Attribution Retraining and High School Mathematics Students with Low Socioeconomic Status

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Abstract

This action research project looked at the relationship between attributions, mathematics confidence and motivations, and achievement among low SES high school students, further this study examined and how attribution retraining might influence these relationships. Prior research included little about low SES high school students and attribution retraining. In this study, attribution retraining was implemented in mathematics classes at an alternative high school that serves mostly low SES students with low achievement. Data collection utilized a mixed methods approach that included data from student surveys, student quizzes, class discussions, academic history data, and mini-interviews. Analysis of pre-treatment data indicated that the students in the study initially had low confidence in their mathematical ability and had low expectations for using math in the future. Post-treatment data showed an increase in confidence in mathematical ability as well as an increase in expectations for future math use. This change was possibly due to the attribution retraining. Data also showed that the students in the study exhibited attributional styles inconsistent with Attribution Theory research literature. These students had attributional styles that should have predicted higher achievement than the academic history data revealed. This unexpected outcome led to investigation of the students' understanding of effort which turned out to be different than the researcher's understanding of effort. This study revealed that while attribution retraining may be beneficial for low SES high school students, these students' understanding of effort must also be addressed in order for them to improve their academic success.

Keywords: Attribution Theory, Attribution Retraining, academic motivation.

Table of Contents

Appendix

Figures

Tables

Acknowledgments

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Chapter 1: Introduction and Literature Review

What is the Problem?

I teach mathematics at an alternative high school in a somewhat rural community where most of the students are from low socio-economic status (SES) homes. In my advisory group this school year, I have 20 seniors, 14 of whom qualify for free/reduced lunch. Nine of those are classified as *homeless* by the federal government.[1] Achievement among the students in my advisory group is very low. It is expected that these students will graduate this year, but only six of them will be graduating on-time. Nine are second-year seniors, three are third-year seniors, and two will be completing their fourth senior year of high school.

This description of my advisory group is fairly typical of all the students in my school. Academic motivation among my students is very low, particularly motivation for mathematics. Motivation to attend school is also low. In a typical day, I may have a quarter of my students absent.

I teach algebra and general mathematics to these students. The previous mathematics experiences of these students have been discouraging for them. Many students can't remember the last time they were successful in a math class; for those that remember it was some time in elementary school. They appear to have very little desire, interest, and motivation to participate in my mathematics classes. My students frequently tell me they are not good at math, they have never been good at math, and they never will be good at math. They seem to believe they are not successful because they have no math ability and nothing will ever change that.

[1] The McKinney-Vento Homeless Assistance Act of 1987 is a United States federal law that provides funding for homeless children and youth. The act mandates services and provisions that schools and district must provide to students who meet the Acts definition of homelessness (US Department of Housing and Urban Development*).*

I struggle every day to provide learning activities that my students will find interesting and motivate them to participate. I try to implement a math-talk learning community that allows for full inclusion for all my students (Hufferd-Ackles, Fuson, & Sherin, 2004). I design tasks and activities with their interests and backgrounds in mind. However, day after day, there are so many students that I struggle to reach, so many students that remain unmotivated to even try to participate. As a teacher, I must ask myself what I can do to motivate these students. Through this action research project, I hope to come closer to answers to this question.

One of the most important concepts in education is motivation because of its relationship to various outcomes such as curiosity, persistence, learning, and performance. If students are motivated, their performance in an academic activity increases. This increase in performance results in more time spent engaged in the activity, resulting in students who learn better and enjoy the activity more than when they are not motivated. Students who are not motivated to learn often do not learn (Middleton, 1995; Salvin, 1984; Vallerand, et al., 1992). Middleton (1995) stated that motivation is “of paramount importance in developing lifelong learners” (p. 254).

Motivation is important to mathematics education because of the link between motivation in mathematics and achievement in mathematics. As students become less motivated to learn mathematics their achievement scores decline (Finn and Rock, 1997; Stipek, 1998; Wentzel, 1998). Much of students’ motivation in mathematics comes from within the students and is dependent on many factors such as beliefs about the value of mathematics and mathematics self-efficacy and self-concept (Stipek, 1998; Wentzel, 1998). Students’ backgrounds and experiences have a great deal of influence on these aspects of motivation. In their study of mathematics achievement and motivation, Chiu and Xihua (2008), found that families play an important role in students’ mathematics self-efficacy and self-concept. Families’ investment in education, education resources, and involvement in school activities increases students' motivation. Students who were more involved in family activities, such as political, intellectual, and cultural discussions, were more motivated to learn. Families of lower SES had fewer financial resources and were less able to participate in their children's education (Chiu & Xihua, 2008). This often means that children from low SES families come to school less motivated to learn and are more likely to become disengaged and drop out of school (National Research Council and the Institute of Medicine [NRCIM], 2004). It is therefore even more important for educators working with students from low SES families to use teaching strategies that increase the motivation of their students. When educators use teaching strategies that enhance students' motivation, students can become more engaged and experience greater achievement (Halat, Jakubowski, & Aydin, 2008; NRCIM, 2004; Stipek, 1998; Wentzel, 1998).

What Does the Literature Say?

Defining motivation. There are many definitions of motivation provided in the educational literature. Valas and Sovik (1994) defined motivation as "interests, curiosity, preference for challenge, and independent mastery" (p. 294) of a particular subject. Middleton and Spanias (1999) defined motivation as "reasons individuals have for behaving in a given manner in a given situation" (p. 66). Middleton (1995) also included definitions of intrinsic and extrinsic motivation. Academic intrinsic motivation is the internal drive or desire of a student to engage in learning for the sake of learning. Academic extrinsic motivation is the drive to engage in a task to obtain a reward or avoid punishment.

Model of motivation. Middleton (1995) and Valas and Sovik (1993) both provided models to explain how motivation works and why various mathematics activities may or may not be engaged in by a student. According to these models of motivation, people are born with a natural curiosity and a desire to learn. Young children are usually highly motivated to try new activities. As children grow and try many new and different things, they begin to build a concept for themselves of things that are interesting and things that are not interesting: *interests* and *non-interests*. When children enter school the academic activities in which they engage are added to their concept of *interests/non-interests*. At some point when presented with a new activity, children begin to compare the new activity to their concept of *interests/non-interests*. If the new activity matches the concept of *interests*, they will be motivated to engage in the new activity. If the new activity matches the concept of *non-interest*, they will not be motivated to engage in the new activity. If the new activity does not match either *interests* or *non-interests*, the child must evaluate the new activity and determine if the activity will meet the child's needs for challenge, control, and enjoyment. If the child believes the activity will meet these needs, the child will engage in the activity as long as these need requirements continue to be met. If the new activity meets these needs consistently enough, the child will classify the new activity as an *interest*. If, on the other hand, the new activity does not continue to meet the child's need requirements, the child will stop engaging in the activity and will classify the new activity as a *non-interest*. (Middleton, 1995; Valas & Sovik, 1993).

Middleton's (1995) and Valas and Sovik's (1993) models for motivation follow the general pattern outlined in Figure 1.1: Model of Motivation. Applying this model to mathematics, we can see that if a student has already classified mathematics as an *interest*, that student will tend to engage in mathematical activities enthusiastically without the need to evaluate the requirements of the activity. On the other hand, if the student has classified mathematics as a *non-interest*, that student will avoid engagement without ever evaluating the activity. Once mathematics activities have been classified according to interest, further evaluation does not take place. It is a very difficult task for teachers to change their students' classification of an activity so that students are motivated to participate in that activity (Middleton, 1995; Valas & Sovik, 1993).

Figure 1.1 Model of Motivation

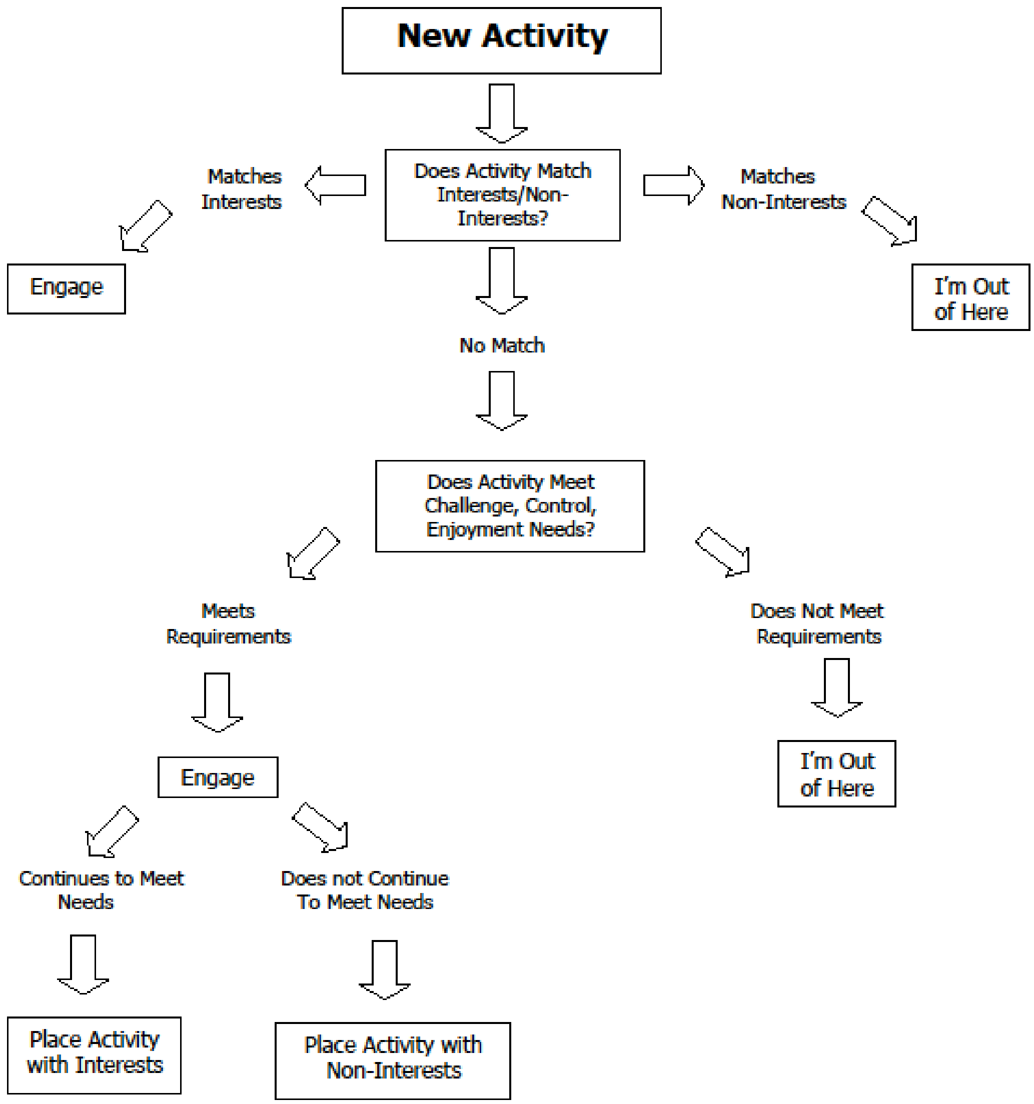

Figure 1.1. Model of Motivation. Adapted from Middleton, J. A. (1995). A study of intrinsic motivation in the mathematics classroom: A personal constructs approach. Journal for Research in Mathematics Education, 26(3), 254-279 and Valas, H., and Sovik, N. (1993). Variables affecting students' intrinsic motivation for school mathematics: Two empirical studies based on deci and ryan's theory on motivation. Learning and Instruction, 3(4), 281-98.

