001, 75). Before entering the class, I was interested in the cooperation, or behavior, of the students, in addition to their motivation, or engagement, with

the subject of mathematics. Would their behaviors and engagement with the subject really have an effect on, and be affected by, the teacher?

“Available research supports a belief that high quality mathematics education for high school students cannot be accomplished unless a high qualified mathematics teacher is in the classroom” (Paul, 2005, 456). Paul then states that though a teacher may possess exceptional talent and may be highly dedicated, they will surely experience road blocks that will hinder their success. I was able to observe a few examples of both the teacher’s teaching method and knowledge of the subject while in the classroom, which could be indications of teacher qualifications. But what about road blocks that the teacher may face? Would I be able to observe some of these road blocks or see how these might limit the teacher’s successes? How would the teacher address these issues in the classroom?

During my visits to the classroom, I had the opportunity to observe some examples of reform-based methods of teaching, student behavior and engagement with the subject, teaching methods of the teacher, and the teacher’s knowledge of the subject. Many ‘road blocks’ also seemed to become apparent to me while I sat in on her class, and I hope to address these as well. I will then raise questions about the long term implications of this teacher’s teaching method as seen from an interview conducted with a former student. This paper focuses on many of the issues that were observed in the classroom of one teacher, in an attempt to begin to understand some of the issues that characterize mathematics teaching and learning in high schools today.

Research Methods

Research Context

This research report is based on notes taken during five separate visits to a local high school mathematics classroom, over a two-week time period. I observed one teacher, Ms. Kinney, who had previously worked with my advisor, Dr. Gwen Lloyd. There were two choices of classes that I had

the opportunity to observe: an Algebra I class that was composed mainly of students who were struggling in Algebra, or a College Geometry class. I was told that the students in College Geometry were in the “college preparatory” track of the high school, whereas the Algebra I class was composed of students in the general track. Because I was looking to research a more mature mathematics class, and due to my personal schedule, I chose to attend and observe the College Geometry class.

I did not interact with the other students when I went to visit, and I tried to remain inconspicuous. The classes were 45 minutes long, and I attended five separate days in a two-week period. The class consisted of about 20 students and all but three of the students were in the 10th grade. The remaining three students were in the 9th grade.

Ms. Kinney taught the class the majority of the time, but Mr. Jones, a student teacher, was present twice and he occasionally assisted Ms. Kinney. During my time of observation, the main focus of the lessons was on the understanding of characteristics of quadrilaterals. In addition, the class spent a few minutes each period beginning to prepare for the state standardized tests.

Researcher's Expectations

Because I have just recently come out of high school, I had several expectations before beginning my observations. This class was a college-prep class, meaning they were at a higher level than a general class but a lower level than honors. Because of this title, I expected to see well-behaved, attentive students who were interested in mathematics. When the students did become disruptive or talkative, I expected that the teacher would discipline the students by sending them out into the hall or to the office, as occurred in my high school classes. I also expected to see a teacher that challenged the students' knowledge of the subject and students who gladly accepted that challenge. Finally, I anticipated the class lessons to unfold as follows: collect homework, class notes which are copied by the students, time set aside for students to practice this work via worksheets

and example problems, and then assignment of homework for the next day. These expectations influenced the ways that I observed and reacted to Ms. Kinney's mathematics instruction.

Data Collection and Analysis

The method of this research was the field observation method. I arrived at the high school immediately prior to the start of class, and took an empty seat towards the back of the classroom to observe. I recorded notes on Ms. Kinney's teaching style, the students' responses to this teaching style, and the interactions between Ms. Kinney and the students.

I collected several worksheets that were passed out during class, in addition to one test that was administered during my observations. I also conducted one interview with Jessie, a former student of Ms. Kinney. This student was taught trigonometry by Ms. Kinney during her 10th grade year at this local high school, and she is now a junior mathematics student at Virginia Tech. This was an informal interview administered via email, and was conducted in order to get a better understanding of the long-term implications of having Ms. Kinney as a high school math teacher, as well as her impressions of Ms. Kinney's teaching style.

After collecting all of the data for my study, I organized and typed up the class notes and then began to look for patterns and reoccurrences in the classes. Upon analysis of common reoccurring themes, I formulated an observation report and began to question some of the implications of the teaching methods I viewed in the classroom. It is important to note that all of the names of students and teachers in this paper are pseudonyms in order to protect their privacy.

