Teachers' Attitude toward Mathematics and its Impact on Students

Eastern Washington University
CHAPTER 1: Introduction

Background

Mathematics is a discipline that often evokes emotional responses in people. Previous experiences with mathematics and individual's beliefs about math influence how they respond when presented with a mathematical task. Without intervention, people tend to react consistently with either feelings of enthusiasm and interest, anxiety and apprehension, or disinterest and detachment when confronted with math-related activities. Emotional responses, beliefs, and behaviors connected to math are the three ingredients that make-up an individual's attitude toward mathematics. Frequently individuals cite experiences in math classes or with specific math teachers as the source of their positive, negative, or neutral attitude toward mathematics. The cumulative effect of our academic experiences with mathematics contributes to the formation of our general attitude toward math. It is therefore necessary for mathematics teachers to be aware of how their attitude (emotions, beliefs, and behaviors) toward mathematics affects students' motivation, interest, and achievement in the subject.

Working with students both at the beginning of their academic careers in preschool through elementary and then also at the end of them in high school and college has allowed me to witness the formation and consequence of these attitudes toward mathematics. In my informal conversations with students, both young and old, I often discover that mathematics educators were integral to the formation of their opinions regarding what mathematics is, how it is learned, and their capacity for perseverance in the subject. Since I have always been a
student with an unbounded interest in the discipline of mathematics, I also have reflected on
my own experiences. In my recollections, there is always an enthusiastic, supportive, and
challenging teacher that inspired and encouraged me to pursue my interest in math. This, in
turn, makes me wonder, what if I had not had teachers that were interested, dedicated, and
skilled in mathematics. Would I have been as motivated to achieve an understanding of difficult
mathematical concepts and persist even when I struggled? From these experiences, an
awareness of and curiosity about the potential effect my love of mathematics can have on
students’ developing attitudes and resulting achievement in math has evolved. In teaching
math what impact, if any, can be made by a teacher’s disposition toward the subject?

Significance of this Study

Teachers serve as mentors and potential role models to their students and as such have
a responsibility to be aware of how their attitude towards mathematics can influence their
students. Teachers, among other significant adults in children’s lives, maintain an important
role in enhancing academic motivation and achievement (Levpušček & Zupančič, 2009). Without
mathematics teachers that are zealous, engaging, and creative, students may form opinions of
the subject that are inaccurate and misguided. Students’ perceptions of their math teachers’
attitude toward math result in significant differences in their motivation and achievement in
mathematics (Levpušček & Zupančič, 2009).

Various research studies have been conducted in the past 30 years in an attempt to
identify the components of teachers’ positive and negative attitudes toward mathematics
(Beilock, Gunderson, Ramirez, and Levine, 2010; Brady & Bowd, 2005; Henderson & Rodrigues,
2008; Isiksal, Curran, Koc, & Askun, 2009; Jackson & Leffingwell, 1999; Kolstad, Hughes, & Briggs, 1994; Philippou & Christou, 1998), how these attitudinal components affect student outcomes in mathematics (Bahr, Balzotti, & Eggett, 2009; Beilock et al., 2010; Brady & Bowd, 2005; Burks, Heidenberg, Leoni, & Ratliff, 2009; Cornell, 1999; Henderson & Rodrigues, 2008; Isiksal et al, 2009; Jackson & Leffingwell, 1999; Kolstad et al., 1994; Philippou & Christou, 1998), and what can be done to change and improve teachers' attitudes and ultimately student outcomes in math (Bahr et al., 2009; Beilock et al., 2010; Burks et al., 2009; Cornell, 1999; Henderson & Rodrigues, 2008; Isiksal et al., 2009; Jackson & Leffingwell, 1999; Kolstad et al., 1994; Kukla-Acevedo, 2009; Philippou & Christou, 1998; Teague & Austin-Martin, 1981). The affective aspects of mathematics education have received increasing attention over the years due to emergent research supporting its significance in predicting students' mathematics achievement.