This model of motivation was very helpful to me in understanding my students and their lack of motivation in my math classes. Many of my students, years ago, classified math as one of their *non-interests* and according to Middleton (1995) and Valas and Sovik (1993) it is difficult to change this classification once it has been made. Many of my students do not even have to enter my classroom to know that they are not interested in what I am teaching. This model has challenged me to reflect on where I fit as the teacher in the motivation process. Since the teacher is the one that designs the classroom activities, it is the teacher's responsibility to align those activities with the students' needs for challenge, control, and enjoyment.

Attribution theory. There is also another aspect of motivation that added to my understanding of my students. This is the idea of Attribution Theory. Weiner (2010) extended the Middleton (1995) and Valas and Sovik (1993) models of motivation by adding Attribution Theory. This theory describes how people seek to explain, or attribute, the causes of events in their lives. Students often attribute their successes and failures to such factors as ability, effort, task difficulty, and luck. Beliefs about past events, which are called attributions, influence expectations for future events. When students believe that achievement is caused by effort, they are more motivated to try because they believe that increased effort will lead to increased achievement. However, when students believe that achievement is caused by ability and ability cannot be changed, they give up more easily if they believe they are not good at the task (Weiner, 2010; Schunk, 1991; Kloosterman, 1988). Applying this theory to mathematics education, if students attribute their failure in math to lack of ability and they believe they cannot change their ability, they will not be motivated to participate in the mathematics classroom.

Attribution Theory helped me to understand how my students' beliefs about their ability in mathematics prevent them from trying. Their lack of motivation indicates an attribution that there is no point in trying because they will fail anyway. They may believe that they are powerless to make any changes in their ability to do math. Shore and Smith (2010) explain that it is important for teachers, particularly in mathematics, to understand students' attributions as this is the first step in understanding students' motivational behavior.

Teaching principles to improve motivation. Four categories of teaching principles emerged from a review of the educational literature on academic motivation. These principles outline strategies that have been shown to help improve the academic motivation of students, especially those of low SES. These principles include *Students' Sense of Autonomy, Reform-Based Curriculum, Supportive School Community,* and *Attribution Retraining*.

Middleton (1995) and Valas and Sovik (1993) stressed the importance of *students' sense of autonomy* in their models of motivation. In order for a student to feel motivated to participate in an activity, they must believe that they will have some measure of control over that activity. Middleton (1995) found that in classrooms where teachers provided the opportunity to choose from a variety of activities, students were more motivated to engage. Valas and Sovik (1993) suggested that teachers minimize external control in the classroom as much as possible and even eliminate deadlines and monitoring. Their research emphasized the importance of giving students the feeling of control in the classroom and suggested classroom practices to improve motivation. These practices included helping students participate in decision making; providing real choices with decisions based on effort, not ability; giving opportunities to develop responsibility and independence; supporting self-management and self-monitoring skills. These practices can help students feel a sense of ownership of the work they are doing and give them the sense of control needed to improve motivation (Manouchehri, 2004;

Middleton, 1995; Skinner & Belmont, 1993; Spitek, Givvin, Salmon & MacGyvers, 1998; Valas & Sovik, 1993).

Reform-based curriculum that included project-based learning and cooperative learning was shown to improve students' motivation to learn in the mathematics classroom (Halat, Jakubowski & Aydin, 2008; Manouchehri, 2004; Meyer, Turner & Spencer, 1997: Spitek et al., 1998). Halat, Jakubowski, and Aydin (2008) compared classrooms that implemented a reform-based curriculum to those using a more traditional approach. The reform-based classrooms used "problem-centered teaching that opens the mathematics classroom to exploring, conjecturing, reasoning, and communicating" (Halat et al., 2008, p. 288). In the traditional approach, teachers told the students facts, demonstrated procedures, showed how to solve the problems, and then had the students practice and memorize facts and procedures. The students in the reform-based classrooms maintained a higher level of motivation than the students in the traditional classrooms.

Supportive school communities were schools which were safe and orderly, encouraged positive teacher-student social relations, and supported family involvement. Research showed that these schools motivate students. These schools were usually smaller and had smaller class sizes (Borman & Overman, 2004; Finn & Rock, 1997; Waxman & Huang, 1996; Wentzel, 1998).

As described previously, attribution theory holds that individuals look for causes to explain why things happen in their lives, especially successes and failures. If students attribute failure to uncontrollable causes, there is no motivation to continue to try. *Attribution retraining* is an attempt to change students' attributions to causes that they can control, thereby increasing their motivation (Försterling, 1985, 2001; Stipek, 1998; Weiner, 2010).

The *supportive school community* and *attribution retraining* both surfaced in my review of the research literature as two areas particularly helpful to the motivation of students of low SES. My school already works very hard to be a supportive school community. We currently implement many of the practices outlined in the research for developing a safe school. For this reason I decided to focus my action research project on *attribution retraining*.

Attribution retraining. Attribution Theory, according to Weiner (2010), explains motivation in terms of students' perception of the reasons for their successes and failures. When students believe that their successes and failures are due to factors that they can control, such as the amount of effort they put into a task, they will continue to try even after experiencing failures. However, when students believe that their successes and failures are due to factors outside of their control, such as innate ability, they will not be motivated to continue after failure. Researchers also found a correlation between attributions of failure to lack of ability and low achievement (Haynes, Daniels, Stupnisky, Perry & Hladkyj, 2008; Shore & Smith, 2010; Weiner, 1985, 2010).

Attributions are, in part, tied to students' views of intelligence. Kloosterman (1988) made the distinction between two views of intelligence, an incremental view and a fixed view. Students with an incremental view believe that their capacity to learn depends on experience, education, and effort. These students tend to be more motivated to learn because they are not concerned about their lack of ability but instead believe that if they put forth effort, they will learn and be successful. Students with a fixed view of intelligence believe that their capacity to learn depends on their innate ability and that this ability is a fixed quantity and cannot change. These students believe that no amount of effort will change their ability, which decreases their motivation to engage in the activity (Kloosterman, 1988; Middleton, 1995).

Students' beliefs about their ability, intelligence, and their attributions of success and failure greatly affect their motivation. Attribution retraining can help students change their view of intelligence and begin to see that success comes from effort and engagement, not a certain ability with which one is born. Through attribution retraining, students can begin to change their beliefs about effort and ability and improve their confidence and motivation in all academic areas including mathematics (Haynes et al., 2008; Perry, Stubnisky, Hall, Chipperfield, & Weiner, 2010; Schunk, 1982; Shores & Shannon, 2007; Struthers & Perry, 1996; Yasutake, Bryan & Dohrn, 1996).

Stipek (1998) stated that the goal of attribution retraining is to help students believe that they are able to succeed if they try, and if they fail it is because either they did not try hard enough; they needed more practice; or they did not use appropriate strategies for approaching the task. Fulk and Mastropieri (1990) suggest the following steps for implementing attribution retraining:

- Explicitly attribute outcomes to controllable causes, particularly effort (effort attribution feedback).
- Teach that failure is a natural stage in learning and a cue that increased effort is necessary.
- Remind students to accept the responsibility for successes when they occur, rather than attributing the success to an easy task or luck.

It is important that the attributions teachers make for their students be explicit, fair, appropriate, and constructive. These direct messages to students about their successes and failures must be based on close and careful observations of students' behaviors and skills. Teachers can model appropriate attributions by purposefully making mistakes and then making explicit attribution statements focusing on effort or strategies (Stipek, 1998).

Attribution retraining can help students change their view of intelligence from fixed to incremental and begin to see that failure is often due to lack of effort not lack of ability. Through such training, students can begin to change their beliefs about effort and ability which improves their confidence, their motivation, and their academic achievement (Haynes et al., 2008; Middleton, 1995; McArthur, 2011; Wilson & Linville, 1985).

Limitations of the research. Much of the research relied on students' self-reflection and self-reporting (Borman & Overman, 2004; Finn & Rock, 1997; Goodenow & Grady, 1993; Kloosterman, 1988; Schunk, 1982). Although this type of information is essential to fully understanding students' views about their education, their ability to self-report and willingness to self-report honestly need to be considered. Additionally, students' age needs to be taken into account. Very young students may lack the metacognition necessary to self-report. For example, one study required students as young as seven to self-report their confidence in their ability to solve subtraction problems (Schunk, 1982). I wonder if these young students possessed enough self-awareness to report accurately. There needs to be a balance between self-reporting and researchers' careful observations in order to triangulate the data and improve credibility (Mertens, 2009).

Some of the studies I reviewed were held over a rather short duration of time, anywhere from a day to several weeks. The researchers were able to identify patterns of change in this short time, but one is left to wonder if the effects last after treatment is complete (Haynes et al, 2008; Schunk, 1982; Wilson & Linville, 1985). Some of the topics investigated were also very narrow (such as a short unit covering a few very specific math concepts) and there was no way to be sure if the results would be transferrable to other topics (Halat et al., 2008; Manouchehri, 2004). More studies need to be done over longer periods of time on many different topics in order to improve the transferability of these findings (Mertens, 2009).

A final limitation is the absence of studies done with high school students. Most of the studies focused on elementary and middle school students (Halat et al., 2008; Schunk, 1982, Waxman & Huang, 1996; Yasutake, Bryan, & Dohrn, 1996). Some studies used college students (Haynes et al., 2008; Perry & Penner, 1990; Struthers & Perry, 1996; Wilson & Linville, 1985). The only study I was able to find that focused on high school students was conducted by Rodríguez-Naranjo and Caño (2010). However, they were testing the validity of a scale they had developed for measuring attributions among adolescents; they were not studying attribution retraining.

Continuing the Conversation

As I reviewed the educational literature on mathematics motivation, I found a lack of research studies that focused on high school students, particularly those from low SES backgrounds. According to the NRCIM (2004) when looking for information about high school students, "the research base is meager compared to that which is focused on younger children" (p. 60). Looking for information about low SES students "limits the empirical base even further" (NRCIM, 2004, p. 60). It is extremely important for research to focus on low SES high school students. These are the students with the most immediate need. These are the students most likely to dropout. The social and economic consequences of leaving high school without graduating are more severe for low SES students than their more financially advantaged peers (NRCIM , 2004).

Also missing from the research, according to Shore and Smith (2009), are studies of intervention strategies that implement attribution retraining. Much of the attribution literature focused on measuring students' attributions, classifying those attributions, and tying those attributions to students' achievement. Few studies focused on the strategies that teachers might use to help students change the patterns of attribution that prevent them from fully participating in classroom activities. Studies of intervention strategies are essential in order for attribution retraining work to be done. Teachers need this information so that they can implement these strategies in their classrooms.

For my action research study, I attempted to answer the following research questions:

- What are the relationships between attributions, confidence in mathematics ability, mathematics motivation, and achievement among low SES high school students?
- How does attribution retraining influence these relationships?

In order to answer these questions, I implemented attribution retraining for my high school mathematics students. I developed and implemented a one-day *Effort and Achievement* lesson. In this lesson, I showed students how effort improves test scores (see Appendix A). I also implemented a one-day lesson in *Attribution Theory*. This lesson described how productive attributions could lead to greater motivation (see Appendix B). After the lessons, I developed with my students a set of classroom norms that included attributing outcomes to controllable causes, emphasizing the importance of effort and its connection to achievement, and mistakes as an acceptable part of learning. Also, as part of the attribution retraining, I modeled productive attributions for my students.

