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The Link Between Teacher Practices and High School Students' Mathematics Self-Efficacy;a Multilevel Analysis

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THE LINK BETWEEN TEACHER PRACTICES AND HIGH SCHOOL STUDENTS' MATHEMATICS SELF-EFFICACY: A MULTILEVEL ANALYSIS

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ABSTRACT

The recent push for accountability based on student achievement, by means of standardized testing, has resulted in the realization that urban students are not performing as well as their suburban counterparts. This gap is even more pronounced in the area of mathematics. Many factors contribute to poor performance on student achievement. Among these are family values and climate, school environment, peer pressure, and test-taking anxiety. A student's judgment of their capability to accomplish a task or succeed in an activity, or *self-efficacy*, is a key factor. Self-efficacy beliefs help determine how much effort a student will expend and how much stress and anxiety they will experience as they engage on a task. Teacher efficacy beliefs, a teacher's perception of how effectively they can affect student learning, have also been found to have a great impact on the self-efficacy, and therefore the achievement, of their students.

The purpose of the study was to investigate the link between teacher practices, their self-efficacy, and their students' mathematics self-efficacy. Teachers, and their students, from several school districts in northeastern Ohio participated in the study. Teachers responded to modified versions of Pajares' (1996) self-efficacy survey and their students responded to a different version of the survey. Participants included 582 students nested within 30 classrooms. The factor analysis identified five dimensions of students’ and four dimensions of teachers’ mathematics self-efficacy. A two-level hierarchical linear model revealed that teachers’ perceived mathematics competency, their ability to engage students, flexibility, teacher gender, and years of teaching experience were significant predictors of all five dimensions of students’ mathematics self-efficacy.

The study recommends regular professional development activities to help teachers implement teacher practices that can positively impact students’ mathematics self-efficacy. Through enhancing students’ mathematics self-efficacy, students’ mathematics achievement is likely to improve.

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CHAPTER I

INTRODUCTION

With the recent push for school accountability based on student achievement there is renewed challenge for urban schools to seek ways to improve student performance. Currently an achievement gap exists between urban and suburban students and the gap is even more pronounced in the area of mathematics. Many factors contribute to poor performance on mathematics tests. For instance, Pajares (2002) identifies a student's judgment of their capability to accomplish a task or succeed in an activity, or *self-efficacy*, as a key factor. Self-efficacy beliefs help determine how much effort a student will expend and how much stress and anxiety they will experience as they engage a task. Teacher efficacy beliefs, a teacher's perception of how effectively they can affect student learning, have been found to have a great impact on the self-efficacy, and therefore the achievement, of their students *(Brownell & Pajares, 1996).*

Statement of the Problem

According to John Glenn, Commission Chair of the National Commission on Mathematics and Science Teaching for the 21st Century (NCMST), it is very important for children to attain competencies in the areas of mathematics because of four main reasons: constant change in the global economy and the American workplace; daily use of mathematics for everyday decision-making; the link between mathematics and U.S. national security needs; and the intrinsic value of mathematical knowledge in culture (NCMST, 2000).

Unfortunately, the mathematics performance of children in the United States is well below that of other industrialized nations. The Trends in International Mathematics and Science Study (TIMSS) provides reliable and timely data on the mathematics and science achievement of U.S. students compared to that of students in other countries. TIMSS studies show declining mathematics performance among American middle school students which has engendered a response by United States school systems. This response was also precipitated by the No Child Left Behind Act of 2001 (NCLB).

The No Child Left Behind Act authorized a number of federal programs to improve the performance of U.S. schools by increasing the standards of accountability for states, school districts, and schools. This increased accountability has extended to teachers who have a major role in educating children. The problem is even greater in urban areas.

More than two-thirds of students living in U.S. low-income urban areas have not demonstrated basic levels of math achievement. Teachers are confronted with a difficult task of meeting the needs of an increasingly academically diverse population of urban students.

In the urban environment there is an unwritten requirement that one sees books and school as “a realm to visit rather than live in” (McWhorter, 2000). This cultural “rule” hinders the dedication of urban, and particularly African-American, students. This extends even to those students who are giving their best efforts by diluting their fundamental commitment. The failure to abide by this requirement is met by teasing from an urban youth’s peers.

It is a long-established and well-documented feature of African-American culture to tease and harass those children who show an affinity for school (McWhorter, 2000). Those individuals who perform well in academics are viewed as “nerds” and as “geeks.” This is even more the case when it comes to mathematics because in the urban community math is seen as a subject that only “bookworms” and people who are not cool master.

Vocational and educational psychologists have become increasingly sensitive to the important role of mathematics preparation in shaping students’ career futures (Betz, 1992). Since mathematics proficiency is required for entry into a wide range of college majors and occupations, the amount of mathematics taken in high school and college becomes a critical determinant of a student‘s range of career options. However, a large percentage of students stop taking mathematics courses during their early high school years, and this decision effectively restricts them from satisfying educational and career alternatives in the future.

This early narrowing of career options due to mathematics avoidance has been seen as particularly detrimental to the career development of urban students. Research indicates that urban students are far less likely to take mathematics courses beyond the 10^{th} grade than are their non-urban counterparts (Eccles, 1998). There is still a racially identifiable group of educational "have-nots" -- young African Americans and Latinos whose opportunities in life will almost inevitably be limited by their inadequate education (McWhorter, 2000).