Limitations

One of the biggest limitations to this study resulted from the fact that I was a college student coming to observe a high school class. I was not very much older than the high school students, and many times I felt as if some of the students' actions were done to catch my attention. I would try to sit in the back of the class to not draw attention to myself, but the back row was always full, so I

had to sit more towards the middle of the classroom. Ms. Kinney even told me once that the students were acting up more than usual because I was present.

Another limitation of this field observation was that most of the observations fell at inopportune times. Specifically, the first day that I observed the class was also the day of the school's "sweetheart dance." The second day was Valentine's Day, and on the fourth day, a former teacher from the school had died in a house fire the night before. Each of these events seemed to take away from the concentration of many of the students in the class and was conducive to a very talkative and interrupted atmosphere.

A third limitation to my observations was that I had never been a teacher nor devoted much time or attention to studying issues that teachers face in the classroom. The only basis on which I drew my conclusions was my own experiences as a student in a classroom and my own interactions with my peers and teachers. The motivation of this field observation came because of my lack of understanding the issues facing teachers today and because of my lack of background with the subject, and this resulted in a large limitation in my research.

A final limitation of my observations is that high schools are now so focused on the standardized testing that occurs in May that many times the teachers seemed rushed to get everything taught before the tests. The Standards of Learning (SOLs) for Virginia Public Schools describe the Commonwealth's expectations for student learning and achievement in grades K-12 in English, mathematics, science, history/social science, technology, the fine arts, foreign language, health and physical education, and driver education. According to the Standards of Learning (though not necessarily agreed upon by all in mathematics research), these standards represent a broad consensus of what parents, classroom teachers, school administrators, academics, and business and community leaders believe schools should teach and students should learn. Students are required to take these tests at the end of certain basic courses they are taught in school. If

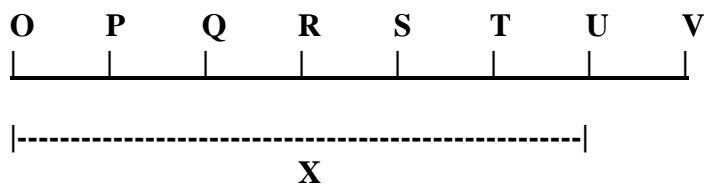
enough students in the school do not pass, this can negatively affect the school or the teachers in it. Thus, many teachers feel the pressure throughout the entire year to teach their students what they need to know to pass these tests. The College Geometry class spent at least 10 minutes of every class on the warm-up practice SOL problems, and this could have affected my view of the teacher's teaching methods.

Observations

Teaching reform vs. traditional-based math

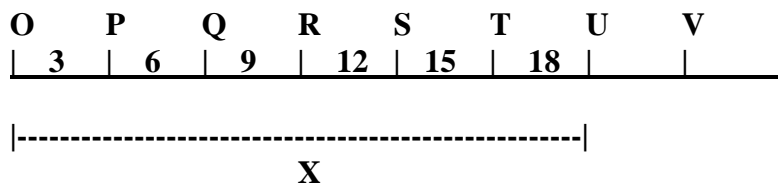
A large topic of discussion in the field of mathematics education today is the idea of a reform-style method of teaching. A study by Kramarski and Mevarech (2003) "illustrates several important facets of teachers' roles pertaining to...the selection and use of worthwhile mathematical tasks that allow significant mathematical discourse to occur. Such tasks should include complex situations that present quantitative information in difference contexts, allow multiple representations, or afford students opportunities to resolve mathematical conflicts" (p. 281). As an observer in Ms. Kinney's classroom, I believe that her goal was to use a reform-based method of teaching to instruct the class. One time she said to me, "I would much rather have my students interacting and talking than sleeping while I lecture to them." Her actions did not always align with her beliefs, though. Ms. Kinney would only occasionally draw on the reform method of teaching in her class lessons, and even when she did use a reform method, the activities were only partially developed. They did not seem to allow 'mathematical discourse to occur'. Much of the time, Ms. Kinney taught the students in a fairly traditional lecture-style manner. Occasionally, though, she would invite students to the overhead to work out problems or engage in activities to stimulate their creativity and further understanding of the material. Based on my experience, when done correctly, these activities can result in the students developing their mathematical reasoning skills.