Through this action research project in my mathematics classroom, I learned about my students' attributional styles, their beliefs about effort and achievement, and their understanding of effort.

Chapter 2: Methods, Description of Participants, and Analysis

This research study examined the relationship between attributions, mathematics confidence and motivation, and achievement among low SES high school students and how attribution retraining influences this relationship. In this chapter, I describe my methods and analysis for this study. First I describe the setting and my participants. Then I discuss the attribution retraining I implemented for my study. I then describe each data source I collected which includes surveys, student quizzes, class discussions, academic history, and mini-interviews. Lastly, I describe how I analyzed the data I collected.

Setting

In an attempt to answer my research questions, I situated my study within my own work context, a high school mathematics classroom in a school that serves mostly low-income students.

My study took place in a district that serves over 4000 students in grades K-12 in a somewhat rural community. I teach at the district's alternative high school that serves about 220 students in grades 9-12 in several alternative programs. The program in which I work serves 125 students. The traditional high school in our district serves approximately 1250 students in grades 10-12. My school's population includes about 5 % Native, 10% Hispanic, 8% Multi-racial, and 77% White. The free/reduced lunch rate is over 65%. Many more students qualify for free/reduced lunch, but do not complete the forms and therefore do not receive the services. Many of the students at my school have come from the traditional high school after being unsuccessful both academically and socially. Therefore most of our students are behind in credits and very low skilled academically.

Participants

The participants in this study included the students from my two Algebra 1 classes and my two Math Navigator classes. The Math Navigator classes are general math classes for students whose skills are extremely low. Most of these students have IEP's in math. Initially there were 44 students in these four math classes. Over the course of the study, seven students dropped my classes: two transferred to other programs in the school, one transferred to a different class in the same program, one transferred to a different district, and the other three dropped out of school entirely. Also, over the nine weeks of the study, eight students joined my classes. This is typical at my school; we allow new students to enroll every three weeks.

I chose my math classes because this study focuses on high school students' motivation in mathematics education. I also chose these students because every student in the Algebra 1 classes has failed Algebra 1 at least once before and every student in the Math Navigator classes had been placed there due to low performance in their previous mathematics classes. Due to their past failures, these students are typically discouraged learners with low self-efficacy and low motivation when it comes to learning mathematics.

I invited all the students from all four classes to participate in the study and gave them each an information letter and consent form. I required each student to return a consent form either agreeing to participate in the study or declining to participate. Thirty-seven students agreed to participate. This was about 70% of the students in my classes. The ethnicity and income status of the participating students was similar to that described above for the whole school. All classes participated in the attribution retraining activities as a way to increase their self-efficacy and thus their motivation in the class. I collected data for only the students who agreed to participate.

Attribution Retraining

The attribution retraining I implemented in my classes included two one-day lessons, one examining the connection between effort and achievement and the other in Attribution Theory. The attribution retraining also included modeling productive attributions and assigning competence that connected effort to achievement by making effort attributions (Cohen, 1994). In the sections that follow, I describe these two lessons in more detail and give examples from my classroom of modeling productive attribution and assigning competence that included effort attributions.

Effort and achievement lesson. After our first quiz of the term, I gave a lesson that connected effort to achievement. At the end of each quiz, I asked the students to rate how much effort they put into studying for the quiz and in completing the quiz. I used the students' effort ratings to make a graph showing students' effort versus quiz scores (see Appendix A). The graph clearly showed that students who gave higher ratings for effort earned higher quiz scores. I used this graph as the basis for the lesson.

I showed the graph and then lead a class discussion concerning what this graph might mean. Most of the students were able to the make the connection between effort and achievement. Once this idea was well established, we discussed our classroom mathematics norm, "Learning takes time and effort."

As my study continued, I repeatedly called students' attention to the connection between effort and achievement and referred to our mathematics norms.

Attribution theory lesson. After our second quiz and quiz reflection, I gave a lesson on Attribution Theory (see Appendix B). This lesson described Attribution Theory to the students and connected those ideas to the students' quiz reflections. To design this lesson I used strategies and lessons suggested by Fulk and Mastropieri (1990), McArthur (2011), and B. Weiner (personal communication, July 7, 2011). Fulk and Mastropieri (1990) outlined steps for combining attribution retraining with math and reading comprehension strategies to improve effort among elementary school students. McArthur (2011) provided a lesson on attribution retraining that focused on college students in communication theory classes. These articles were helpful in planning my lessons and implementing the attribution retraining for my study, but I felt unsure if I was adapting these strategies appropriately for high school students.

The lesson I developed was not particularly well received by some of the students. They resented me using math time for concepts that they clearly did not consider to be math. Most of the students, however, were able to understand how their attributions might make them more motivated.

Modeling productive attributions. From the start of the study, I modeled productive attributions. When I would make a mistake, such as misspelling something I was writing on the board, I would confess that spelling has always been difficult for me, but that I was continuing to practice to improve my spelling. If I made an error in arithmetic, I would emphasis that I needed to be more careful. In the self-talk I modeled out loud to the students, I always attributed my mistakes to controllable causes.

When students made unproductive attributions, I would give them a productive attribution instead. For example, a student came in after school to do a make-up quiz. After finding out he had done poorly, he said, “I’m retarded.” I said, “You were in a hurry.” By giving students productive attributions to replace their own unproductive ones, I hoped to help students recognize controllable causes for their successes and failures.

Making effort attributions. As part of the status treatment[2] I used in my classes (Cohen, 1994), I added assigning competence that connected effort to

[2] Groups of students tend to develop beliefs about themselves and each other such that some students are perceived as more capable and able to contribute to the group than others. This is what Cohen (1994) called *status ordering*. Such ordering can make it difficult for all students to participate fully in group and class activities. To deal with this problem, Cohen (1994) suggested a status treatment she called *assigning*

achievement. I watched for groups working especially well together, and I connected that to the quality of their assignment. I would make comments such as, "Look at how hard your group is working! Everyone is participating and working together. That must be why your project is turning out so well."

I assigned competence through effort attributions to individual students as well. When a student did well on a quiz or other assignment, I made comments that connected their success to effort. I said things like, "You really took your time on this quiz. That must be why you did so well." Or "I see you did all of your homework before this quiz. Do you think that might be why you got such a high score on the quiz?" By assigning competence through effort attributions, I hoped to help students see the connection between their own effort and achievement.

Data Sources

I collected both qualitative and quantitative data from students in my study using a mixed methods approach (Mertens, 2009). This approach allowed for flexibility in gathering and analyzing my data. I collected data from student surveys, student quizzes, class discussions, academic history data, and student mini-interviews.

Student surveys. The first week of classes, my students completed the Math Beliefs Survey and the Modified Fennema-Sherman Mathematics Attitude Scale (F-SMAS) (Doepken, Lawsky & Padwa, 2011). I used these surveys to analyze students' attitudes about mathematics and their beliefs about themselves as mathematics students (see Appendix C and D for copies of these two surveys). For clarity, I will refer to these two surveys as Math Belief Survey 1 and Math Beliefs Survey 2 (F-SMAS) for the rest of this paper.

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competence. To assign competence, the teacher must look for opportunities to point out a specific ability or skill exhibited by a student of low status in the group or class.

Also during the first week of classes the students completed the Attributional Style Questionnaire for Adolescents (ASQ-A) (Rodríguez-Naranjo & Caño, 2010). This survey helped me determine my students' initial attributional styles[3] (see Appendix E for a copy of this survey). For clarity, I will refer to this survey as Attributional Style Survey (ASQ-A) for the rest of this paper.

During the eighth week of classes, after we had worked with attribution retraining along with our regular mathematics curriculum, students completed the two Math Beliefs surveys again. This allowed me to compare the results from the second surveys to the earlier surveys to see changes in students' mathematical beliefs.

Another survey I used was the Revised Causal Dimension Scale (CDSII) (McAuley, Duncan & Russell, 1992; see Appendix F for a copy of this survey). For clarity, I will refer to this survey as Quiz Reflection Survey (CDSII) for the rest of this paper. This measure is more qualitative and asks students to look at a particular event of success or failure and answer questions about the causes of that event. B. Weiner (personal communication, July 14, 2011) suggested using this measure as part of the reflection process after a test or quiz has been returned to the students. I had students complete this measure after each of the four biweekly quizzes was scored. This survey allowed me to look for changes in attributions over the course of the study.

Student quizzes. Every two weeks students took a quiz over the objectives we covered during that two-week period. At the end of the quiz, I asked the students to rate their effort on the quiz and their effort in studying for the quiz. I was surprised by the effort ratings on the first two quizzes. I was expecting many students to give themselves low rating for effort, because what I had observed during the first four weeks of the term was what I considered low effort, such as low attendance, tardiness, few homework

[3] A student's attributional style is the pattern of beliefs that the student holds about the causes of the events in his/her life including the causes of academic successes and failures.

assignments turned in, and low class participation. What the students reported, however, was fairly high rates of efforts. Therefore I added additional questions about effort on the last two quizzes. On Quiz 3, I asked students to give a definition of effort after their rating; and on Quiz 4, I asked for a definition of effort and two examples of how they demonstrate effort in their classes at schools.

Class discussions. In each of the four classes I used in my study, I held a class discussion about students' math beliefs. The questions I asked appear in Appendix H. Many of the questions I asked in the class discussions were similar to those asked in the surveys. By holding class discussions I wanted to see if students were willing to share publicly about their math beliefs. I also wanted to be able to triangulate my data as suggested by Mertens (2009).

I recorded these class discussions with an audio recorder. I tried to include all students in these class discussions. Unfortunately, I was only able to get about half of each class to participate.

Academic history. The research literature on motivation has found a connection between students' attributional style and student achievement (Haynes et al., 2008; McClure et al., 2011; Wentzel & Wigfield, 1998). In an attempt to determine if this connection holds true for my students, I collected data about my students' past academic achievement which included GPA and credits earned. This data gave me a clear picture of my students' achievement.

Student mini-interviews. After each quiz and Quiz Reflection Survey (CDSII), I examined students' responses about effort and attributions. When I had questions about a student's response, I put this quiz aside and sometime within the next week I held a mini-interview with the student. I asked clarifying questions about the student's responses to the survey questions and the student's definitions and examples of effort. I interviewed about four students per class each week. These mini-interviews gave me additional insight into what my students believed about their effort, achievement, and attributions.

Date Analysis

Student Survey. I analyzed the survey data in several ways. The Math Beliefs Survey 1 required students to agree or disagree with statements about their math beliefs. I entered this data into a spreadsheet and determined what percentage of the students agreed, disagreed or had no opinion. The Math Beliefs Survey 2 (F-SMAS) was similar but contained many more questions. These questions represented four categories: confidence in math, usefulness of math, belief in math as a male domain, and perception of math teachers. I was only interested in the first two categories but had the students answer all the questions for the pre-treatment survey. For the post-treatment survey, I had students answer questions for only the first two categories. I made a spreadsheet that totaled the questions for each category and then I transferred this data to another spreadsheet so that I could determine the percentage of students in each category.

During the eighth week of classes, students completed the first two surveys again as post-treatment surveys. I analyzed the post-treatment surveys in the same way as the pre-treatment surveys. This allowed me to compare the results from the post-treatment surveys to the pre-treatment surveys to see changes in students' mathematical beliefs (see Appendix C and D for copies of these surveys and Appendix G for additional references about their development).