According to reports from the National Assessment of Educational Progress (NAEP) on U.S. students' mathematics achievement for 2009, over half of our students in the 4th and 8th grades are below the proficient level in mathematics, and as students progress through school the percentage that fall below proficient grows. This happens because of the cumulative nature of mathematics skills and content. A lack of proficiency in the early elementary grades can lead to years of remediation that make it difficult for students to catch back up. It would be interesting to investigate whether the states that are well below the national average in mathematics achievement correlate with a large population of teachers with strong negative attitudes toward mathematics.
In my own career, this research will help me be a leader and mentor in mathematics education by allowing me to be more aware of my own attitudes toward math and how they affect my teaching of the subject. I can facilitate other educators' awareness of the unintentional effects their own attitudes toward mathematics have on their ability to be effective math teachers, and offer professional development opportunities that cater to alleviating these negative attitudes and improving mathematics instruction.

Area of Focus

The purpose of this project is to investigate teachers' attitudes toward mathematics by researching math-related emotional responses, beliefs, and behaviors that teachers commonly experience. In particular, I want to examine how a teacher's positive or negative attitude toward math impacts students' motivation and achievement in the subject. My goal is to identify math teachers' effective and ineffective instructional practices that are a direct result of their attitude (emotions, beliefs, and behaviors) toward mathematics. As well, I will provide constructive strategies and techniques for addressing and changing teachers' attitudes toward math that negatively impact students' learning.

Research Questions

1. What are some of the researched emotional, behavioral, and belief related components of teachers' attitude toward mathematics?

2. Which emotional responses, beliefs, and behaviors pertaining to mathematics have a positive impact on students?
3. Which emotional responses, beliefs, and behaviors pertaining to mathematics have a negative impact on students?

4. How can teachers address / change their emotional responses, beliefs, and behaviors pertaining to math that negatively impact students' motivation and achievement in mathematics?

5. How can teacher preparation programs, actions of administrators, and professional development opportunities enhance / encourage emotional responses, beliefs, and behaviors in teachers that positively impact students' motivation and achievement in mathematics?

Possible Limitations

Some limitations of my research into how teachers' attitudes toward mathematics impact students and how we can improve them:

- Sustainability of observed effects – The research often cites changes in teachers' attitudes towards mathematics as a result of the conditions in the study, but are these changes in attitude permanent or temporary.

- Restricted samples – The samples I am able to evaluate and analyze in my research are limited to the samples that have been previously studied, and the limitations inherent in their sample designs therefore affect the generalizability of my conclusions.
Definitions of Terminology

1. **Attitude** – A complex mental state involving emotional responses, beliefs, and dispositions to behave in certain ways toward something (Princeton University, 2006).

2. **Math Self-esteem** – An emotional response of trust or confidence in one’s ability to learn and perform tasks in mathematics (Isiksal et al., 2009).

3. **Math Anxiety** – A negative emotional response to math or the prospect of doing math described as a fear of mathematics that hinders one’s ability to manipulate and solve math problems within a variety of everyday life and academic contexts (Beilock et al., 2010; Gresham, 2009).

4. **Math Self-efficacy** – Math-specific beliefs about one’s ability or competency to perform mathematical tasks, resulting in future performance expectations (Gresham, 2009).

5. **Gender Ability Beliefs** – Beliefs that one sex is inherently better at something than the other. For example, a traditionally held gender ability belief regarding mathematics is “...boys are good at math and girls are good at reading” (Beilock et al., 2010).

6. **Math Utility** – Beliefs about the usefulness of mathematics to everyday life.

7. **Instrumental Understanding** – Belief that mathematics competency requires knowing the rules of math without knowing the reasons behind them, necessitating memorization and skill-and-drill exercises (Skemp, 2006).
8. Relational Understanding – Belief that mathematics competency requires knowing what to do and why in math, enables methods to be adapted to novel problems and situations (Skemp, 2006).

9. Math Avoidance – Conscious or unconscious defensive behavior by which a person tries to escape and avoid mathematical situations and anxiety to protect self-worth.

10. Math Achievement – Level of attainment in any or all mathematics skills, usually estimated by performance on a test, number of math content hours, or GPA.

11. Reform-based Pedagogy – Instructional behaviors motivated by beliefs that math is a web of connected concepts, relational understanding is preferable to instrumental understanding, math is a creative and natural human activity, there are many ways to arrive at the correct solution, the process is more important than the answer, we learn best when we construct our knowledge, student-directed activity is more beneficial than teacher-directed, and real-world contexts make math meaningful and motivating to students (Bahr et al., 2009).