Researchers have underscored self-efficacy as an important academic performance determinant (Pajares, 1996; Schunk, 1989; Zimmerman, Bandura & Martinez-Pons, 1992). Self-efficacy refers to personal beliefs about one's capabilities to learn or perform skills at designated levels. Mathematics self-efficacy is a more specific estimate of confidence within one's ability to perform well with regard to particular mathematics tasks (Matsui, Matsui & Ohnishi, 1990). Mathematics self-efficacy is positively correlated with mathematics achievement and to student valuing of mathematics as well as their expectancies for success in mathematics (Meece, Wigfield & Eccles, 1990).

Teacher efficacy has been defined as teachers' "beliefs in their ability to have a positive effect on student learning" (Ashton, 1985). Teachers' sense of efficacy influences the effort they put into teaching, the goals they set and their level of inspiration. Therefore, teacher efficacy influences the practices that teachers employ. These practices directly impact the mathematics self-efficacy of their students which directly affects student performance in mathematics. Employing effective teacher practices is even more critical when dealing with those who are more at risk.

Purpose of the Study

The purpose of this research will be to investigate the link between teacher practices and the mathematics self-efficacy among high school students. It is hoped that the results of this study will reveal the specific teacher practices that have a positive or negative effect on student's self-efficacy. It is important that such practices be determined so teachers can work at improving their students' self-efficacy beliefs, and by extension, can help improve the achievement of urban students in mathematics.

Teachers, and their students, of 5 school districts in northeast Ohio, were selected to participate in this study. The teachers were given modified versions of Pajares' (1996) self-efficacy survey -- one for them to take, and a different version for their students to take. The data was analyzed using a Hierarchical Linear Model (Bryk & Raudenbush, 1992). This process will reveal the link between specific teacher practices and the mathematics self-efficacy of urban students when students' individual characteristics are controlled.

Research Questions

1. What are the dimensions of teacher and student mathematics self-efficacy?
2. To what extent do individual student variables such as tutoring, family structure, gender, race, and educational aspirations predict the dimensions of student's mathematics self-efficacy?
3. To what extent does teacher efficacy predict the dimensions of student's mathematics self-efficacy?

Significance of the Study

The future of the world lies in the hands of today's youth. Therefore, it is important that educators train them well. Bandura (1984) hypothesized that an individual's beliefs "touch, at least to some extent, most everything they do." It is, therefore, quite damaging when an individual believes that he cannot learn. When this happens, the individual is less likely to engage in tasks that require the skills that they don't believe they possess. In fact, such ones are more likely to give up when difficulties arise. An inaccurate perception of one's mathematics capability, not lack of capability, is responsible for an individual's poor math performance. It follows then that it would be very beneficial if researchers were to identify methods that could be used to identify and alter such inaccurate judgments. Researchers have also demonstrated that self-efficacy beliefs influence an individual's choices of major and career (Hackett, 1995). In many instances underestimation of capability is more responsible for an individual's avoidance of a major or career than his lack of competence or skill. It should therefore be a primary goal of educators to identify and alter their students' inaccurate self judgments.

There is a well-confirmed knowledge base on effective instruction, but teachers need massive amounts of information for effective, sustainable improvement and data-driven decision making. The bottleneck to improving teaching and learning is a lack of systematic, usable information on individual student performance and progress at the classroom level.

Quality mathematics instruction should result in citizens capable of functioning productively in this highly technological, capitalistic, and democratic society. Researchers propose that mathematics is very relevant for real-life problem solving (Lemire, 2003). The general public's aversion to mathematics needs to be acknowledged. Adults need both functional math skills (numeracy) and knowledge of mathematical concepts for full participation in society.

Limitations

The following limitations should be considered when interpreting the results of this study:

1. Individual teacher responses within a building differ among multiple teachers. Therefore, individual responses were analyzed, as well as building responses. Responses were then aggregated by buildings.
2. Findings from this study are valid to the extent that the instruments are. Perhaps another instrument could be designed that has even higher validity.

Definition of Terms

Accountability - Being held responsible for the learning/instruction in a school setting.

Northeastern Ohio Schools - The Northeastern Ohio Schools consist of more than 80,000 students. Of these, more than 16,000 are in high school.

Mathematics Self-efficacy - Self-efficacy is defined as one's beliefs about his or her ability to successfully perform specific tasks in mathematics.

Self-efficacy - Self-efficacy is defined as one's beliefs about his or her ability to successfully perform specific tasks in specific situations (Zeldin & Pajares, 2000).

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

In order to help educators to identify and alter their students' inaccurate self judgments a review of the literature is necessary. It is important to find out what the research says concerning: a) the importance of mathematics; b) self-efficacy; c) mathematics self-efficacy; and d) teacher practices.

Self-efficacy

Social cognitive researchers hold self-belief as a basic tenet. According to Bandura's social cognitive theory, the person is the agent of change. The relationship between personal and environmental factors is emphasized. The interdependency of these two factors is a major teaching (Corsini & Wedding, 1989). Therefore, self-efficacy is the central concept of social cognitive theory. Self-efficacy is defined as one's beliefs about his or her ability to successfully perform specific tasks in specific situations (Zeldin & Pajares, 2000).