The Attributional Style Survey (ASQ-A) required students to imagine 15 different situations that might happen in their lives and determine the causes of those situations. Then the students determined the extent to which those causes were internal, controllable, and stable. I used a spreadsheet for this data to determine my students' initial attributional styles. (See Appendix E for a copy of this survey and Appendix G for additional references about its development.)

The Quiz Reflection Survey (CDSII) that I used after each quiz asked students to determine if they succeeded or failed on the quiz, give a cause (attribution) for the success/failure and then rate the extent to which that attribution was internal, controllable, and stable (the dimensions for the attribution). I used a *within-case display* to analyze the data from these surveys (Miles & Huberman, 1994). In the *within-case display*, I entered the attributions, the dimensions of those attributions, and the type of attribution (effort, ability, situation, etc.). From this display I was able to find themes and patterns in my students' attributions.

Student quizzes. I used a spreadsheet for the effort ratings that students gave for all four quizzes. This sheet allowed me to identify patterns in student quiz effort ratings. I also used a *within-case display* for the students' responses about effort on the Quiz 3 and Quiz 4. In this display I entered students' definitions of effort and students' examples of effort. This allowed me to see patterns in their responses.

Class discussions. I transcribed the audio recordings I made of the class discussions. I reviewed the transcripts looking for common themes in students' beliefs about their math ability and its usefulness in their future. I looked for common themes among students and across classes. I compared this data to the data gathered in the surveys and again looked for common themes.

Academic history. The research literature on attribution retraining found a connection between students' attributional style and student achievement (Haynes et al., 2008; McClure et al., 2011; Wentzel & Wigfield, 1998). In an attempt to determine if this connection held true for the students in my study, I collected data about my students' past academic achievement which included GPA and credits earned.

I analyzed the academic history data so that I could obtain some sort of measure of my students' academic achievement. I knew that the students I typically had in my classes usually had low skills and were behind their peers academically and wanted some way of actually measuring this. I looked at the GPA data, but questioned how useful this would be. For example, there were several students with relatively high GPA's, 3.5 to 4.0, but some of those students had less than one high school credit even though they were juniors or seniors.[4] These students had moved many times and had not stayed in a school long enough to accumulate even failing grades or they had simply not been enrolled in school at all. I decided that I needed to use their total credits as a measure of achievement. Using the total credits earned and the number of years a student had been in high school, I calculated a credits-earned per year figure. I then compared this to what a student needs to earn in order to graduate in four years. Although I realize that this measure was limited because it essentially measured the pace at which the students had earned credit and did not measure their skills.

Student mini-interviews. I recorded the information I gathered from the mini-interviews in the same *within-case displays* I used for the quiz effort ratings and definitions and the Quiz Reflection Surveys (CDSII). This helped me clarify the ratings and definitions from the quiz and reflections on the surveys. By asking students to explain what they had written on their quizzes and surveys, I was better able to understand their beliefs and attributions.

Limitations

One of the concerns of this study is that much of my data came from student surveys and interviews which required student to self-reflect and self-report. While

[4] In my district, a student's status as a freshman, sophomore, junior, or senior is determined by the student's age and the number of years the student has been in high school, not by the number of credits a student has earned.

students' ideas and opinions are essential to my study, some of the ideas on which I asked students to reflect were things they may not have thought about before. Sometimes it seemed difficult for them to determine what their attitudes and beliefs really were and some students seemed unwilling to self-report truthfully. To help address this concern, I discussed the meaning of the surveys and gave students plenty of time to reflect on the survey questions.

Another area of concern is that in this research study, I was the researcher as well as the teacher. I usually get to know my students well and some of the students in my study I have had in classes previous years, so it was difficult to analyze the data with a fresh perspective. Also my relationship with my students might have affected their answers to survey and mini-interview questions. Some students, even high school students, try to please the teacher and sometimes they might have told me what they thought I wanted to hear. To help eliminate this concern, I impressed upon students how important it was to have their honest answers.

The patterns of attendance and tardiness of the students in my study may also be a threat to the creditability of my study. School is not always a priority for many students. Over the course of my study my average daily attendance was 77%. While I started out with 37 students in my study, because of the absenteeism, there were times when I was only able to collect data on as few as 24 students.

Another possible threat to the creditability of my study is that the classroom is a very dynamic place. There were many things going on all the time and everything was always changing. I continued to strive to implement the teaching practices that I have learned in the master's program at TESC and through in-service classes I have attended. For this reason it is impossible to know if the changes I observed in the students in my study were due to the attribution retraining I implemented or were caused by some other factor going on in the classroom. Mertens (2009) referred to this as the *multiple-treatment interference*. Although I was not intentionally investigating any other treatments, any teaching strategies I used could have been the cause of patterns I observed in the classroom.

A final threat to the validity of my study is something that Mertens (2009) called *strength of the experimental treatment*. Mertens suggested that "it is not reasonable to expect that students' learning attitudes, self-concepts, or personalities can be affected by an experiment of short duration" (p. 132). This was a very real concern to me. The students in my study have spent many years (sometimes as many as 20) developing their mathematical beliefs. It is unrealistic for me to expect to influence those beliefs in nine weeks.

In an attempt to improve the validity of my study, I spent a great deal of time observing my students and recording those observations. I collected data from several areas so that I was able to triangulate the data and show the same themes from different data sources. My research was peer reviewed several times during the course of the study. At all times during my study I remained aware of my conflicting positions of teacher and researcher and tried not to let this influence my analysis of the data.

Timeline

My school uses nine week terms as reporting periods. There are four terms in a school year. I started my study during the first week of the term in September and continued to collect data throughout the nine weeks of the term which ended in November. The following is a timeline showing my data collection.

Week 1:
- Consent Letters went out
- Administered Math Beliefs Survey 1
- Administered Math Beliefs Survey 2 (F-SMAS)
- Administered Attribution Style Survey (ASQ-A)

Week 2
Monday: Math Beliefs Class Discussions
Thursday: Quiz 1

Week 3
Monday: Quiz Reflection Survey (CDSII) with Quiz 1 feedback
Effort and Achievement Lesson
Tuesday: Mini-Interviews about Quiz 1

Week 4
Thursday: Quiz 2

Week 5
Monday: Quiz Reflection Survey (CDSII) with Quiz 2 feedback
Attribution Theory Lesson
Tuesday: Mini-Interviews about Quiz 2

Week 6
Thursday: Quiz 3

Week 7
Monday: Quiz Reflection Survey (CDSII) with Quiz 3 feedback
Tuesday: Mini-Interviews about Quiz 3

Week 8
Thursday: Quiz 4
Re-administered Math Beliefs Survey 1
Re-administered Math Beliefs Survey 2 (F-SMAS)

Week 9
Monday: Quiz Reflection Survey (CDSII) with Quiz 4 feedback
Tuesday: Mini-Interviews about Quiz 4

I collected my data following the timeline shown above. I analyzed the data as I collected it and then compared pre- and post-treatment data at the end of my study. In the following chapter, I explain what this data taught me about the students in my study.

Chapter 3: Research Findings

Introduction

Four findings emerged from my data analysis. One was expected: the students in my study lacked confidence in their mathematics ability and they had low expectations for using math after they graduate from high school. Two findings were unexpected: these students had attributional styles that should predict higher achievement and there was a disconnect between my students' understanding of effort and my understanding of effort. The last finding, an increase over the course of the study in students' confidence in their math ability and the usefulness of mathematics, may have been influenced by the attribution retraining I implemented as a part of my study.

These findings, especially the unexpected ones, have led me to think differently about my students' understanding of effort and how I might be able to help them learn about the kind of effort necessary for success.

In this chapter I will explain how my research data led to the four research findings mentioned above.

Research Findings

Low confidence in math ability and low expectations for future math use. Students from low SES families often lack confidence in their ability to be successful in mathematics (Chiu & Xihua, 2008; NRCIM, 2004). My data showed this to be true for the students in my study.

The students in my study lacked confidence in their ability to achieve in their mathematics classes. They also did not believe that math was necessary or useful in their lives. I have believed this to be true from personal observations of my students and from listening to them discuss their successes and failures in my classes. Through this action research project, I collected data that confirmed my original beliefs.

Two surveys I gave at the beginning of my study clearly showed these students' lack of confidence to be successful in mathematics: Math Beliefs Survey 1 and Math Beliefs Survey 2 (Modified Fennema-Sherman Mathematics Attitude Scales, F-SMAS). (See Appendix C and D.) In the Math Beliefs Survey 1, 43% rated their ability in mathematics as low or very low and another 41% said they had average math ability, with only 16% rating their math ability as high. In the Math Beliefs Survey 2 (F-SMAS), 63% reported that their math ability was low or very low; 34% reported their math ability was average; and only 2% reported they had high math ability.

Students' lack of confidence in their math ability also came out in our class discussions. I asked student to talk about how they felt about math. (See Appendix H for sample class discussion questions.) I asked directly if they felt they were good at math. Typical responses included the following:

- "Obviously I'm not good at math. This is my senior year and I don't have any math credit. I tried it and I failed it. I have all my other credit."
- "Some people are good at language arts and others are good at math and science. You can't be good at both. I'm good at language arts and not math or science."
- "I am good at some things in math, like I can do points and percents, but I can't do anything else."
- "People who are good at music are good at math. My brother plays the guitar and he is good at math. I'm not good at music, so I can't do math either."

These initial surveys and class discussions also indicated that students did not find math particularly useful nor did they have much of an expectation for using math in the future. The Math Beliefs Survey 2 (F-SMAS) showed that only 2% believed math to be useful and important to their future; 30% felt that it might have some future use; 39% did not expect to use math after high school; and 29% were unsure. Our class discussions confirmed these results. When asked how they saw themselves using math in the future, few expected to use math after graduating from high school. A common response to the question, "How will you use math after you graduate?" was "I won't."

In these class discussions I challenged students to think about ways that math might be used in future careers. Although most students could not see themselves using math in their futures, all four classes were able to generate a list, similar to the one that follows, of careers that use math:

- Cashier
- Construction Worker
- Casino Worker
- Childcare Provider
- Teacher
- Surveyor
- Auto Mechanic
- Welder

I also pushed them to think of ways they might use math in their personal lives after they graduate. A typical list in all four classes looked like this:

- Cooking (changing recipes)
- Home Budget
- Paying Bills
- Balancing Checkbook
- Evaluating your Paycheck
- Calculating Gas Mileage

It is not surprising that the students in my study had low confidence in their mathematical ability. All of the students in my two Algebra 1 classes had taken and failed Algebra 1 at least once before. At the start of the term there was one ninth grader who had not taken Algebra before, but he moved away the second week of the study. In my Math Navigator classes, all of the students had also been unsuccessful in previous math classes.

It is also understandable that students in my study had low expectations for using math after they graduate. Most came from homes with parents who have limited education. Very few, if any, had parents who have been to college and many will be the first one in their family to graduate from high school. These students did not see math being used or valued by the adults in their lives, and this may be the reason they did not believe that they will not need math in their future.

Attributional styles that should predict higher achievement. Attributional styles of the students in my study turned out to be different than I had expected. Because my students' achievement is low, I expected them to make unproductive attributions, such as attributions to causes that are external, uncontrollable, and stable[5] (unchanging) as the literatures suggested (Haynes et al., 2008; McClure et al., 2011; Weiner, 2010; Wentzel & Wigfield, 1998). I expected them to blame their failures on lack of ability, the difficultly of a task, or bad luck. I did not expect them to include effort as a cause for either success or failure and I did not expect them to take any personal responsibility for the outcomes.