12. Traditional Pedagogy – Instructional behaviors motivated by beliefs that math requires memorization of facts and procedures, instrumental knowledge is sufficient for understanding, math is a fixed and unchanging discipline, there are set algorithms for solving every math problem, getting the correct final answer is most important, we learn best from passive absorption of clear, step-by-step demonstrations of procedures, teacher-directed activity is more beneficial than student-directed, and textbooks provide the context for mathematics learning.
13. Mathematics Methods Course – A class designed to introduce content and methods for effective teaching of mathematics.
Chapter 2: Literature Review

There is an increasing amount of research on the affective aspects of mathematics education due to findings that indicate attitudes toward mathematics have a substantial influence on mathematics instruction and learning. In the education of children, it is important for teachers to be aware of the significant impact and consequence their attitudes can have on students. According to Princeton University’s WordNet 3.0 (2006), attitudes are complex mental states involving emotional responses, beliefs, and dispositions to behave in certain ways toward something. A well supported theory of attitude structure in psychology is the ABC model (affect, behavior, and cognition). Affect refers to gut reactions or emotional responses, behavior includes overt actions and covert intentions, and cognition is constituted by beliefs and opinions. Together they constitute three distinct components of attitude (Breckler, 1984).

Teachers’ attitudes toward mathematics both overtly and covertly influence the classroom atmosphere by affecting their emotional responses, beliefs, and behaviors related to math. In review of the literature, I will inventory the emotional responses, beliefs, and behaviors identified as outcomes of teachers’ attitudes toward mathematics, and cite which outcomes have a positive or negative effect on students’ achievement in math. In conclusion, I will address how teachers can manage and reform attitudes toward math that negatively impact students’ mathematics achievement, and mention what preparatory programs, actions of administrators, and professional development opportunities can impart in the development and support of teacher attitudes that have a positive impact on students.
Teachers' Attitude toward Mathematics

Measureable evidence of a teacher's attitude toward math can be revealed by their emotional responses toward mathematics, beliefs about mathematics, and behaviors. In order to research and study teachers' attitudes toward math, emotional responses, beliefs, and behaviors must be quantified and recorded. Quantifying these emotions, beliefs, and behaviors has required researchers to develop reliable and valid surveying instruments as well as interview and observation coding procedures. From the data collected by these surveys, interviews, and observations, researchers can infer a teacher's overall attitude toward math. The collected data is statistically analyzed to measure and evaluate which math-related emotions, beliefs, and behaviors correlate with various student outcomes.

Emotional Responses toward Mathematics. Repeated emotional responses to mathematics contribute to the formation of an individual's overall schema of mathematics (Philippou & Christou, 1998). Without intervention, these emotional responses toward mathematics contribute to the formation of enduring and permanent attitudes toward the subject. Prevalent emotional responses toward math felt by teachers are like/dislike of mathematics, math anxiety, and self-esteem related to math. These emotional factors have been found to impact students' math achievement.

By making use of various self-rating scales used to measure emotional responses toward math, research has concluded that the majority of in-service and pre-service teachers either like or dislike mathematics (Kolstad, Hughes, & Briggs, 1994; Philippou and Christou, 1998). The rarity of neutral responses on these scales indicates how polarized teachers' feelings about
mathematics are. In other studies, pertaining to math anxiety, average scores on the Mathematics Anxiety Rating Scale (MARS) and Abbreviated Mathematics Anxiety Scale (AMAS) suggest a high proportion of American female elementary pre-service teachers harbor some level of anxiety related to mathematics (Brady and Bowd, 2005; Isiksal, Curran, Koc, & Askun, 2009). These findings do not apply consistently to their male counterparts. In exploring teachers' self-esteem connected to math, results from Henderson and Rodrigues (2008) show that approximately half of the participating pre-service teachers, including highly qualified ones, lack feelings of self-esteem related to mathematics. The self-esteem teachers feel when they are teaching mathematics impacts students' motivation to achieve in math (Burks, Heidenberg, Leoni, & Ratliff, 2009).

**Beliefs about Mathematics.** Beliefs about mathematics affect teachers' attitudes toward math. Teachers' beliefs about math utility, whether effective math instruction requires instrumental or relational understanding, and the difficulty or ease of mathematics have been shown to impact students' math achievement. Teachers' math self-efficacy and gender ability beliefs have also been found to impact student outcomes.