How Acquired

According to Bandura (1986, 1995) people form their self-efficacy perceptions from four sources: a) past performance accomplishments (also known as mastery experience), b) exposure to and identification with efficacious models (vicarious learning), c) access to verbal persuasion and support from others, and d) experience of emotional or physiological arousal in the context of task performance (Bandura, 1986, 1995).

Researchers have proved that past performance accomplishments are the most important sources of self-efficacy (Bandura, 1986, 1997; Lent, Lopez, & Bieschke, 1991; Gavin, 1996). There are mastery experience concerns: an individual's interpretation of his past successes raises his self-efficacy while his interpretation of his past failures lowers his self-efficacy. Continued success generates high self-efficacy while continued failure can lower self-efficacy beliefs.

The ability to acquire new responses by watching someone else perform a task and the doing it ourselves is a strong determinant of one's personality. This tendency to learn by observing the positive and negative consequences of others is what Bandura calls vicarious experiences. An individual's experiences can be limited due to extenuating circumstances which, in turn, limit their sources of information. The result is that they fail to develop strong self-efficacy perceptions (Eisenberg, Martin, & Fabes, 1996).

Verbal persuasions are positive verbal messages and social encouragement. These enable an individual to exert the extra effort and maintain the needed persistence to succeed. The result is that the individual acquires a higher level of self-efficacy. Becker (1984) found that sometimes persuasion from at least one person is beneficial to one's self-efficacy when pursuing a graduate degree. This persuasion usually comes from a teacher.

Stress, tension and mood have a pronounced effect on one's ability to succeed. This is the fourth way of acquiring self-efficacy. Positive thinking enhances one's self-efficacy while despair and depression can be a detriment to it. According to Swanson and Woitke (1997), whether experiences reinforce or promote low levels of self-efficacy depends on the individual's perceptions and whether or not the barriers are overcome.

These four sources of efficacy information continually and reciprocally interact to affect performance judgments that in turn influence human performance. People who have more sources of efficacy have higher self-efficacy beliefs and higher academic achievement (Pajares, 1995).

The Influence of Self-efficacy on Human Behavior

Self-efficacy perceptions influence human behavior in three ways. A person's choice of behavior is the first way human behavior is influenced. An individual is more likely to engage in a task in which they feel competent and confident and will avoid those in which they do not feel that way.

The second way that self-efficacy beliefs influence human behavior is they help determine how much effort one will put into an activity and how long they will persist in it. The higher the level of self-efficacy, the more effort an individual will give and the longer will be his perseverance in a given task (Pajares, 1996).

Finally, self-efficacy beliefs influence an individual's thought patterns and emotional reactions. People with high self-efficacy are serene when approaching difficult tasks. Conversely, people with low self-efficacy beliefs may believe that things are harder than they really are. This belief brings them stress and a narrow vision of how best to solve a problem (Pajares, 1996).

When an individual is a student, his self-efficacy beliefs have an influence on his academic performance in many ways. In general, researchers have established that self-efficacy beliefs are correlated with other self beliefs and with academic changes and outcomes and that self-efficacy is a strong predictor of related academic outcomes. Self-efficacy beliefs influence the choices that students make and the courses of action that they pursue. The results can be positive or negative depending on the student's self-efficacy beliefs.

Positive Results

The higher the sense of self-efficacy, the greater the effort, persistence, and resilience of the student will be. Persons with a higher sense of self-efficacy will also have less stress and anxiety as they engage a task. As a result, such ones will realize a higher level of accomplishment.

Students with high self-efficacy also engage in more effective self-regulatory strategies. Such students monitor their academic work time more effectively and persist when confronted with challenges (Bouffard-Bouchard, Parent, & Larivee, 1991).

Negative Results

Some of the negative results of low self-efficacy are apparent from our review of the positive results of high self-efficacy. These include a student's high amount of stress, lack of effort, and lack of persistence when facing difficulties. In addition, Wilczenski and Gillespie-Silver (1991) state that a student's internalization of repeated failure can weaken the student's ability to achieve. This weakened sense of efficacy in turn may limit the level of future performance these students are willing to try and their persistence under stressful conditions. Low perceptions of ability, therefore, become reinforced by experience.

Mathematics Self-efficacy

As has been mentioned, self-efficacy is a strong predictor of academic performance. Research has shown that this is the case in the area of mathematics. Motivation researchers have found that differences in mathematics achievement can be explained, in part, by an individual's self-beliefs about their mathematics capabilities. Primary among these self beliefs are the students' math self-efficacy. Mathematics self-efficacy is the confidence that a student has in his ability to solve mathematics problems, complete mathematical tasks, or succeed at mathematics-related careers. Many research studies have been conducted to determine the effects of a student's mathematics self-efficacy.

Researchers who have investigated the relationship between math self-efficacy and various mathematics outcomes report significant correlations and strong direct effects. For example, O'Brien, Martinez-Pons, and Kopala (1999) surveyed 11th graders to examine the relations among mathematics self-efficacy, gender, ethnic identity, and career interests in mathematics and science. Sirin (2005) also examined socioeconomic status and academic achievement. Science career interests were predicted solely by science-mathematics self-efficacy. Self-efficacy was predicted by academic performance and ethnic identity. Academic performance was predicted by socioeconomic status. Gender directly affected career interests (Martinez-Pons, 1999).