The survey I gave at the start of my study, the Attributional Style Survey (ASQ-A) (see Appendix E) showed that 56% of the students in my study attributed the cause of events in their lives to something about themselves (internal), while only 15% attributed these events to causes outside themselves (external). I was expecting this to be the opposite with most of the students making external attributions.[6] This survey also showed that students took more personal responsibility for the events in their lives than I expected, with 59% attributing the causes of events in their lives to things over which they had control, such as their own effort and behavior. Only 12% attributed causes of

[5] Often we think of stability as a positive attribute. According to Attribution Theory, however, if we believe a cause to be stable that means we believe that the cause cannot be changed. Stability is an unproductive attribution. Unstable attributions are more productive, because we believe that unstable causes can be changed.
[6] 29% showed attributions that were neither internal nor external.

events to things they could not control, such as difficulty of a class or the behavior of others. The stability attributions came a little closer to my expectations. I expected more students to make attributions to causes that were stable (unchanging) than unstable; 24% chose stable attributions, such as innate ability, while 14% chose unstable attributions, such as events in their lives. The majority of students, 62%, made attributions that were neither stable nor unstable.

The Quiz Reflection Survey (CDSII; see Appendix F) also showed similar unexpected results, with the majority of the students making productive attributions. Sixty-seven to 76% of the students gave internal attributions; 56% to 78% identified attributions over which they had control; and 40% to 64% identified attributions that could be changed (unstable).

I gave the Quiz Reflection Survey (CDSII) after each of the four biweekly quizzes. The survey gave students the opportunity to reflect on their performance on each quiz. They identified their performance as either successful or unsuccessful and then they gave a cause for their success or failure. Finally, they determined the extent to which that cause was internal, controllable, and stable. I gave the Quiz Reflection Survey after each quiz hoping to identify any changes in my students' attributional styles over the course of the study, to see if the attribution retraining I was implementing was influencing their attributions. Table 3.1, Attributional Dimensions Chosen, shows the percent of students identifying each attributional dimension.

Table 3.1. Attributional Dimensions Chosen

Quiz Reflection Survey	Locus of Control			Responsibility			Stability		
	Internal	Neutral	External	Personal	Neutral	Other	Stable	Neutral	Unstable
Quiz 1	67%	15%	19%	78%	15%	7%	19%	41%	40%
Quiz 2	67%	22%	11%	56%	25%	19%	23%	19%	59%
Quiz 3	75%	17%	8%	76%	12%	12%	13%	35%	52%
Quiz 4	76%	24%	0%	76%	18%	6%	18%	18%	64%

As can be seen in Table 3.1, only the Locus of Control seemed to follow a pattern toward a more productive attributional style (more students identified the Locus of Control as internal and fewer identified Locus of Control as external as the term went on). The other dimensions of attribution did not follow this pattern. For the Responsibility dimension, the more productive attribution is personal responsibility. This measure remained about the same with the exception of the second quiz which went down. For the Stability dimension, the more productive attribution is Unstable, which followed an increasing pattern with the exception of the third quiz. While no particular pattern of change could be seen in the data, the results show that the majority of my students showed productive attributions; that is they reported attributions that were internal, self-controllable, and changeable (unstable).

Not only did the students in my study have unexpected attributional styles, their attributions themselves turned out to be unexpected. The literature suggested that typically low achieving students tend to attribute the causes of their successes and failures to their ability, the difficulty of the task, or luck. Low achieving students do not usually make attributions to effort (Haynes et al., 2008; McClure et al., 2011; Weiner, 2010; Wentzel & Wigfield, 1998). However, the data collected from the Quiz Reflection Survey (CDSII) showed that the students in my study attributed their successes and failures to effort (or lack of effort) more often than any other cause. No students reported luck as a cause of success or failure on any of the quiz reflections. Table 3.2, Attribution Types Chosen, shows the percent of the students that chose each attribution type.

As with the dimensions of attributions, the types of attributions show no pattern of change over the study. The attribution retraining I implemented did not appear to influence students' attributions. In all four Quiz Reflection Surveys (CDSII) the majority of the students choose effort as the cause of their success or failure.

Table 3.2. Attribution Types Chosen

Quiz Reflection Survey	Effort[7]	Ability[8]	Situation[9]	Task
Quiz 1	70%	11%	4%	15%
Quiz 2	48%	15%	33%	4%
Quiz 3	57%	30%	13%	0%
Quiz 4	65%	12%	23%	0%

The beliefs of the students in my study about the importance of effort were also apparent in the Math Beliefs Survey 1 that I gave at the beginning of the study. (See Appendix C.) Seventy-eight percent of the students agreed that math ability and performance could be improved with effort. Only 5% disagreed and 16% were unsure.

Our class discussions also confirmed students' beliefs about effort. When asked if effort could make you better in math the response in all classes was overwhelming agreement.

The final data I gathered to attempt to determine the relationship between students' attributions, mathematics confidence and motivation, and achievement was academic history data. I wanted some measure of the achievement level of the students in my study. Many studies I read gathered GPA data as an assessment of achievement. These studies were usually done with students at the same grade level and similar numbers of credits (Haynes et al., 2008; Wentzel & Wigfield, 1998). GPA did not seem to be a good description of achievement for the students in my study since they had such varying amounts of total credit and some students with relatively high GPA had very little credit even though they were junior and seniors. For example, there were

[7]Some of the typical responses that students gave that indicated an effort attribution included the following: tried hard, listened in class, paid attention, didn't attend class, and didn't study.
[8]Typical responses that indicated an ability attribution included the following: I'm awesome, I'm stupid, I learn quickly, and I don't understand what we are doing.
[9]Attributions that indicated that there was another situation happening in the student's life included the following: in a bad mood, came late or left early on test day, and wasn't feeling well.

several students with relatively high GPA's, 3.5 to 4.0, but some of those students had less than one high school credit even though they were juniors or seniors.[10] These students had moved many times and had not stayed in a school long enough to accumulate even failing grades or they had simply not been enrolled in school at all. I decided that I needed to use their total credits as a measure of achievement. Using the total credits earned and the number of years a student had been in high school, I calculated a credits-earned per year figure. I then compared this to what a student needs to earn in order to graduate in four years. I realize that this measure was limited because it really measured the pace at which the students had earned credit.

In my district, a student normally earns six credits each year, with a total of 24 credits after four years in high school. A minimum of 22 credits is needed to graduate. The minimum number of credits needed to graduate on time is five and a half per year. The students in my study had earned an average of 2.9 credits per year. These students were averaging a little less than half of what a typical high school student would be earning. This would mean that it would take these students an average of seven and a half years to graduate from high school. Clearly from the academic history data the students in my study exhibited low achievement.

Attributional styles and beliefs about effort of the students in my study did not match what the research showed are typical of low achieving students. The research literature demonstrated that low achieving students tend to have attributions that are external, uncontrollable, and stable. Low achieving students also make most attributions for ability, task difficulty, and luck, not usually effort (Haynes et al., 2008; McClure et al., 2011; Weiner, 2010; Wentzel & Wigfield, 1998). The students in my study tended to make attributions for effort that were internal, controllable, and unstable. This

[10] In my state, a student's status as a freshman, sophomore, junior, or senior is determined by the student's age and the number of years the student has been in high school, not by the number of credits a student has earned.

attributional style, according to the literature, is more typical of high achieving students, but clearly from the academic history data I collected, the students in my study were not achieving at a high level.

With attributional styles that should support high achievement, I wondered why the students in my study were so behind their peers academically. When the average student takes four years to graduate from high school, why is it taking these students so much longer? The answer may lie in these students' definition of effort that turned out to be very different than my definition. My data revealed a disconnect between student and teacher understanding of effort, and I gathered additional data to investigate this disconnect. I discuss this in the next section.

Disconnect between student and teacher understanding of effort. Part of the goal of attribution retraining is for students to develop an understanding of the importance of effort and its connection to achievement and that effort is something over which the student has control and the power to change. To gain an understanding of students' beliefs about their own effort, on each quiz I asked students to rate their effort on a scale of 1 to 5 (1 being low effort and 5 being high effort.) I asked for a rating of their effort on taking the quiz and their effort in preparing for the quiz. As I explained the effort rating, I talked about what I meant by effort. I explained that effort in preparing for the quiz would mean more than just studying the night before. I gave examples of effort such as doing homework consistently, attending class regularly, and participating in class discussions and group work.

On the first two quizzes I was surprised by the number of students who gave themselves high ratings for effort. Over half of the students said their effort had been high or very high. This surprised me because what I had observed in the first four weeks of the term was not what I considered high effort. The average daily attendance was less than 65%, the average daily participation points[11] was less than 60%, and the average number of homework assignments completed was 33%. Clearly my understanding of effort was different than my students' definitions of effort.

I began to collect data that would help me understand what my students meant by effort. On Quiz 3, along with their effort rating, I asked the students to explain what effort meant to them. Then I started what I called mini-interviews. These mini-interviews involved taking individual students aside and asking specific questions about what they had written about effort. On Quiz 4, I again asked for their effort rating and their definition of effort, and this time I also asked for two examples of effort.

Most of the students in my study defined effort as trying hard, working hard, and/or doing your best. Only four of the 27 who responded on Quiz 3 and three of the 24 who responded on Quiz 4 defined effort as having something to do with attending class regularly, doing homework, or paying attention in class. Even when asked for examples of effort on Quiz 4 or in the mini interviews, only a few students were able to explain effort beyond "working hard" or "trying your best."

This effort data might explain why these students' productive attributions, explained in the previous section, do not lead to the high achievement outlined in the literature. The students in my study believed that there is a connection between effort, ability, and achievement; they believed that effort is the cause of their successes and failures; and they believed that effort is internal and something under their control. However, their understanding of effort was so limited that their beliefs in effort did not lead to achievement. This unexpected outcome brought me a deeper awareness of my students' understanding of effort. Perhaps what I have observed as a lack of motivation

[11] Each day students give themselves participation point, which we call *SSA* for *Student Self-Assessment*. Then I indicate whether I agree with their self-assessment. The average of student points and teacher points are given each day. A student earns full points by arriving on time, getting to work right away, and staying engaged the whole period.

is really this lack of understanding of the effort it takes to be successful in school. This realization has caused me to consider how I might do things differently in the classroom. I discuss this further in Chapter 4.

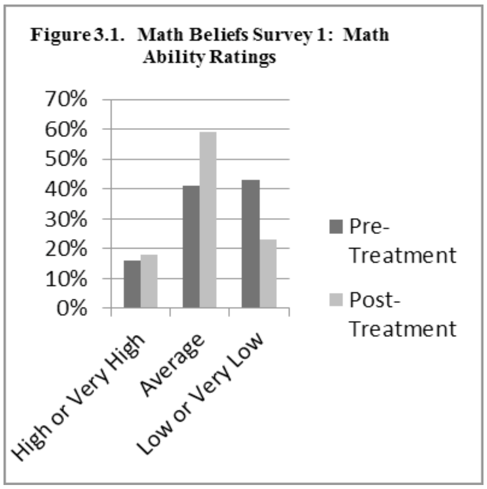
Increased confidence in math ability and increased expectations for future math use. Analysis of the data indicates that there does appear to be a possible increase in students' confidence in their math ability. The two Math Beliefs surveys that I gave the first week of the study, I repeated as post-treatment surveys. In the initial Math Beliefs Survey 1, 43% of the students rated their math ability as being low or very low. In the post-treatment survey, this percentage had dropped to 23%. The Math Beliefs Survey 2 (F-SMAS) also showed a decrease in the number of students who rated their math ability as low or very low. This percentage dropped from 63% in the pre-treatment survey to 26% in the post-treatment. While the percentage of students rating their math ability as high or very high increased by only 2% in the Math Beliefs Survey 1, that percentage increased by 30% in the Math Beliefs Survey 2 (F-SMAS). Table 3.3, Pre-Treatment and Post-Treatment Math Ability Ratings, shows the percent of students in each category for both surveys.