When the students went up to the overhead, it was usually to answer the warm-up question. Some of the students made a joke of going up to the overhead, and it appeared to me that they were merely seeking attention. One girl, Ally, went up to the overhead to answer a question, and would just stand there. When Ms. Kinney asked her how she did the problem, she would respond “I don’t know” and laugh about it. Because the warm-up problems were always multiple choice, some of the time, the students would simply go up to the overhead and circle the correct answer, and then sit back down. Once in a while, though, a student would come to the overhead and spend time working out the problem and explaining it to other students. On one specific occasion, Brad came to the overhead to answer the following question:



If the length of PS is 9, then what is the length of X?

He carefully explained that since each of the segments are equal and PS is 9, each segment must be 3. Thus, since there are 6 segments in X, $3 * 6 = 18$. One of the students in the class responded “That don’t make sense.” Brad then tried to explain his reasoning more carefully. Between each segment, he wrote the sum of the current and previous segments, to show that they added up to 18:



The confused student then understood why he got the problem wrong, and Brad sat down. This was a very good example of how reform-style teaching can be effectively used in a classroom setting.

However, this engagement and interaction between students helping other students understand only happened once or twice during my observations.

An example of a class activity that seemed to me to have potential for rich mathematical discourse was a pipe-cleaner project. The students were given 4 coffee stirrers and one pipe-cleaner. After dividing the pipe-cleaner into fourths, they then connected each of the coffee stirrers together to make a quadrilateral by sticking the pipe-cleaners into the ends of each stirrer. Thus, the students created a shape that could be manipulated into several different quadrilaterals: a square, a parallelogram, and a rhombus. After creating this adjustable shape, the students were asked by Ms. Kinney to use the figure to “look at the angles, sides and other things we’ve talked about.” Unfortunately, most of the students took this as an opportunity to play with the figures. They would put it on their head to look like yarmulkes or wear it as jewelry. Ms. Kinney then asked the class “Does this meet the requirements to be a quadrilateral?” as she held up her figure. The class answered yes, and then Ms. Kinney proceeded to go through a worksheet on the requirements and characteristics of parallelograms, rectangles, squares, and rhombi. The students stop playing with their figures to copy what Ms. Kinney was writing on the overhead about each type of quadrilateral.

Though this activity had the potential to be developed into an exploratory project for students, they were too busy playing with the figures to explore much of anything about them, and Ms. Kinney simply ended the activity with class notes. This project quickly became a very traditional way of approaching the subject; they were given a worksheet and had to list out the characteristics of the shapes, where the information was provided by Ms. Kinney. Then, when the students began talking and interacting amongst themselves, Ms. Kinney explained to them that they would have to copy the material out of a textbook if they did not keep quiet: “You ought to be writing this down. This is much better than copying terms out of a textbook, which is what you’ll be doing otherwise.” I would imagine, though, that having the students copy terms out of a textbook

would have been very similar to copying the terms down from the overhead. My personal experiences with both methods of copying notes are quite similar in terms of a lack of mathematical understanding and reasoning. The students were given only a short opportunity to explore the angles and relationships between the shapes themselves, but they chose instead to play with the figures. In what seemed to be the only method of discipline at the time, Ms. Kinney diverted their attention from the figures to copying notes from the overhead, which did work well to calm down their playing.

Student Comprehension

In general, the students in the class appeared to be at a very low level of understanding of mathematics. During the two-week span that I was visiting the class, they spent the entire time learning about characteristics of quadrilaterals. I remember learning about squares having equal sides and congruent angles when I was in elementary school, and I found it hard to believe that students in a college-prep course were studying this. One student in the class had not even heard of a rhombus. When Ms. Kinney passed out a handout on the figure, the student said “What’s a room-bus?” The class very carefully covered all of the material during the two weeks I was there, and clearly they were not reviewing the material from a previous class.