In a study by Gavin (1996), attitudes were found to be integral in decisions to study mathematics. A high level of self-efficacy beliefs was directly related with the decision to pursue a mathematics related course of study.

Lent et al. (1996) surveyed 103 college students who cited past performance as the most influential basis for their efficacy beliefs about mathematics. Women cited physiological reactions and teaching quality more often than men did.

Pajares and Miller (1995) asked 391 students to provide 3 types of mathematics self-efficacy judgments: confidence to solve mathematics problems, confidence to succeed in math-related courses, and confidence to perform math-related tasks. Criterial tasks were solution of math problems and choice of math-related majors. As hypothesized, students' reported confidence to solve the problems they were later asked to solve was a more powerful predictor of that performance than was either their confidence to perform math-related tasks or to succeed in math-related courses. Similarly, confidence to succeed in math-related courses was a stronger predictor of choice of math-related majors than was either confidence to solve problems or to perform math-related tasks. Results support Bandura's (1986) contention that, because judgments of self-efficacy are task specific, measures of self-efficacy should be tailored to the criterial task being assessed and the domain of functioning being analyzed to increase prediction.

Pajares and Miller (1994) used path analysis to investigate mathematics problem solving from a social cognitive perspective and found that self-efficacy to solve math problems was more predictive of that performance than were prior determinants such as gender or math background or than common mechanisms such as anxiety, self-concept, and perceived usefulness of mathematics. Self-efficacy also mediated the effects of gender and math background both on the common mechanisms and on the performance task. Men and women differed in performance, but these differences were mediated by the students' self-efficacy perceptions. That is, the poorer performance of women was largely due to lower judgments of their capability.

Lopez and Lent (1992) explored the relationship of four sources of self-efficacy information to the mathematics self-efficacy of 50 high school students. They found prior performance to be the most efficient predictor of self-efficacy. Global academic self-concept did not explain unique self-efficacy variation beyond prior performance. The effect of self-efficacy on perceived utility of mathematics to future plans was mediated by students' mathematics interests.

Bouffard-Bouchard, Parent, and Larivee (1991) found that students with high mathematics self-efficacy are better at solving conceptual problems. They further found that as a student's math self-efficacy increases, so does the accuracy of the self-evaluations they make about the outcomes of their self-monitoring.

Cooper and Robinson (1991) investigated the relationships among Hackett's suggested variables of mathematics and career self-efficacy, perceived external support, mathematics background, and mathematics performance among male and female students selecting mathematics-based college majors. Self-efficacy beliefs, mathematics ability, mathematics anxiety, and level of support from parents and teachers were significantly related to mathematics performance.

Self-efficacy in mathematics has also been found to be positively related to the strategy of reviewing notes. It was found to be negatively related to relying on adults for assistance (Zimmerman & Martinez-Pons, 1990).

Collins (1982) conducted a study of children of low, middle, and high mathematics ability who had, within each ability level, either high or low mathematics self-efficacy. The participants were tested were given a set of math problems to complete. After receiving the same mathematics instruction, the students were given new problems to solve and an opportunity to rework those they had missed. Level of mathematics ability was related to performance but, regardless of ability level, children with high math self-efficacy completed more problems correctly and reworked more of the ones they missed.

Hackett and Betz (1982) investigated the relationship of mathematics self-efficacy expectations to the selection of math-based college majors. Based on results obtained from a pilot sample of 115 college students, 52 math-related tasks were selected from an initial 75-item pool. Subjects, 153 female and 109 male undergraduates, were asked to indicate their degree of confidence in their ability to successfully perform the tasks or problems or to complete the college course with a grade of "B" or better. As predicted, the mathematics-related self-efficacy expectations of college males were significantly stronger than were those of college females, particularly with regard to mathematics-related college courses. Mathematics self-efficacy expectations, but not any mathematics performance index, contributed significantly to the prediction of the degree to which students selected math-based college majors, thus supporting the postulated role of cognitive mediating factors in educational and career choice behavior. The utility of the concept and measure of mathematics self-efficacy expectations for the understanding and treatment of mathematics anxiety and mathematics-avoidant behaviors is discussed.

The Importance of Teacher Practices

More than two-thirds of students living in U.S. low-income urban areas have not demonstrated basic levels of math achievement. Teachers are confronted with the difficult task of meeting the needs of an increasingly academically diverse population of urban students. School teachers, whose positions lend them considerable influence and power over a student's experiences, are very important to the success of an urban student in mathematics. Unfortunately, they can also unwittingly contribute to a student having low self-efficacy and a resulting poor performance in math. Researchers have demonstrated that the beliefs of teachers hold influence on both their classroom behavior and student outcomes. Some researchers have suggested that teachers would be well served by paying as much attention to their students' perceptions of competence as they do to their actual competence (Hackett & Betz, 1989).

Based on a summary of research findings on best teacher practices in mathematics education, recommendations are given to improve mathematics teaching practices. Among the recommendations are: learning should be student-centered not teacher-centered; students can learn both concepts and skills by solving problems; whole-class discussion following individual and group work improves student achievement; and using technology in the learning of mathematics can result in increased achievement and improved student attitudes. Other research has found that such things as having students set goals, giving frequent and immediate feedback to increase student confidence, helping students develop internal standards, modeling, detailed planning, high teacher expectations for student success, and the involvement of students by questioning.