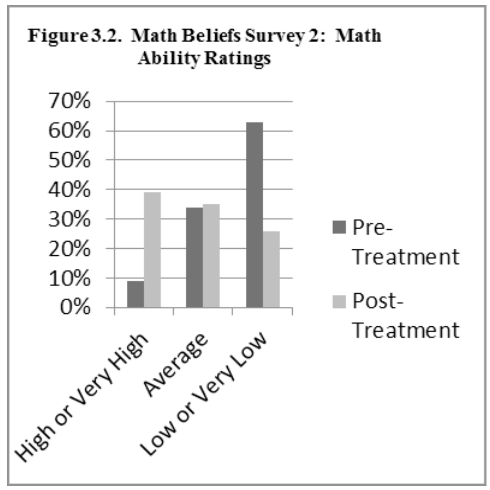
Table 3.3. Pre-Treatment and Post-Treatment Math Ability Ratings

		High or Very High	Average	Low or Very Low
Math Beliefs Survey 1	Pre-Treatment Survey	16%	41%	43%
Math Beliefs Survey 1	Post-Treatment Survey	18%	59%	23%
Math Beliefs Survey 2 (F-SMAS)	Pre-Treatment Survey	9%	34%	63%
Math Beliefs Survey 2 (F-SMAS)	Post-Treatment Survey	39%	35%	26%

Figure 3.1, Math Beliefs Survey 1: Math Ability Ratings, and Figure 3.2, Math Beliefs Survey 2: Math Ability Ratings, compare the pre- and post-treatment results in a

different format. These figures show that fewer students rated their math ability as low or very low in the post-treatment surveys than in the pre-treatment surveys, and more students rated their math ability as high or very high in the post-treatment surveys than in the pre-treatment surveys.





There was also an increase in the number of students in the study who believed that effort could improve one's math ability. In the pre-treatment Math Beliefs Survey 1, the majority of the students seemed to believe that math ability could be improved through effort with 78% of the students agreeing on the survey. This number increased to 95% of the students agreeing on the post-treatment survey. The pre-treatment survey showed 5% disagreed and 16% unsure. The post-treatment survey showed only 5% unsure and no one disagreeing.

The Math Beliefs Survey 2 (F-SMAS) also showed changes in students' beliefs about the usefulness of mathematics and its importance in their future. While the pre-treatment Math Beliefs Survey 2 (F-SMAS) showed that only 2% believed math to be useful and important to their future, this percent increased to 13% in the post-treatment survey. Thirty-nine percent reported that they did not expect to use math after high school in the pre-treatment survey, while only 13% reported this expectation on the post-treatment survey. In the post-treatment survey, the number of students reporting that math would be important in the future increased, while the number expecting not to use math at all decreased.

The attribution retraining I implemented could have had an influence on students' beliefs about their math ability and their beliefs that ability could be improved with effort. The modeling I did of productive attributions[12] could have helped more students connect effort to ability and increase their confidence in their own math ability. The *Effort and Achievement* lesson I gave (see Appendix A and Chapter 2, page 25) could have had an influence as well.

There are other practices I use in my classroom that could have influenced students' beliefs. Our classroom norms concerning self-talk[13] could have helped more students make the effort-ability connection and increase their confidence in their own math ability. We also use cooperative learning, group-worthy tasks (Lotan, 2003), and status treatments (Cohen, 1994), which are all instructional strategies that help improve students' confidence in their math ability. Another strategy I use is teaching in context. I try to connect the math concepts I present in class to their use in the world by addressing the questions my students typically ask such as "Why does this matter?" This strategy not only helps students care about what they are learning because the content is connected to their own personal experience, it helps them see math as useful and may be the reason more students reported an expectation for using math after graduation in the post-treatment survey than in the pre-treatment survey. Another thing that could have brought about the increase in students' beliefs about the usefulness of

[12] Examples: "You understand that now because you did your homework all week." And "Look at how hard your group is working! That must be why you have done such a great job on this project."
[13] Classroom norms require students to not refer to themselves as stupid or retarded and if they say they can't do something, they must add the word "yet" to their sentence indicating that with effort they can learn.

mathematics is that I talk to my classes about how I, and people I know, use math in their jobs and in their personal lives. Some students are amazed that math can be so useful.

A final possible reason for the changes I observed in students' beliefs is that the students in my study may be reporting what they think I want to hear. Our school and my classes are relatively small. I have had over half (58%) of the students in my study in classes in previous years. Twenty percent of the students in the study were also in my advisory group. At the time of the study, I had been talking about my work in the Master of Education program for over a year. The students in the study knew the study was important to me and may have been trying to please me.[14]

Summary of Findings

The students in my study displayed productive attributional styles, meaning they made attributions to effort that were internal, controllable, and unstable. These students believed in the power of effort to increase their academic achievement. This attributional style and belief in effort, according to the attribution theory research literature, should help these students be motivated and achieve academically. But clearly this is not the case for these students; something is getting in the way of their academic success. What may be limiting their achievement is their understanding of effort and what it really takes to achieve in school. While the students in my study believed in the connection between effort and achievement, they did not fully understand what that effort really means. In other words, they had not yet learned how to be students. Perhaps these

[14] I overheard the following discussion between two students while taking one of the surveys:
Student 1: "I'm just going to mark all A's."
Student 2: "Don't do that. This is important to Sharon."

students' inability to *be students* was what has prevented their attributions from motivating them to achieve.

I've always known that the students typically enrolled in my classes do not know what it takes to be successful students, and over my years of teaching, I've tried to teach them how to be students. This action research project, however, has caused me to look at my students' effort (or seemingly lack of effort) in a different way. Maybe what I have previously seen as lack of motivation is really this lack of understanding of effort. My students believe in effort and they believe they are trying. Now I must figure out how to help them understand the kind of effort it takes to be successful and enable their attributions to be effective.

Chapter 4: Conclusions

Research Findings and the Research Literature

I began this action research project hoping to investigate ways to improve the motivation of my students who come mostly from low SES homes. I know that if my students are not motivated to participate and learn, it matters little what I do in the classroom in terms of instructional strategies or curriculum. I know that motivation is the key to academic success (Middleton, 1995; Salvin, 1984; Vallerand, et al., 1992). In my literature review I briefly summarized *Attribution Theory* and how our attributions influence our confidence and motivation, and I discussed *Attribution Retraining* and how changing our attributions can improve our confidence and academic motivation (Weiner, 2010). In this action research project, I investigated the relationships between attributions, mathematics confidence and motivation, and achievement among my students and how attribution retraining might influence those relationships.

During my initial data collection, I learned that the students in my study lacked confidence in their mathematics ability. In two separate surveys and in class discussions, the majority of the students in my study rated themselves as low or very low in mathematics ability. This was consistent with the research literature I reviewed that found students from low SES families often lack confidence in their ability to be successful in mathematics (Chiu & Xihua, 2008; NRCIM, 2004).

Attribution Theory research literature suggested that attributional styles can predict achievement. Students with productive attributional styles had higher achievement than students with unproductive attributional styles[15] (Haynes et al., 2008; McClure et al., 2011; Weiner, 2010; Wentzel & Wigfield, 1998). From the research

[15] Students with productive attributional styles believe that causes of events are generally internal, controllable, and unstable (can be changed). Students with unproductive attributional styles believe that causes of events are generally external, uncontrollable, and stable (cannot be changed).

literature, I expected the students in my study (whose skills and high school credits earned were below grade-level) to exhibit unproductive attributions. My findings were not consistent with the research literature. The students in my study had productive attributions that should predict higher achievement than their academic records showed.

Not only did the students in my study have unexpected attributional styles inconsistent with the research literature, their attributions themselves turned out to be unexpected and inconsistent with the literature. The research literature suggested that typically low-achieving students tend to attribute the causes of their successes and failures to their ability, the difficulty of the task, or luck. Low-achieving students do not usually make attributions to effort (Haynes et al., 2008; McClure et al., 2011; Weiner, 2010; Wentzel & Wigfield, 1998). However, the students in my study tended to attribute their successes and failures to effort (or lack of effort) more often than any other cause, such as ability or luck.

Discovering that the students in my study had attributional styles and beliefs in effort that were inconsistent with the research literature lead me to investigate what these students really believed about effort. From this further investigation, I learned that these students had a very narrow definition of effort. They defined effort as “trying your best”. They also were unable to give examples of what effort looked like to them. I did not find anything in the Attribution Theory research literature I reviewed concerning students’ understanding of effort and whether there was a connection between attributions of effort and understanding of effort.

The students in my study participated in attribution retraining which included a lesson in Attribution Theory and a lesson in the connection between effort and achievement. The attribution retraining also included modeling productive attributions.[16] The students in my study displayed an increase in their confidence in their own math

[16] (See Chapter 2, page 25, for a more complete description of the attribution retraining implemented in my study.)

ability over the course of the study. This is consistent with attribution retraining research which showed evidence that students involved in attribution retraining displayed an increase in their confidence in their own mathematics ability (Haynes et al., 2008; McClure et al., 2011; Perry & Penner, 1990; Perry,et al., 2101; Schunk, 1991; Shores & Shannon, 2007; Struthers & Perry, 1996; Wilson & Linville, 1985).

Recommendations for Future Teaching Practice

My action research has shown me that there are things I need to do in my classroom to help my students be successful. I need to continue with the attribution retraining I started as part of this project; I need to find a way to teach my students about the effort necessary for success; and I need to re-evaluate my grading practices.

Attribution retraining. The attribution retraining I implemented during this study appeared to contribute to the increase in the confidence in math ability that was demonstrated by the students in the study. Because increased confidence can lead to greater achievement (Schunk, 1991), I plan to continue the practice of modeling productive attributions in my current classes and to implement the Attribution Theory and Effort versus Achievement lessons in future classes (see Chapter 2). I hope to continue to study Attribution Theory and learn more about how to conduct attribution retraining in my classroom. I feel that I have only just begun to understand these ideas and their power to improve student learning.

Effort training. This action research project has caused me to look at my students' effort (or seemingly lack of effort) in a different way. My findings showed that the students in my study believed that effort could lead to achievement and they believed that they were trying. When asked to rate their own effort the majority of the students in my study gave themselves high ratings. But what I observed was not the kind of effort that leads to achievement. I saw students who did not attend class regularly, did not complete assignments, and did not participate in class activities. What this means for me in my classroom is that I need to research and develop strategies for teaching high school students the kind of effort that will potentially lead to success. I envision this as an entirely new topic for a literature review and action research project. (See *Strategies for teaching effort* page 59.)