Teachers' beliefs about the utility of mathematics are often found to correlate with either a more positive or negative attitude toward the subject (Philippou & Christou, 1998). For example, a teacher who believes that math has little use in everyday life would tend to have a more negative attitude about the subject. Math utility beliefs affect teachers' motivation to teach and learn mathematics, and as a result, students' motivation to achieve in math. Teachers tend to approach mathematics teaching and learning in either an instrumental or
relational way based on their beliefs about the nature of mathematics. They consequently
deem math to require memorization of procedures and rules without meaning, or knowing
what to do and why based on foundational conceptions of underlying mathematical structures
and strategies that make sense (Skemp, 2006). These teacher methodology beliefs have been
cited by students’ as contributing to their overall attitudes toward math (Cornell, 1999; Jackson
& Leffingwell, 1999; Levpušček & Zupančič, 2009). Teachers’ beliefs about the difficulty or ease
of mathematics also impact students’ motivation and achievement in math. Whether a teacher
believes math concepts are easy or hard effects how much explanation, remediation, review,
and patience they include during instructional time. The presence or lack of extra help and time
to understand math is frequently mentioned in students’ recollections of contributing factors to
their positive or negative outlook on math (Cornell, 1999; Jackson & Leffingwell, 1999).

Teachers’ math self-efficacy beliefs are also a result of their attitude toward math
(Henderson & Rodrigues, 2008; Philippou & Christou, 1998). If teachers believe in their
competence and capacity to successfully teach mathematics to their students, they are better
able to be helpful educators who take instructional risks in the classroom and more frequently
incorporate best practices in their mathematics lessons (Guskey, 1988). Teachers’ gender ability
beliefs pertaining to mathematics influence students’ desire to achieve in math. Studies reveal
that teachers who believe that one sex is inherently better at math than the other negatively
affect female students’ achievement in math (Beilock, Gunderson, Ramirez, & Levine, 2010;
Jackson & Leffingwell, 1999).
Teachers' Behaviors. Teachers' math-related behaviors and personal math achievement are influenced by their attitude toward mathematics (Cornell, 1999; Jackson & Leffingwell, 1999; Philippou & Christou, 1998). Behaviors of teachers include math avoidance, math pursuit, and instructional behaviors in the classroom which can all affect students' success or motive in math. Teachers' personal math achievement also impacts their attitude toward mathematics, and consequently, students' achievement.

Math avoidance and math pursuit are conscious or unconscious behaviors that are influenced by the recurrence of negative or positive math-related experiences (Brady & Bowd, 2005). People, including teachers, generally avoid stimuli and situations that cause them to feel negatively, and conversely pursue and seek out experiences that invoke positive responses. This fact is no different in the realm of mathematics and math instruction. Teachers engage in instructional behaviors that support students' understanding and achievement in mathematics or hinder it by increasing students' avoidance behaviors in math (Turner et al., 2002). Indicators of teachers' pursuit of mathematics, such as math achievement, number of math content hours, and GPA, have been found to significantly impact student achievement in math (Kukla-Acevedo, 2009). A teacher's level of achievement in mathematics also affects how they respond to math and what they believe about math which has consequences for students in the classroom (Brady & Bowd, 2005). Teachers' success or failure in formal mathematics education experiences contribute to how comfortable and confident they are teaching mathematics (Brady & Bowd, 2005) which impacts student achievement.
Impact of Teachers’ Attitude toward Math

The emotional responses, beliefs, and behaviors that comprise a teacher’s attitude towards mathematics have been investigated further to determine which of them positively or negatively impact student achievement in mathematics. This has been accomplished by comparing teacher characteristics regarding attitude toward math with student data, including scores and interview responses over time. The components of a teacher’s attitude toward math that correlate with positive student outcomes will be discussed first, then the components of a teacher’s attitude towards math that correlate with negative student outcomes will be addressed.