Student-Centered Learning

Black South African students have a poor success rate in school exit mathematics examinations. Attempts have been made to shift teachers' practices from teacher-centeredness to learner-centeredness, in Black schools. So far, the attempts have failed to yield the desired results. In order to help improve the situation Nkhoma (2002) conducted a study with the aim of learning from students and teachers in Black schools what classroom practices they feel would lead to success in school mathematics, in their impoverished context. In South African school curriculum circles the term, 'learner-centered', means the direct opposite of teacher-centered instruction. Teacher-centered instruction is seen as representing anything that is bad about teaching and learning. Learner-centeredness is therefore associated with progressive instructional methods occurring in the developed world and to which, by implication, the developed countries owe their economic success. It is sometimes referred to as child-centered, progressive, transformative, tender-minded or 'soft' pedagogy. *Understanding Outcomes-Based Education: Knowledge, Curriculum and Assessment in South Africa*, is a South African Government Education department document edited by Lubisi et al. (1997), which explains that the new curriculum, learner-centeredness, is seen as the development of learning programs and materials which puts learners first, recognizing and building on their knowledge and experience, and responding to their needs. In another South African government document, the *Curriculum Framework for General and Further Education and Training*, from the National Department of Education (1995), learner-centeredness is described as:

1. Putting learners first, recognizing and building on their knowledge, skills, abilities and experience, and responding to their needs.
2. Delivery of learning content (knowledge, skills, attitudes and values) that takes account of the general characteristics, developmental and otherwise, of different groups of learners.
3. Acknowledging and accommodating different learning styles and rates of learning both in the learning situation and in the attainment of qualification.
4. Acknowledging and incorporating the ways in which different cultural values and lifestyles affect the construction of knowledge in the development and implementation of learning programs.

5. Motivating learners by providing them with positive learning experiences, by affirming their worth and demonstrating respect for their various languages, cultures and personal circumstances is a pre-requisite for all forms of learning and development. This should be combined with the regular acknowledgement of learners' achievements at all levels of education and training.
6. Encouraging learners to reflect on their own learning progress and to develop skills and strategies needed to study through open learning, distance education and multi-media programs.

Whole-Class Discussion

Owens et al (1998) examined how whole-class discussion following individual and group work improves student achievement. The interactive, supportive classroom allowed the students to move towards a feeling of pleasure and a sense of being able to do mathematics themselves because they themselves were validating the mathematics. It was the opportunity to be openly responsive that encouraged the changes. The results showed some of the values of the approach being undertaken in the subject *Mathematics for K6 Teachers.* The interactive constitution of the social norms within the learning community meant that the students felt comfortable with the approach and what it was attempting to do. The cooperative, problem-centered approach facilitated the mathematics learning of many of the students in the classes and developed in them a confidence in their own abilities to, at least, get started on mathematical problems.

Use of Technology

Goos et al (2003) investigated using calculators in the learning of mathematics. They found that the introduction of technology resources into mathematics classrooms promises to create opportunities for enhancing students' learning through active engagement with mathematical ideas; however, it was found that little consideration has been given to the pedagogical implications of technology as a mediator of mathematics learning. The paper used data from a 3-year longitudinal study of senior secondary school classrooms to examine pedagogical issues in using technology in mathematics teaching — where "technology" included not only computers and graphics calculators but also projection devices that allow screen output to be viewed by the whole class. The researchers theorize and illustrate four roles for technology in relation to such teaching and learning interactions — master, servant, partner, and extension of self. Their research shows how technology can facilitate collaborative inquiry, during both small group interactions and whole class discussions where students use the computer or calculator and screen projection to share and test their mathematical understanding.

Ysseldyke et al (2003) examined the effect of adding a computerized curriculum-based instructional management system as an enhancement to ongoing math instruction. Two math tests were used to contrast performance gains for students in the treatment group in comparison to two control groups: a same-school math instruction-only group, and a randomly selected district-wide math instruction-only group. Teachers in the experimental group implemented the treatment with varying degrees of fidelity, so the researchers examined the impact of the level of implementation on student performance. They also examined the extent to which the treatment worked differently for high, middle, and low achieving students. There were positive outcomes for students in classrooms in which teachers used the instructional management system (Accelerated Math [AM]). In fact, students enrolled in classrooms where teachers implemented the AM intervention to a greater degree benefited the most. Gains in math performance were consistent for high, middle, and low performing students. Use of a computerized instructional management system enabled teachers to differentiate instruction, make instructional adaptations for students of all ability levels, and provide students with relevant practice and immediate informed feedback. It also resulted in significant gains in math achievement.

Goal Setting

Seijts and Latham (2001) investigated “the effect of distal learning, outcome, and proximal goals on a moderately complex task.” The effects of learning versus outcome distal goals in conjunction with proximal goals were investigated in a laboratory setting using a class-scheduling task. The 96 participants needed to acquire knowledge in order to perform the task correctly. A ‘do your best’ outcome goal led to higher performance than the assignment of a specific, difficult outcome goal. However, the assignment of a specific, difficult learning goal led to higher performance than urging people to ‘do their best.’ Goal commitment was higher in the learning goal than in the outcome goal condition. The correlation between task-relevant strategies and performance was positive and significant. The number of task-relevant strategies implemented by participants assigned a distal learning goal in conjunction with proximal goals was higher than in any other goal condition. Setting a distal outcome or learning goal that included proximal outcome goals, however, did not lead to higher performance than the setting of a distal outcome or learning goal alone. Self-efficacy correlated significantly with performance, and this effect was mediated through strategy development. Furthermore, the discovery of task-relevant strategies affected self-efficacy through an increase in performance.