My grading practices. Several years ago, my school was involved in the High Schools that Work (HSTW) initiative. We applied to be a part of this initiative and were given state grant money to participate in professional development designed to improve the academic achievement of our students and increase our school's graduation rate. It was through HSTW that I was first formally introduced to *standards-based grading*, although my school had used different forms of this grading practice for years. In *standards-based grading*, a student does not complete a class or grade level until that student can show mastery of the objectives, or standards, set for that class or grade level (Guskey & Bailey, 2001; Marzano, 2006). In high school, this means that a student does not earn credit for a course until that student has demonstrated mastery of the standards for that course. I have been a proponent of *standards-based grading*, until this study; now I am not so sure.

My district is moving towards *standards-based grading*. The math department at the other high school in my district is currently using *standards-based grading* in all their math classes. If a student does not demonstrate mastery of the objectives for the course[17], that student does not pass the class and earns no credit for taking the course. The students must retake the course and again attempt to master the standards and earn credit. Homework and assignments are not collected or recorded. In my school, we have more flexibility when it comes to awarding credit. We are able to give partial

[17] Students are given multiple opportunities to demonstrate mastery of objectives by retaking assessments as many times as they choose.

credit during a grading period. Prior to this study, students in my classes earned half the available credit in a grading period through their daily classwork and participation and the other half of the available credit by meeting objectives. I started this combination of *standards-based grading* and a more traditional approach after discussions with teachers from the other high school. These teachers shared with me their frustration with students who will not do homework or other assignments because these things are not counted in their grade.

After my study, I have begun to reevaluate my grading practices. Is there a connection between grading practices and students' understanding of effort? Does a grade based completely or partially on mastery send students the message that effort doesn't matter? When things like participation, attendance, and assignments are not counted into a final grade, do students begin to believe that these things are not important? Or does the *standards-based grading* practice of multiple opportunities to show mastery send the message that increased effort does indeed lead to success?

These are questions I will continue to consider for my classroom as my district continues to stress *standards-based grading* and as I continue to research ways to bring effort training to my students. As with effort training I discussed above, I envision this as an entirely new topic for a literature review and action research project. (See *Grading policies and practices* page 60.)

Continued Research in My Classroom

One of the biggest limitations of my study was its short duration. Nine weeks is a very short time to expect changes and it is difficult to know if any changes that were observed would be lasting. I would like to continue to collect data and continue to investigate the relationships between attributions, mathematics confidence and motivation, and achievement among my students. Because of the short duration of this study I was able to look at only past achievement. I would like to also look at how attribution retraining might influence future achievement, especially the state *End-of-Course* test that is required of all students.

Areas of Future Action Research

My action research study has introduced me to several areas where I would like to see further research within the education research community. I would like to see research and development of attribution retraining lessons, development of strategies for teaching effort to high school students, research concerning the connection between effort and grading practices, and research concerning the attributional styles of high school students in different kinds of educational settings.

Attribution retraining lesson plans and research. As I mentioned in Chapter 1: *Introduction and Literature Review*, I found few studies that focused on the strategies that teachers might use to implement attribution retraining. Much of the attribution literature focused on measuring students' attributions, classifying those attributions, and tying those attributions to students' achievement. I found only two articles that focused on the strategies that teachers might use to help students change the patterns of attribution that prevent them from fully participating in classroom activities (Fulk & Mastropieri, 1990; McArthur, 2011).

Before implementing attribution retraining in my classroom for this study, I looked for lesson plans and was disappointed by how difficult it was to find them. Fulk and Mastropieri (1990) outlined steps for combining attribution retraining with math and reading comprehension strategies to improve student effort. This article was focused on elementary school students and teachers. McArthur (2011) provided a lesson on attribution retraining that was focused on college students in communication theory classes. These articles were helpful in planning my lessons and implementing the attribution retraining for my study, but I felt unsure if I was adapting these strategies appropriately for high school students.

Further research needs to be done on attribution retraining strategies and lessons need to be written for teachers to use at all grade levels. Studies of intervention strategies are essential in order for attribution retraining work to be done. Teachers need this information so that they can implement these strategies in their classrooms to help students form productive attributions that can lead to improved academic achievement.

Strategies for teaching effort. While reflecting on ways to help my students understand what effort really means, I went back to the research literature looking for strategies for teaching effort. From my brief review of effort literature and further consideration of the students in my study, I believe the problem lies in three areas where these students are deficient: study skills, work ethic, and ability to delay gratification. Study skills include note taking strategies, organizational skills, research skills, and time management (Cottrell, 2003). Work ethic is the “beliefs, values, and principles that guide the way individuals interpret and act upon their rights and responsibilities within the work context at any given time” (Miller & Coady, 1984, p. 5). Delayed gratification is “people's willingness to postpone receiving an immediate reward in order to gain additional benefits in the future” (Cheng, Shein & Chiou, 2012, p. 121). It is a combination of these three things (study skills, work ethic, and delayed gratification) that appears to me to be what is preventing my students from being able to demonstrate the effort needed to succeed.

In my brief review, the literature I found on study skills focused mostly on college students; the literature I found on work ethic focused on high school and college students in vocational and technical programs; and the literature on delayed gratification came from psychology literature and did not focus on education.

Further research needs to be done on all aspects of teaching effort—study skills, work ethic, and delayed gratification—in an academic setting not just a vocational or psychological setting. This kind of training could benefit students at all grade levels. But is this combination what my students are really missing? Their needs are so big. They need to learn everything about doing school: bringing a pencil to class, arriving on time, coming every day, paying attention, participating, putting the phone/music away, completing assignments and not losing them. Can these things be taught? Is there such a thing as "effort training"? Research needs to be done to determine what these students are missing and how to teach them to succeed.

Grading policies and practices. As part of the effort training research I described above, I would like to see research in the possible connection between students' understanding of effort and teachers' grading practices. Do students make a connection between what components of a class go into the final grade and the importance of those components to the students' success in the class? What kinds of grading practices would most enhance students' understanding of effort?

High school students without access to alternative programs. Every student in my study started their high school experience at a high school other than the one at which I currently teach. Some were overwhelmed by the large numbers of students at their previous high school. Many were failing and at risk for dropping out. Some were behind in credits due to illness, incarceration, family mobility, or homelessness. Some were expelled from their previous schools. All of the students in my study sought out an alternative high school experience or at least were willing to try something different when it was presented to them by peers, parents, academic advisors, or the court system. I wonder if there is a connection between these students' attributional styles (which are inconsistent with the research literature) and their willingness or ability to seek out or at least try something different. The students in my study had attributional styles that led them to believe that events in their lives were caused by things they could control and change. Did these attributional styles enable them to seek educational alternatives?

It would be valuable to see studies of high school students who are also behind their peers academically but did not seek educational options. What might their attributional styles be? Would these students have attributional styles that lead them to believe that events in their lives are caused by things that they can not control or change? Would these attributional styles prevent them from making changes in their lives that might lead to success?

Closing Comments

The purpose to this study was to investigate the relationships between attributions, mathematics confidence and motivation, and achievement among low SES high school students and how attribution retraining might influence those relationships. Through this action research project, I was hoping to come closer to understanding what I could do to motivate my students to participate in my math classes. I was hoping that attribution retraining might be part of the answer. Although the attribution retraining might have contributed to the increased confidence in mathematical ability of the students in my study, my findings revealed that these students had attributions that did not need to be *retrained;* what needed retraining was their understanding of effort and what it takes to be successful in school. Perhaps what I had always thought was lack of motivation is really lack of understanding of the kind of effort it takes to achieve academic success.

During my literature review, I learned that mathematics motivation is extremely complex. Through this action research project, I learned that it is much more complex than I originally thought, especially for low SES high school students. Mathematics motivation for low SES high school students is a very complicated puzzle, and attribution retraining is just one of the very small pieces.

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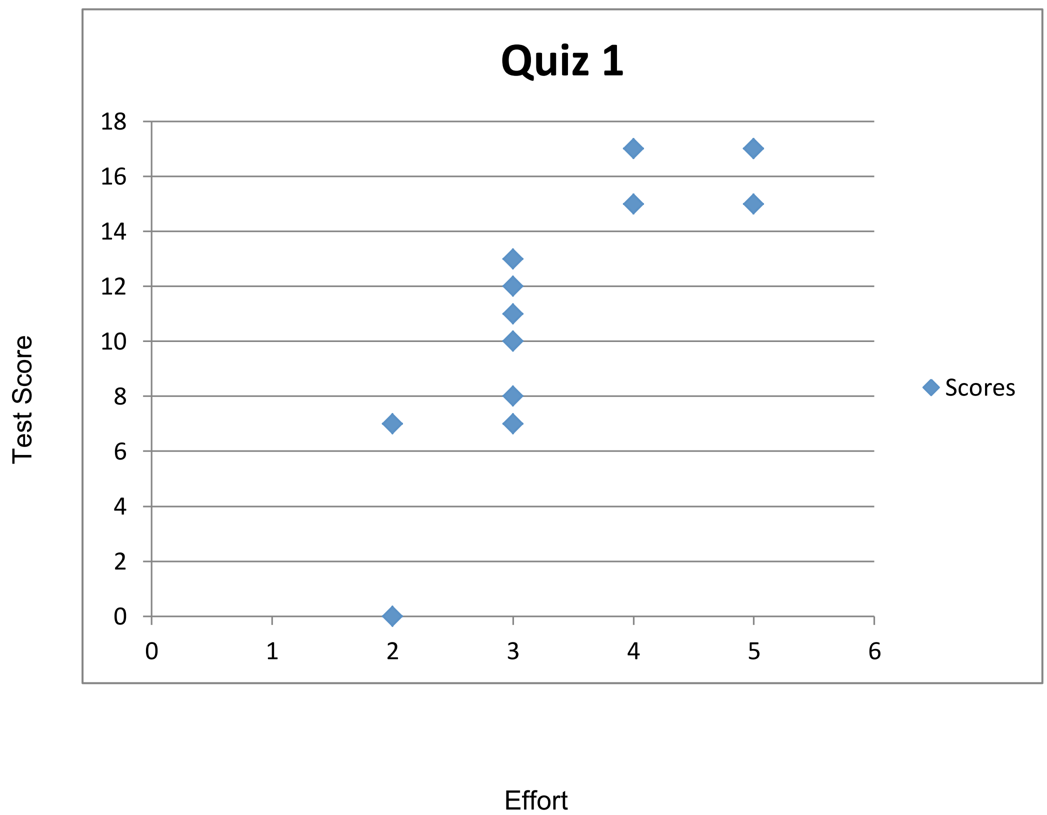
Appendix A

Algebra 1
Effort Versus Achievement



Appendix B

Attribution Lesson Plan

Lesson Introduction:
Show photos or describe situations that could have ambiguous causes Have students write down what is happening in each photo or situation.

Explain Attribution Theory:
1) Explain that Attribution Theory maintains that we seek to find causes for the things that happen in our lives and the lives of others.
2) Explain that when deciding why something happens, we make decisions that are usually, unconsciously based on dimensions of attributions. (Show **Attribution Theory** table while explaining dimensions.) Three of these dimensions are listed below:

Locus of control: Is the event internal or external?
Stability: Is the event permanent or temporary?
Responsibility: Is the event within your personal control, someone else's control or neither?