Student Behavior

About a quarter of every class time was spent calming the students down. Often the class seemed out of control and had constant interruptions. One time, when the class was exceptionally talkative, Ms. Kinney had a very unique approach to soothing the class. She said, “Let’s go to our happy place for a minute. Put your heads down, mouths closed. To make this work, everyone must participate... no-one says a word.” Surprisingly, all of the students listened and put their heads on their desk. She then said: “Tense up the muscles in your feet. Scwinch them hard, make them hurt. Count to 10 and release them.” Then she went through every major muscle group of the body, up to

the students' shoulders. She had them relax, and then checked their five senses by asking them to smell something good in their mind, taste something good, hear something good, see something pleasant, and feel something soft. Then she said:

Go to your happy place. I'll leave you there. It can be real or made up or half and half. You can relax and feel safe and feel good about yourself... Now I want you to listen to me. I realize you've had a lot of material condensed. Still, there is a lot of material to go. I think all of you will pass the SOL. In order to do that, we can't have extra talking. You need to concentrate. I will always give you extra talking time...I know what it's like...I will try to make the material interesting. I expect that you will be the best person you can be. Not only in math behavior, but in your consideration of others...you all are capable of great things.

After a few minutes, she asked them to raise their heads when they were ready. Most of the students remained calm after this activity. There was much less talking, and the students were more relaxed for the remainder of the class period. Unfortunately, though, this relaxation activity took up 15 minutes of the 45 minute class period. There is an important possibility that in this class there were students with attention problems or even special needs of which I was not aware, and it is not fair of me to assume that this activity was not an important part of the classroom experience for these students. If there were students with attention problems, then that could have important implications for how Ms. Kinney would have to address the class. After class, Ms. Kinney came up to me to clarify her 'happy place' activity. She explained how it was such a good exercise to calm the students down.

When I spoke with her some more about her classroom, she also said, as stated before, that she would much rather have a class of students that were a bit talkative and interacted with each other than a class with blank stares and sleeping students. She also explained to me how her class was much more reform-based than traditional and that she does not agree with lectures because students do not learn that way. My only argument against this statement is that the students may not

have been learning any more material by not paying attention and talking, as what typically happened in class, than if they were sleeping instead.

One time, Ms. Kinney passed out a worksheet with problems pertaining to solving simple equations with quadrilaterals. Not only was this a very traditional approach to having the students learn the material, but she also said, as she handed out the worksheet “it is not a joint effort.” Ms. Kinney told the students that they were not allowed to work with each other and instead had to work quietly by themselves to solve the worksheet problems. When I spoke with Ms. Kinney individually before, she was very excited about students interacting with each other to learn the material, but during my observations in her classroom, it seemed that she was discouraging the students from doing so, even during purely academic times. It is important to note this distinction between students acting up and being interruptive versus students working together to solve math-related problems.

Student Engagement

Another issue that I observed while in Ms. Kinney’s class was that the students were not at all engaged in the mathematics they were being taught. Every day for the start of the lesson, Ms. Kinney would put up a warm-up on the overhead for the students to complete. This warm-up would always be one or two SOL practice questions, occasionally related to the current lessons. They were intended to give the students practice for the upcoming state standardized tests. Most of the students would simply write the warm-up questions down and wait until Ms. Kinney or another student went up to the overhead to explain the solutions. In the meantime the students would talk to their friends about topics unrelated to the warm-up or class. If they had questions about the problems, they certainly were not asking Ms. Kinney for help or trying to solve the problems on their own.

A second example that I observed in the class concerning student engagement was one day when the students were given a test. Mr. Jones, the student teacher, was actually the one who

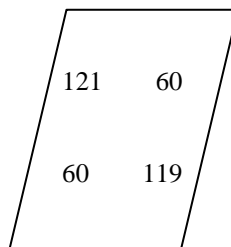
prepared and administered the test to the students that day, and he included on the back of the test an extra-credit question: “What was [Mr. Jones’] baseball number in college?” Immediately upon realizing there was an extra credit question, students began begging to be given a hint for the answer instead of trying to work through their test. It took Mr. Jones several minutes to convince the class that they needed to work on their test and not worry so much about the extra-credit question. The students were so much more fascinated about what number Mr. Jones had on this baseball team in college than about the test. From the two weeks that I observed this class, it appeared to me that the students were much more concerned about everything else that was happening in class rather than the mathematics being taught, which seemed to be having severe implications on how Ms. Kinney was being forced to teach.