Wolters et al (1996) investigated the relation between goal orientation and students' motivational beliefs and self-regulated learning. The relations between three goal orientations and students' motivational beliefs and self-regulated learning were examined in a correlational study of 434 seventh and eighth grade students. Data were collected over two time points (fall and spring) within one school year with self-report questionnaires. Regression analyses revealed that adopting a learning goal orientation and a relative ability goal orientation resulted in a generally positive pattern of motivational beliefs including adaptive levels of task value, self-efficacy, and test anxiety, as well as cognition including higher levels of cognitive strategy use, self-regulation, and academic performance. Results showed that adopting an extrinsic goal orientation led to more maladaptive motivational and cognitive outcomes. These findings were replicated across three different academic subject areas of English, math, and social studies.

Frequent and Immediate Feedback

Greene et al (1999) examined gender and motivation in high school mathematics classes by using an expectancy-value framework. There were 366 students (146 males, 212 females) from a school with an enrollment of approximately 1900 students (81% Caucasian, 8% Native American, 5% Hispanic, 4% African American, and 2% Asian). These students completed a questionnaire consisting of 92 items which measured students' situation-specific goals (4 subscales), task-specific values (3 subscales), task-specific beliefs (3 subscales), and gender self-schemata (2 subscales). Students' percentage grade in math and self-reported effort in math class were the dependent variables. The three sets of task-specific variables each accounted for between 11% and 14% of variance in achievement, while the gender self-schemata variables contributed another 2%. Task-specific goals were much stronger predictors of effort than any other set of variables. An unexpected finding was that, for both males and females, endorsing the stereotype that mathematics is a male domain was negatively related to reported effort. There were also differences in the prediction of achievement and effort based on gender and math class type (required or elective). Several path models supported these results.

Teacher–student relations are an important factor influencing student motivation (see Wentzel, 1996). A pattern of increasing consistency in gender differences in teacher–student relations across grade level (e.g., Bracken & Crain, 1994; Leaper, 1991; Thorkildsen & Nicholls, 1998; Wentzel, 1998) suggests the possibility that these gender differences are at least partially an outcome of differential classroom socialization practices. Research suggests that boys receive more negative teacher feedback concerning failure to follow directions, whereas girls receive more positive feedback concerning compliance (e.g., J. Brophy, 1985; K. B. Hoyenga & K. T. Hoyenga, 1993). In 2001, Morgan conducted a study of 5th and 6th graders (79.8% Caucasian, 9.2% Hispanic, 6.1% Asian, 2.2% Pacific Islander, and 1.8% African, predominantly lower middle class) who were randomly assigned to receive 1 of 5 feedback patterns. All students received positive competence-related feedback. Relative to the other conditions, the typical "male" feedback pattern decreased students' activity interest, perceived competence, and liking for the teacher. Students receiving typical "male" feedback reported less willingness to work with the teacher again; however, they did not report less willingness to work on the activity either alone or with a friend.

High Teacher Expectations

Muller (1998) investigated the link between teachers' and students' expectations and academic performance. Their paper analyzed whether the minimum competency exam requirement for high school graduation affects students' academic performance directly or affects the educational process by moderating the effect of teachers' expectations on students' mathematics test score gains, proficiency levels, and high school graduation. Tenth-grade students and their mathematics teachers from the National Education Longitudinal Study of 1988 were analyzed. Contingent, negative associations were found between the minimum competency exam requirement and both mathematics proficiency and performance. The requirement was also not found to be associated with the odds of earning a diploma. In the case of mathematics achievement, teachers' expectations were a more important predictor of learning gains and proficiency than were students' expectations. Students' expectations better predicted who earns a diploma. The minimum competency exam requirement was found to moderate the association between teachers' expectations and mathematics achievement but did not affect the relation between teachers' expectations and high school graduation.

Piggott and Cowen (2000) examined the effects of teacher race, pupil race, and teacher–child racial congruence on teacher ratings of the school adjustment of 445 kindergarten through fifth-grade children from 70 classrooms in 24 racially mixed urban schools. Most classrooms yielded 8 child participants: 4 African American and 4 White, with 2 boys and 2 girls per group. The two race groups were closely matched by school, grade level, teacher, and socioeconomic status. Ratings were provided by 26 African American and 44 White teachers, matched by age and years of experience. African American children were judged by both African American and White teachers to have more serious school adjustment problems, fewer competencies, more stereotypically negative qualities, and poorer future educational prognoses than White children. The relation between stereotypic teacher views and other adjustment indicators was consistently higher for African American children than for White children. African American teachers, compared to White teachers, rated all children as having more competencies and fewer problems, and had more positive academic expectations for all children. No significant teacher race × student race interactions were found.