3) Ask students to share the causes of what is happening in the photos or situations. Have them fill in the **Attribution Theory** table with you as you discuss.
4) Refer back to the CDSII. Have students give causes for their success or failure. Have them fill in the **Quiz Success/Failure Attributions** table with you as you discuss.
5) Explain how attributions for learning often fall into four categories:

Effort
Ability
Task Difficulty
Luck

On the **Quiz Success/Failure Attributions** table, identify which causes fall into which category. Add attributions if some categories are missing.
6) Explain how attributions that are internal, self-controllable, and unstable lead to more motivation. Use the **Quiz Success Attributions** table and the **Quiz Failure Attributions** table to emphasis this idea. Discuss how we can change our thinking to more productive attributions and how our math norms are designed to help us do that.

Attribution Theory

Sample Attributions	Locus of Control (internal or external)	Stability (permanent or temporary)	Responsibility (within personal control)
Image 1:			
Image 2:			
Image 3:			

Quiz Success/Failure Attributions

Sample Attributions	Locus of Control (internal or external)	Stability (permanent or temporary)	Responsibility (within personal control)
Cause 1:			
Cause 2:			
Cause 3:			
Cause 4:			

Quiz Failure Attributions

Sample Attributions	Locus of Control (internal or external)	Stability (permanent or temporary)	Responsibility (within personal control)
Cause 1: Ability I failed the quiz because I am not smart.	Internal	Stable	Uncontrollable by me or others
Cause 2: Task Difficulty I failed the quiz because the class is too hard.	External	Stable	Uncontrollable by me, others can control this
Cause 4: Luck I failed the quiz because I am no good at taking quizzes	Internal	Stable	Uncontrollable by me
Cause 3: Effort I failed the quiz because I didn't pay attention in class.	Internal	Unstable	Controllable by me

Quiz Success Attributions

Sample Attributions	Locus of Control (internal or external)	Stability (permanent or temporary)	Responsibility (within personal control)
Cause 1: Ability I passed the quiz because I am smart.	Internal	Stable	Uncontrollable by me or others
Cause 2: Task Difficulty I passed the quiz because the class is too easy.	External	Stable	Uncontrollable by me, controllable by others
Cause 4: Luck I passed the quiz because I got lucky.	External	Unstable	Uncontrollable by me
Cause 3: Effort I passed the quiz because I paid attention in class, did my homework.	Internal	Unstable	Controllable by me

Appendix C

Math Beliefs Survey 1

1) Rate your ability in math: 5 4 3 2 1
High Low

2) Rate your motivation to learn math: 5 4 3 2 1
High Low

3) Rate your interest in learning math: 5 4 3 2 1
High Low

4) Rate your understanding of the state mathematics graduation requirements: 5 4 3 2 1
High Low

5) How much do you agree or disagree with these statements:

a) Intelligence is something you are born with and it will never change:

5 4 3 2 1
Agree Disagree

b) Ability in math is something you are born with and it will never change:

5 4 3 2 1
Agree Disagree

c) Math ability can be improved:

5 4 3 2 1
Agree Disagree

d) Math ability can be improved through effort:

5 4 3 2 1
Agree Disagree

Appendix D

Math Beliefs Survey 2
Modified Fennema-Sherman Mathematics Attitude Scales (F-SMAS)

Using this scale will help you and me find out how you feel about yourself and mathematics.

Below is a series of sentences. You are to mark your answer by telling how you feel about them.

As you read the sentence, you will know whether you agree or disagree. If you strongly agree, circle A after Number 1. If you agree, but not so strongly, or you only "sort of" agree, circle B. If you disagree with the sentence very much, circle E for strongly disagree. If you disagree, but not so strongly, circle D. If you are not sure about a question or you can't answer it, circle C.

Do not spend too much time with any statement, *but be sure to answer every statement.*

Work quickly, but carefully.

There are no "right" or "wrong" answers. The only correct responses are those that are true *for you*. Whenever possible, let the things that have happened to you help you make a choice.

1. I am sure that I can learn math. A B C D E
2. My teachers have been interested in my progress in math. A B C D E
3. Knowing mathematics will help me earn a living. A B C D E
4. I don't think I could do advanced math. A B C D E
5. Math will not be important to me in my life's work. A B C D E
6. Males are not naturally better than females in math. A B C D E
7. Getting a teacher to take me seriously in math is a problem. A B C D E
8. Math is hard for me. A B C D E
9. It's hard to believe a female could be a genius in mathematics. A B C D E
10. I'll need mathematics for my future work. A B C D E
11. When a woman has to solve a math problem, she should ask a man for help. A B C D E
12. I am sure of myself when I do math. A B C D E
13. I don't expect to use much math when I get out of school. A B C D E
14. I would talk to my math teachers about a career that uses math. A B C D E
15. Women can do just as well as men in math. A B C D E
16. It's hard to get math teachers to respect me. A B C D E
17. Math is a worthwhile, necessary subject. A B C D E
18. I would have more faith in the answer for a math problem solved by a man than a woman. A B C D E
19. I'm not the type to do well in math. A B C D E
20. My teachers have encouraged me to study more math. A B C D E
21. Taking math is a waste of time. A B C D E

22. I have a hard time getting teachers to talk seriously with me about math. A B C D E
23. Math has been my worst subject. A B C D E
24. Women who enjoy studying math are a little strange. A B C D E
25. I think I could handle more difficult math. A B C D E
26. My teachers think advanced math will be a waste of time for me. A B C D E
27. I will use mathematics in many ways as an adult. A B C D E
28. Females are as good as males in geometry. A B C D E
29. I see mathematics as something I won't use very often when I get out of high school. A B C D E
30. I feel that math teachers ignore me when I try to talk about something serious. A B C D E
31. Women certainly are smart enough to do well in math. A B C D E
32. Most subjects I can handle OK, but I just can't do a good job with math. A B C D E
33. I can get good grades in math. A B C D E
34. I'll need a good understanding of math for my future work. A B C D E
35. My teachers want me to take all the math I can. A B C D E
36. I would expect a woman mathematician to be a forceful type of person. A B C D E
37. I know I can do well in math. A B C D E
38. Studying math is just as good for women as for men. A B C D E
39. Doing well in math is not important for my future. A B C D E
40. My teachers would not take me seriously if I told them I was interested in a career in science and mathematics. A B C D E
41. I am sure I could do advanced work in math. A B C D E
42. Math is not important for my life. A B C D E
43. I'm no good in math. A B C D E
44. I study math because I know how useful it is. A B C D E
45. Math teachers have made me feel I have the ability to go on in mathematics. A B C D E
46. I would trust a female just as much as I would trust a male to solve important math problems. A B C D E
47. My teachers think I'm the kind of person who could do well in math. A B C D E

Doepken, D., Lawsky, E., Padwa, L., Modified Fennema-Sherman Attitude Scale. Retrieved July 10, 2011 from http://www.woodrow.org/teachers/math/gender/08scale.html

Appendix E

Attributional Style Survey
Attributional Style Questionnaire for Adolescents (ASQ-A)

Answer the following questions for each situation below:

Situation #:__________
1) Imagine the situation described is happening to you. Write down the most important cause of the situation.

2) Is the cause you have written due to something about yourself, or something about other people or circumstances?

Totally due to other people or circumstances 1 2 3 4 5 6 7 Totally due to me

3) Is the cause you have written something others people can change or control?

Other can totally change or control 1 2 3 4 5 6 7 Others cannot change or control

4) In the future, would the cause you have written be present again?

Will never again be present 1 2 3 4 5 6 7 Will always be present

5) Is the cause you have written something you can change or control?

I can totally change or control 1 2 3 4 5 6 7 I cannot change or control

Situations:

1. Your classes are going badly.
2. You are overwhelmed with missing assignments.
3. You are worried about your upcoming check-in.
4. You got a bad progress report.
5. You have been suspended from school.
6. You have received a referral at school.
7. You are thinking about dropping out.
8. You cannot do everything that people expect of you.
9. Your parent is angry, shouts at you , and punishes you for something that has happened.
10. You have been unable to sleep well for several nights.
11. You have a serious conflict or disagreement with a parent.
12. You often feel tired and rundown.
13. You have a problem with a girlfriend/boyfriend.
14. You feel uncomfortable in a situation.
15. A person you would like to be friends with does not want to be your friend.

Rodríguez-Naranjo, C., & Caño, A. (2010). Development and validation of an attributional style questionnaire for adolescents. *Psychological Assessment*, 22(4), 837-851

Appendix F

Quiz Reflection Survey
Revised Causal Dimension Scale (CDSII)

Describe your performance on last week's quiz.

Do you feel you were successful?

What do you think caused you to perform the way you did?

Think about the cause or causes you have written above. The items below concern your impressions or opinions of this cause or causes. Circle one number for each of the following questions.

Is the cause(s) something:

1. Something about you	9 8 7 6 5 4 3 2 1	something about others or the situation
2. Other people can control or control	9 8 7 6 5 4 3 2 1	other people cannot control or change
3. Permanent and unchangeable	9 8 7 6 5 4 3 2 1	temporary and could change
4. You can control or change	9 8 7 6 5 4 3 2 1	you cannot control or change

McAuley, E., Duncan, T. E., & Russell, D. W. (1992). Measuring causal attributions: The revised causal dimension scale (CDSII). *Personality and Social Psychology Bulletin*, 18(5), 566-573.

Appendix G

The surveys used in this study have been developed and tested for validity by several different researchers in a number of different studies. Some of these studies are listed below.

Attributional Style Questionnaire for Adolescents (ASQ-A)

Higgins, N. C., & Hay, J. L. (2003). Attributional style predicts causes of negative life events on the attributional style questionnaire. *Journal of Social Psychology*, 143(2), 253.

Peterson, C. (1991). On shortening the expanded attributional style questionnaire. *Journal of Personality Assessment*, 56(1), 179

Peterson, C., Semmel, A., vonBaeyer, C., Abramson, L.Y., Metalsky, G. I., & Seligman, M.E.P. (1985). The attributional style questionnaire. *Cognitive Therapy and Research*, 6, 287-300.

Rodríguez-Naranjo, C., & Caño, A. (2010). Development and validation of an attributional style questionnaire for adolescents. *Psychological Assessment*, 22(4), 837-851

Modified Fennema-Sherman Mathematics Attitude Scales (F-SMAS)

Doepken, D., Lawsky, E., Padwa, L., Modified Fennema-Sherman Attitude Scale. Retrieved July 10, 2011 from http://www.woodrow.org/teachers/math/gender/08scale.html

Fennema, E., & Sherman, J.A. (1976), Fennema-sherman mathematics attitudes scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for research in mathematics education,* 7(5), 324-326.

Sachs, J., & Leung, S. (2007). Shortened versions of fennema-sherman mathematic attitude scales employing trace information. *Psychologia: An International Journal of Psychology in the Orient*, 50(3), 224-235. doi:10.2117/psysoc.2007.224

Revised Causal Dimension Scale (CDSII)

McAuley, E., Duncan, T. E., & Russell, D. W. (1992). Measuring causal attributions: The revised causal dimension scale (CDSII). *Personality and Social Psychology Bulletin*, 18(5), 566-573.

Appendix H

Class Discussion Questions

1) Raise your hand if:

You are good at math.

You like math.

People in your family are good at math.

People in your family like math.

2) What makes some people good at math and others not good?

3) Can you get better at math if you aren't good at it right now?

4) Is there such a thing as a "math gene", "natural math ability", etc.

5) What about effort? Does trying make any difference?

6) How do you see yourself using math when you graduate?

7) How confident are you that you will be able to meet the math requirements for high school graduation?