Emotional Responses that have a Positive Impact. Teachers’ emotional responses to mathematics that positively impact students’ math achievement include enthusiasm for mathematics, low math anxiety, and high math self-esteem. A classroom environment that generates enthusiasm for math most certainly has an enthusiastic mathematics teacher behind it. A teacher’s enthusiasm for mathematics is internalized by their students (Jackson & Leffingwell, 1999). Students’ enthusiasm for mathematics mirrors that of their teacher and motivates them to achieve in math. Students of enthusiastic teachers are observed to be more often on-task (Bettencourt, Gillett, Gall, & Hull, 1983). Teachers with low math anxiety consistently report more positive attitudes toward math, including greater enjoyment of math and higher self-esteem related to math (Brady & Bowd, 2005; Isiksal, Curran, Koc, & Askun, 2009). When teachers have high self-esteem related to math they are less dependent on always having the right answers and are not afraid to deviate from the textbook (Burks, Heidenberg,
Leoni, & Ratliff, 2009; Henderson & Rodrigues, 2008). These positively oriented emotional responses to math contribute to a more positive overall attitude toward math, and consequently, teachers that are more motivated and effective at learning and teaching mathematics.

_Beliefs that have a Positive Impact._ Teachers who believe that math is useful to everyday life and that effective math instruction requires relational understanding positively impact students’ achievement in math. Teachers with high math self-efficacy and a belief that math ability is gender neutral also affect student achievement positively. Teachers who believe that math is useful to their lives tend to have more positive attitudes toward math (Philippou & Christou, 1998). When teachers appreciate how math is relevant to their life and classroom goals, and also to the ambitions of their students, teachers are more motivated to effectively teach math. Teachers who believe effective math instruction requires relational understanding often apply constructivist principles to lessons which positively affect students’ math achievement (Neal, 2004). Teachers with high math self-efficacy beliefs tend to engage in practices, such as cooperative, student-directed instruction, associated with high achievement gains for students (Philippou & Christou, 1998). Teachers with high math self-efficacy generally have lower math anxiety (Gresham, 2009). Teachers that believe that, “All students can do math,” impart this view to their students, especially to girls, which encourages them to work hard and strive to achieve in math (Beilock, Gunderson, Ramirez, & Levine, 2010).

_Behaviors that have a Positive Impact._ Behaviors of effective math teachers are commonly correlated to positive attitudes toward math. Teaching performance and attitude
toward math are found to be positively correlated; as teachers' attitude toward mathematics improves so does their mathematics teaching performance (Teague & Austin-Martin, 1981). Some of the teacher behaviors mentioned to positively impact students are the use of reform-based pedagogy and connected, indirect instructional techniques. Additionally, teachers who are academically supportive, implement error diagnosis, and employ remediation help students succeed in math. Finally, teachers who demonstrate high math competency and achievement, as measured by GPA, number of math content hours, and math content test scores, positively impact student outcomes in math (Kukla-Acevedo, 2009).

Implementation of reform-based pedagogy results in meaningful and substantive achievement gains as measured by both traditional and alternative assessments (Bahr, Monroe, Balzotti, & Eggett, 2009). Reform-based pedagogy centers on students constructing knowledge of mathematics in meaningful, real-world contexts through mathematical tasks, discussions, and proofs. Teachers who emphasize mathematics' connection to everyday problems, tasks, and requirements make math meaningful and motivating to students. Teachers who include hands-on activities and student-directed lessons in their math instruction do this as well (Cornell, 1999). Teachers who help students remediate misunderstandings provide students with multiple opportunities to demonstrate competencies, model thinking processes, and allow time for students to share problem-solving strategies, provide motivational support for their students (Turner et al., 2002). It is beneficial for students to see math teachers struggle or not have the answer to a problem readily available because it allows students to witness critical reasoning and problem-solving skills (Burks, Heidenberg, Leoni, & Ratliff, 2009). Students
benefit from watching teachers reason and problem-solve mathematically because it models effective strategies for finding solutions (Burks, Heidenberg, Leoni, & Ratliff, 2009).

Students who perceive their math teachers to be more academically supportive achieve greater mastery of math concepts (Lévpunče & Župančič, 2009). Offering students additional reinforcement and extra time on topics they are struggling with or are feeling anxious about can help increase student success and reduce negative math-related experiences (Jackson & Leffingwell, 1999). For example, teachers can provide written or verbal supplemental reviews, tutoring sessions, and alternative testing options. Examining and analyzing student work for systematic errors helps teachers provide appropriate and focused instructional experiences that address their specific misunderstandings. By remediating student errors through focused instruction, teachers impact students' achievement positively.