The Use of Questions

Karabenick and Sharma (1994) investigated the relation between perceived teacher support of student questioning in the college classroom to student characteristics and role in the classroom questioning process. College students' perceptions of their teachers' support of student questioning (SQ) were examined. Perceived teacher support had significant and consistent relationships with students' motivational tendencies and strategy use typical of self-regulated learners. Perceived teacher support affected the likelihood of SQ by influencing whether students had a question to ask and their level of inhibition. Students perceived high levels of support, which does not account for the low incidence of SQ in college classrooms. Agreement between student perceptions and teacher self-reports suggested that creating opportunities for questions and providing high quality answers are important dimensions of teacher support. The possible self-fulfilling consequences of perceived teacher support are discussed. Teacher support for SQ may influence the likelihood that students formulate questions.

White (2003) investigated the productivity of mathematical classroom discourse with diverse students. She found that productive mathematical classroom discourse allows students to concentrate on sense making and reasoning. It also allows teachers to reflect on students' understanding and to stimulate mathematical thinking. The importance of including all students in classroom discourse and the positive influence of classroom discourse on students' mathematical thinking were among her findings. Four themes emerged from the classroom discourse: (a) valuing students' ideas, (b) exploring students' answers, (c) incorporating students' background knowledge, and (d) encouraging student-to-student communication.

Role Modeling

The proportion of Latino and African-American students in urban schools is increasing rapidly. It is a well known and well documented fact that most urban students of color perform poorly in school mathematics (McWhorter, 2000; Ysseldyke, 2003). With the focus on the mathematics performance of these students has come to an improvement in their performance in recent years. Even so, urban students of color continue to score well below whites and Asian-Americans on examinations of basic skills, advanced placement, and college entrance tests which have significant life consequences for such students (Tate, 1997). The National Council of Teachers of Mathematics (NCTM) has strongly recommended that in addition to basic skills, Latino and African-American students need to improve in their abilities to solve problems, reason, communicate, and make connections in mathematics (NCTM, 1989). It is, therefore, imperative that educators strive to improve the mathematics performance of these students.

To improve the mathematics achievement of Latino and African-American urban students, educators must first understand the learning environments in which urban students of color prosper. Research indicates that a teacher's beliefs and practices are very instrumental in the mathematics success and failure of the urban student of color. A teacher's stereotypes about students and their conceptions of teaching are enough to influence student performance (Good and Brophy, 1997; Wiley and Eskilson, 1978;

Oakes, 1990). Given the demographics of the current teaching force, the propensity for relying on stereotypes is great. That is, while most teachers are white, middle-class females who prefer to teach in rural communities like the ones in which they grew up (Zimpher and Ashburn, 1992), many of them obtain teaching positions in urban settings, where students live very different experiences (Grant, 1989). Law and Lane (1993) write that many of these teachers have negative attitudes about individuals from cultures other than their own. Ladson-Billings (1997) suggests that effective teachers of African-Americans have in-depth knowledge of their students.

Several research studies have shown the importance of role models with respect to the self-efficacy of and academic success of students. Noteworthy is the lack of success that is directly attributable to a lack of role models.

Role models have long been thought to play an important role in young peoples' development. Zirkel (2002) presented a study that explored the ways that race and gender-matched role models can provide young people with a greater sense of the opportunities available to them in the world. A longitudinal study of 80 young adolescents revealed that students who reported having at least one race and gender-matched role model at the beginning of the study performed better academically up to 24 months later, reported more achievement-oriented goals, enjoyed achievement-relevant activities to a greater degree, thought more about their futures, and looked up to adults rather than peers more often than did students without a race and gender-matched role model. These effects held only for race and gender-matched role models

— not for non-matched role models. Finally, the results held irrespective of the educational achievements of the specific role model.

Katz (1999) examined the tensions inherent in the relationship between Latino immigrant youth and their teachers at a desegregated urban middle school in Northern California, exploring these tensions from both the students' and teachers' perspectives. His study was based upon data from a year-long ethnographic study of the school experiences of eight immigrant students from Central America and Mexico, all of whom had older siblings or close friends involved in neighborhood gangs. It also included interviews with the students' teachers regarding their perceptions of the students. Significantly, students named teachers' discrimination against them as Latinos as the primary cause of their disengagement from school, refusing to invest in learning from those teachers. At the same time, the teachers felt they were trying their best to do a good job, responding to the school administration's mandate to invest in other students who were considered most likely to keep standardized test scores high. Thus the study found that teachers' attitudes and practices perceived by students as racist may be actually linked to structural conditions within the school, such as tracking and high teacher turnover, that preclude caring relationships with students.

Chapter Summary

The purpose of chapter II was to provide historical information in order to help educators to identify and alter their students’ inaccurate self judgments. It was important to find out what the researchers said concerning: a) the importance of mathematics; b) self-efficacy; c) mathematics self-efficacy; and d) teacher practices. To date, there are no sources that specifically link teacher practices and the mathematics self-efficacy of urban students. Given the importance to teachers, administrators, and society in general of improving the math performance of urban students, the results of this study will be very helpful.

CHAPTER III

METHODOLOGY

This dissertation investigated the link between teacher practices and high school students' mathematics self-efficacy. The effects of teacher practices (macro level) and individual student characteristics (micro level) on the students' mathematics self efficacy was determined using the hierarchical linear model (HLM) suggested by Raudenbush and Bryk (2002). The specific details about this model will be explained later in this chapter.