Teacher’s attitude towards the students and subject knowledge

On the first day of my observations, two of the students were playing with a tissue and disrupting the class while Ms. Kinney was trying to teach. She then called them ‘stupid’ and ‘stupider’ because of their misbehaving. During a break in the class, she came over to my advisor, who was observing the class with me on that day, to apologize for saying that to the students. I found it interesting that her actions seemed to indicate that she was much more concerned with what we thought about her calling the students names than she was about what the students thought about her calling them names. Though she may have apologized later in the class after we had left, her first priority seemed to be us. During my observations I observed on several occasions her demonstrating that she cared very deeply about her students, and many times after class, students would approach her for guidance and assistance with their problems. In fact, during my interview with Jessie, a former student of Ms. Kinney’s, she stated: “Ms. Kinney is such a sweet woman. She cares more about her students’ well being than other teacher I have known. Also she was always around to let students talk about their problems, whether they were academic or personal problems.”

From my observations in Ms. Kinney's class, it appeared to me that others agreed. Is it generally accepted for teachers to tease their students in the classrooms? Is this why so many of Ms. Kinney's students come to her for advice, because she is more like a peer than an authority? It is probably unjustly harsh to claim that Ms. Kinney meant any harm by her comments to the two students, but it does call into question the appropriateness of the relationship that teachers have with their students.

A very interesting incident occurred on my third trip to the class. The students were given a problem to do for homework that asked them if a certain figure was a parallelogram. They were given that two opposite pairs of angles were 60 degrees. Ms. Kinney asked the class if by knowing the two opposite angles were congruent, if that made the other pair of opposite angles congruent. One student claimed "The opposite angles have to be congruent." Ms Kinney replied: "Is enough information given from [the picture] to determine if [the unmarked angles] are congruent? If one pair of opposite angles is congruent, does the other pair have to be?" The students all agreed, "yes." Then she said "Well, what if you have this?:"



All you can use is that 60 and 60 are congruent. You need that both pairs of opposite angles are congruent to be a parallelogram." Even though the students disagreed and claimed that she cannot have a figure that looks like the one above, Ms. Kinney continued to tell them that it was plausible. Soon after, the bell rang and the students left. I was very surprised that Ms. Kinney would present the above figure to the class as a viable example of why an object with one pair of congruent opposite angles could not be considered a parallelogram. I did not come the following day to

observe, and it is very possible that Ms. Kinney realized her mistake and corrected it the next day in class. It is also important to point out that everyone, including teachers, makes mistakes, and that it is unreasonable for me to base my entire opinion of Ms. Kinney's subject knowledge on this one incident. Further, it is important to note that I was surprised that the students were paying enough attention to Ms. Kinney to catch her mistake. Many of the students in the class were engaged in this discussion of the parallelogram, which was contradictory of many of my previous observations of their engagement.

Implications

After referring back to my original question about whether a teacher who believes that reform-based methods of teaching are better than the traditional style would actually implement some of the suggestions administered by the NCTM, several other questions were raised. The question that came to me as I observed the class was whether or not a reform-based method would have worked on a class like Ms. Kinney's. Or, were the students too immature to handle the time given to them to 'explore' the activities? Because of some of the behavior problems from the students, there may not have been the appreciation needed to explore the mathematics. Though, this question raises the obvious concern that if these high school students are too immature to handle the reform-oriented pedagogy, then how would students in K-8th grade be able to handle it either? Another point is that Ms. Kinney needed to get through as much material as she could before the SOLs in order for the students to be as prepared as possible for the tests. She knew that if enough students did not pass the test, in her class and in the school, that there could be negative effects. Thus, while she may have desired to teach a more reform-based method of instruction, she may have only been able to go so far with her activities due to strict time constraints on learning the material before May. The students in this school, though, typically do well on the SOL testing for geometry, so if Ms. Kinney is feeling stressed to complete the required material even though prior

years' test results do not indicate a need for stress, how can the teachers like Ms. Kinney be helped to feel less overloaded throughout the year. In other words, could the SOL requirements and stress from the test may have been indirectly restricting how Ms. Kinney could implement reform methods in her classrooms?

As I briefly touched on earlier, another one of my concerns from observing Ms. Kinney's class is that these students are in a college-prep class. Instead of being at the high level of mathematical understanding that I thought they would be at, they were trying to answer basic questions such as: 'What is a square?' If the students were just now beginning to understand what congruent angles and parallel sides represent in terms of quadrilaterals, what were they learning before this course? Were the students really this far behind prior to entering Ms. Kinney's College Geometry class? Unfortunately, questions such as "What's a room-bus?" make me believe that some of the students are really having a hard time grasping this material. Students should be learning or at least be vaguely familiar with the characteristics of rectangles and parallelograms in middle school, not in a college-prep course. Maybe they are being taught this material earlier, but they do not seem to be retaining this knowledge. This entire experience has also helped me to see that not all students pick up math as well as I did, and that many college-prep students are not experiencing high school mathematics in the same ways that I did.