Teachers' success and high achievement in mathematics correlate with more positive attitudes toward mathematics and lower math anxiety which subsequently affects students' learning (Brady & Bowd, 2005; Cornell, 1999). Similarly, teachers need to create instructional experiences that allow every student to be successful in math, since these affirmative encounters with math contribute to students' formation of positive attitudes toward math (Ma & Xu, 2004). Goldhaber and Brewer (1997) found that teachers who hold a BA or MA in mathematics positively affect students' math achievement when compared to teachers without a mathematics degree. Even more significantly, effects of teachers' overall GPA, math education GPA, and increased numbers of math content hours directly resulted in more effective math teachers and increased student achievement over time (Kukla-Avevedo, 2009).
Emotional Responses that have a Negative Impact. Some emotional responses of teachers to math that negatively impact students are dislike of mathematics, high math anxiety and low math self-esteem. Teachers’ dislike of mathematics can have a destructive impact on students’ conceptions of math (Philippou & Christou, 1998). Apathy and indifference toward mathematics are teacher attributes cited by students as reasons for lacking motivation in math class and disliking mathematics in general (Burks, Heidenberg, Leoni, & Ratliff, 2009; Philippou & Christou, 1998). Teachers who have high math anxiety are often afraid of mathematics and avoid math related activities, including developing and planning effective math lessons and instruction (Beilock, Gunderson, Ramirez, & Levine, 2010; Isiksal, Curran, Koc, & Askun, 2009; Philippou & Christou, 1998). The higher a female teacher’s math anxiety, the lower their female, but not male, students’ math achievement, and the more likely their female students’ ability beliefs fall along traditional gender lines (Beilock, Gunderson, Ramirez, & Levine, 2010).

More than half of the pre-service teachers surveyed in Henderson and Rodrigues (2008) have little or no confidence pertaining to their mathematical abilities. Teachers with low self-esteem in math often have trouble teaching it effectively because they lack the confidence to take instructional risks and deviate from prescribed textbooks during lessons promoting a narrow perspective of intended learning (Brady & Bowd, 2005; Henderson & Rodrigues, 2008).

Beliefs that have a Negative Impact. Teachers’ beliefs about mathematics that have been shown to negatively impact students’ learning include math is useless to everyday life, effective math instruction requires an instrumental approach, and math is easy. Teachers’ who have low math self-efficacy and a gender bias view of math ability also negatively impact student outcomes. When teachers do not acknowledge the usefulness of mathematics, they are
not motivated to teach it and consequently create an attitude of indifference in their students, who lack an understanding of the real-world applications of math. Teachers who believe math requires only instrumental knowledge tend to include a lot of skill-and-drill exercises and memorization of procedures which lead students to the belief that this is the nature of mathematics (Cornell, 1999). When teachers' act as though they believe that mathematical concepts and algorithms are easy and self-explanatory, they offer limited explanations and remediation which can lead frustrated students to failure in math (Cornell, 1999). Teachers' low math self-efficacy beliefs are associated with negative attitudes towards math which can be transferred to students (Philippou & Christou, 1998). Twenty to forty percent of in-service and pre-service teachers in Austin, Wadlington, and Bitner's (1992) study indicated that they agreed with the statement, "Men are better in math than women," indicating a gender bias belief pertaining to math ability. Female students who confirm traditional gender ability beliefs, as verified by their female teachers, have lower math achievement (Beilock, Gunderson, Ramirez, & Levine, 2010). Gender bias of teachers can also result in girls being ridiculed more often than boys and receiving less additional assistance when they need remediation (Jackson & Leffingwell, 1999).