The behavior that I observed in this class made me again call into question how to properly handle students who were disruptive to the class. It appeared as though Ms. Kinney's 'happy place' method worked at calming the students down, but it took up so much of the class time, that I had to ask myself if there was a better way? I never witnessed her ask a student to leave the room, and I cannot help but wonder if it may have helped to remove the disruptive students from the situation. Though this was a primary method of punishment at my high schools, I do need to take into account that other schools may use this only during severe situations. Concerning her inconsistency with

dealing with the distracting behavior in the classroom, I found it hard to decide whether the students' misbehaving was causing Ms. Kinney to have to be so inconsistent with the class, or if because Ms. Kinney was an inconsistent teacher, the students found it easier to misbehave.

In reference to Ms. Kinney's mistake that was made on the problem with the parallelogram, is it possible that this mistake (and presumably any teachers' mistake) could have an effect on the students? Could this have an effect not only on the students' comprehension of the material (for if they are learning false information their understanding will surely be lower than if they learned accurate material), but also on their behavior and engagement level in the classroom? When the students know that something is incorrect but the teacher refuses to acknowledge her mistakes, the students could very well lose respect for their teacher, which could result in discipline problems and the students' lack of excitement about the material. This incident is in no way one that just Ms. Kinney made, and it is important to understand that every teacher will make mistakes in their teaching.

A former student of Ms. Kinney gave an interesting perspective on her experience in the classroom. Jessie states: "There were two other girls in my calculus class who were also in Ms. Kinney's trig class. The three of us felt extremely behind the other people in our class, because we really hadn't learned much in Ms. Kinney's class. The first few weeks of calculus, which were supposed to be a review of what we should have learned in trig, were really difficult." Is this a prevalent issue in schools today? Does the effect that one teacher has on a student have a substantial impact on the students later abilities? As stated by Paul (2005), the quality of the teacher does determine the quality of the mathematics education, which, as shown through Jessie interview, can thus have a negative effect on the student's abilities later in their mathematics careers. It is important to note that Jessie did not feel that the 'happy place' activity was detrimental to her experience in the classroom: "I thought that the happy place exercise was a good thing. It helped

people learn how to make themselves relax when they were really stressed out.” She then stated, though, that many students in the class took advantage of the activity: “But a bunch of times people in my class would just ask Ms. Kinney to let us go to our happy places solely because they didn't feel like doing work that day. It was kind of an easy way to get a free day.”

Through this research, I learned a great deal about mathematics in today's schools and how to appreciate the different experiences that many students and teachers have. I was very fortunate in high school to be in a class where everyone truly wanted to learn the mathematics, and there was not much disruption that the teachers had to set aside class time to deal with. I also was fortunately to not feel rushed by the state standardized testing that many students today have to face throughout the year. I feel that Ms. Kinney did the best that she knew how with the circumstances that were given to her, and that there were many obstacles and road blocks that she had to face as a teacher, of which she had little control over. I hope that some of these issues will be addressed in order to create a better atmosphere for students and teachers in today's mathematics classrooms in schools.

I am very appreciative of Ms. Kinney allowing me to visit and observe her classroom during my visits. I recognize that many times she spent her lunch break to discuss with me what happened during that day's class, and she was more than willing to help me in any way I needed. She was truly a caring teacher and person who was interested in improving the lives and classroom circumstances of her students. I hope that there are many more teachers out there like Ms. Kinney who devote so much of themselves to creating a safe and caring environment for their students.

References:

- Battista, M.T. (1994). Teacher beliefs and the reform movement in mathematics education. *Phi Delta Kappan*, 462-470.
- Kramarski, B. & Mevarech, Z.R. (2003). Enhancing Mathematical Reasoning in the Classroom. The effects of cooperative learning and meta cognitive training. *American Educational Research Journal*, 40, 281-310.
- Paul, C.A. (2005). Sound Off. *Mathematics Teacher*, 98, 456-458.
- Williams, S.R. & Ivey, K.M (2001). Affective Assessment and Mathematics Classroom Engagement: A Case Study. *Educational Studies in Mathematics*, 47, 75-100.