**Behaviors that have a Negative Impact.** Teacher behaviors that negatively impact student outcomes in mathematics are the exclusive use of traditional pedagogy and isolated, direct instructional techniques. Also, teachers who demonstrate low math competency and achievement as well as math avoidance and aversion behaviors negatively impact students' achievement. Teachers who focus only on textbook exercises, worksheets, and calculations tend to implement traditional mathematics pedagogy. These types of teacher behaviors have
been identified as boring and uninspiring to students (Cornell, 1999). Teachers who teach math in an isolated context without connection to the real-world contribute to students’ perceptions of math as irrelevant to their lives (Cornell, 1999). It is critical that teachers demonstrate connections between the concepts in a math course and the students’ interests and future goals (Burks, Heidenberg, Leoni, & Ratliff, 2009). Teachers, who only praise a correct answer, include few opportunities to discuss and explain mathematical strategies, and do not respond to students’ mistakes and misunderstandings with remediation, withhold motivational support for their students (Turner et al., 2002). About two-thirds of the pre-service teachers in Henderson and Rodrigues’ (2008) study performed below competence on an online assessment based on math requirements for 11-14 year olds, and it has been found that primary teachers without strong math knowledge perform poorly in mathematics teaching assessments (Goulding, Rowland, & Barber, 2002). Math avoidance is a behavioral response that has been learned over time as a way to cope with the negativity surrounding prior experiences with mathematics. Teachers who have negative responses to mathematics, such as anxiety or fear of failure, tend to avoid math related activity, including instructional planning.

Changing Attitudes that have a Negative Impact

Teachers can address and change their negative attitudes toward math through additional math-related coursework, professional development, and an awareness of the impact of their attitudes on students. There is considerable evidence demonstrating that both increased math content and pedagogical knowledge are important to effective teaching and decreasing negative attitudes toward math (Kukla-Acevedo, 2009). When teachers
acknowledge and disclose their experience with math anxiety, then describe the remediation strategies they used to overcome it, they help students reduce their own anxiety and facilitate their learning and enjoyment of math (Jackson & Leffingwell, 1999). Additional coursework in mathematics boosts teachers' self-esteem related to math and reduces math anxiety because they feel better prepared to teach it. Teachers who enroll in mathematics methods courses report significant reductions in math anxiety levels (Teague & Austin-Martin, 1981). Teachers can reduce their math anxiety by enrolling in professional development math training seminars and workshops (Beilock, Gunderson, Ramirez, & Levine, 2010). The collaborative and supportive nature of professional development opportunities provides a forum for teachers to share struggles and successes with various innovative instructional techniques.

A teacher's negative attitude toward math makes it difficult for them to create student interest in math, motivate children to learn mathematics, or influence student attitudes toward math positively, contributing to students' overall lack of achievement in math (Kolstad, Hughes, & Briggs, 1994). Surveys of student responses indicate that negative experiences and teacher attitudes in mathematics can be so profound that the effects students feel from them persist twenty or more years later (Jackson & Leffingwell, 1999).

Implications for Teacher Preparation Programs

Teacher preparation programs need to take teachers' preexisting and exiting attitudes toward mathematics into consideration when developing program requirements because they can contribute to enhancing or diminishing pre-service teachers' positive or negative perceptions about math (Philippou & Christou, 1998). Mathematics methods classes that focus
on the historical-developmental origins of math help teachers view mathematics as a creative human activity that is constantly changing instead of a fixed and finished subject (Philippou & Christou, 1998). Effective mathematics methods courses have been shown to lessen pre-service teachers’ math anxiety, demonstrate how math is useful to everyday life, and increase the satisfaction they experience from math-related activity (Philippou & Christou, 1998). Minimal mathematics requirements for elementary education certification need to be rethought, if preparatory programs want to develop teachers with both strong math skills and positive math attitudes (Beilock, Gunderson, Ramirez, & Levine, 2010). College instructors need to find ways of assessing and alleviating math anxiety among pre-service teachers (Kolstad, Hughes, & Briggs, 1994). If pre-service teachers do not possess levels of competence and confidence in mathematics that are necessary for developing teaching skills that translate into effective math teachers, institutions need to take more responsibility for increasing and developing these math-related teaching skills and confidence (Henderson & Rodrigues, 2008). University and school partnerships positively contribute to pre-service, in-service, and student outcomes in math (Bahr, Monroe, Balzotti, & Eggett, 2009). Opportunities for pre-service teachers to conduct mock lessons with feedback and observe experienced educators teach are crucial and effective faculty development techniques (Burks, Heidenberg, Leoni, & Ratliff, 2009).

Implications for Administrators

According to Kukla-Acevedo’s (2009) results, administrators need to more strongly consider the number of math content hours and overall GPAs of prospective teachers when staffing math positions. “A teacher who took 11 hours of math content will have higher student
math scores than a teacher who took 10 hours of math content and will have incrementally higher student math scores over the years” (Kukla-Acevedo, 2009, p. 56). Establishing public school – higher education partnership endeavors can accelerate reforms in mathematics education necessary to the success and improvement of students’ math achievement (Bahr, Monroe, Balzotti, & Eggett, 2009). Administrators need to develop opportunities and times for peer groups of teachers to meet and discuss classroom trials of innovative mathematics teaching approaches (Burks, Heidenberg, Leoni, & Ratliff, 2009). It may be beneficial to create teams of specialized math teachers, especially at the elementary level, based on the evidence that a teacher’s attitude toward a subject significantly impacts student outcomes. This recommendation is especially relevant to elementary math, since this is where foundational mathematics concepts are learned and a higher proportion of teachers maintain negative attitudes toward math.

*Implications for Professional Development*

Coordinating reform-based professional development opportunities for in-service teachers with pre-service teacher programs enhance the mathematics instruction provided by both groups and increase student achievement in math (Bahr, Monroe, Balzotti, & Eggett, 2009). Professional development workshops and seminars should facilitate teachers’ development of math content hook resources, such as compilations of intriguing questions and lessons that are tied to current issues and topics; these resources help teachers engage their students in the learning of mathematics (Burks, Heidenberg, Leoni, & Ratliff, 2009).
Conclusion

Teachers need to be aware of how their attitude toward mathematics manifests itself in their emotional responses, beliefs, and behaviors related to math. Teachers' emotions, beliefs, and behaviors associated with math affect students' motivation, achievement, and interest in the subject. Teachers' positive or negative attitudes toward math have enduring effects on students, and can perpetuate a cycle of interest or disinterest in mathematics. Attitudes are difficult to change because they are such complicated constructs of our psyche, but teachers who recognize the components of attitude that negatively impact students, in themselves, can take actions to address them. Being proactive and taking steps to improve our attitudes toward mathematics helps us be more effective, knowledgeable, and enthusiastic math teachers. Programs for pre-service teachers, actions of administrators, and professional development opportunities need to offer more tools to teachers for assessing their attitude toward math and developing more positive perspectives of mathematics.

Very solid first draft!
References


EDUC 520
Self Evaluation of Chapters 1 & 2

Name: [Redacted]  
Title of the Project: Teachers' Attitude toward Mathematics and its Impact on Students

Scoring Criteria
4 Outstanding: Meeting or exceeding all expectations
3 Proficient: Meeting most expectations
2 Mediocre: Meeting some expectations, but lack of focus or organization
1 Novice: Major difficulties in meeting basic expectations
- does not reflect graduate quality work

Chapter 1
Knowledge of the topic
Articulation/Smooth flow
Convention/Format (Model F)
Depth of the analysis

Chapter 2
Relevancy/Focused all the time
with Research Questions in Chapter 1
Knowledge of the topic (15 sources)
- Important figures/studies used
- All perspectives
- Multiple sources reviewed in each aspect
Articulation/Smooth flow
- Between paragraphs
- Between concepts
Convention/Format (Writing Manual)
In-text citations & References (APA style)

Comments:

TOTAL 7.5/8

TOTAL 8.5/20
EDUC 520  
Evaluation of Chapters 1 & 2

Name__________________

Title of the Project _____________________

Scoring Criteria

4 Outstanding: Meeting or exceeding all expectations
3 Proficient: Meeting most expectations
2 Mediocre: Meeting some expectations, but lack of focus or organization
1 Novice: Major difficulties in meeting basic expectations
   - does not reflect graduate quality work

Chapter 1

Knowledge of the topic 2 1
Articulation/Smooth flow 2 1
Convention/Format (Model F) 2 1
Depth of the analysis 2 1

TOTAL 7 8/pts 26/28

Chapter 2

Convention/Format (Model F) 4 3 2 1
Relevancy/Focused 4 3 2 1
Knowledge of the topic (15 sources) 4 3 2 1
Citation & References (APA style) 4 3 2 1
Articulation/Smooth flow 4 3 2 1

TOTAL 19 20/pts

Comments: Well researched.