Participants

Student-level (Level-1) subjects included a sample of 582 high school students. These students were selected from four school districts in northeast Ohio. These subjects (n = 582) who comprised the sample were from a total of 4 high schools with a total population of 3,012 students who were taking math (13.4%).

Single-stage cluster sampling was used to select teacher-level (Level-2) subjects, who consisted of 30 high school teachers from the aforementioned four school districts.

Instrumentation

Two self-administered questionnaires were used in the study. These questionnaires were adopted from Pajares (1996). One was completed by the teachers and the other was completed by their students.

The purpose of the questionnaire for teachers was to gather specific information regarding their efficacy, practices, and characteristics. The questionnaire is divided into three sections. The first section gathered information about the teacher's efficacy, the second section gathered information about the teacher's practices, and the third section gathered information about the teacher's characteristics.

The purpose of the questionnaire for students was to gather specific information regarding students' mathematics self efficacy and characteristics. The questionnaire is divided into two sections. The first section gathered information about the student's mathematics self-efficacy and the second section gathered information about the student's characteristics.

Data Collection Procedures

Permission for collecting data was obtained from the Cleveland State University Human Subjects Review Board prior to mailing questionnaires and obtaining data from the aforementioned school districts. In addition, permission for conducting research and collecting data in the districts was granted through a "Cooperative Research Studies Agreement" between this investigator and the director of the Center of Urban School Collaboration. Specific guidelines were agreed upon and adhered to throughout the process of this study.

Data for this study consists of two components. First an instrument was distributed to all available high school teachers in the aforementioned school districts. The questionnaire was used to identify and measure the effects of teacher practices. The second component is an instrument that identified and measured individual student characteristics.

Prior to administering the questionnaires, this investigator contacted every school principal in the four school districts and determined the correct number of high school teachers, and the number of students each teacher has, in each district. A large envelope containing the correct number of surveys, pencils, and pre-addressed return envelopes was then delivered to every teacher who was a subject in the study.

Cover letters and questionnaires, one for the teacher and one for each of their students, were delivered to the 30 high school teachers who were chosen to participate in the study. Each envelope contained a teacher questionnaire and several student questionnaires that the teacher administered to the students. A letter that explained the purpose of the study and encouraged timely completion of the questionnaires was also in each envelope. Upon completion of the questionnaires, teachers were asked to seal the questionnaires in pre-addressed reply envelopes and return them to the investigator. A letter explaining the study was also sent to the principal of every school at which questionnaires were administered. The letter explained the study and requested the support and cooperation of the principal.

A reminder letter was to be sent to every teacher who had not returned their questionnaires two weeks after the questionnaires were delivered. Those teachers would then be encouraged to complete and return the questionnaires within a week. Fortunately, this was not necessary because the teachers in all four districts completed their tasks in a timely manner. After all questionnaires were received, a letter of thanks was mailed to all participating teachers and their principals.

Variables and Measures

The study utilized multiple variables that were examined at both the teacher (macro) and student (micro) levels.

Student-Level Variables

The student-level variables that were included in the study are gender, age, grade, GPA, tutoring, expected grade, family status (traditional or non-traditional), three variables that measure ethnicity (Black, White, and Other), number of siblings, and siblings (does the student have any siblings).

Teacher-Level Variables

(TCOMP) is a measure of how competent the teacher is in her teaching ability.

(SENGAGE) is a measure of the extent to which the teacher’s method of instruction in the classroom engages the student.

(FLEX) measures the extent to which the teacher is flexible and accommodating to the students.

(RCOMP) is a measure of how competent the teacher feels that she is relative to other math teachers.

Data Analysis

A Hierarchical Linear Model (HLM) (Raudenbush & Bryk, 2002) was used to determine the extent to which teacher practices affected high school students' mathematics self-efficacy. The HLM 2-Level Model/ Version 6.0 was used in conjunction with the Statistical Package for Social Sciences (SPSS-8.0) in the Windows Vista environment for the analysis of data. The 0.05 alpha level was used as the criteria for determining statistical significance.

Rationale for Using HLM

Analysis of the data was done using the hierarchical linear model (Raudenbush & Bryk, 2002) in order to determine the influence of student and teacher level variables on the mathematics self-efficacy of urban high school students. Hierarchical linear modeling (HLM), involves the prediction of achievement of students who are nested within an organizational structure, which in turn may be nested in larger groups, and is ideally suited for use in education (Adcock, Sipes, & Phillips, 1998). Bagaka's (1992) points out the importance and frequent use of studying the effect of the educational group in education research. He further notes that group-oriented variables may form a part of a set of independent variables hypothesized to have an effect on some individual level of variable (Bagaka's, 1992).

In this study using HLM, individual student mathematics self-efficacy is explained as a function of teacher-level characteristics, while taking into account the variance of mathematics self-efficacy with respect to student-level variables. Through HLM we determined whether certain teacher practices can moderate the effects of student variables, such as family status and gender, on the students' mathematics self-efficacy. Thus, HLM provided the ability to explain the differences in students' mathematics self-efficacy using teacher-level characteristics such as use of teacher competence, student engagement, and flexibility. HLM was better able to predict student mathematics self-efficacy, and as a result student achievement outcomes, by simultaneously moderating student-level and teacher-level variance.

Model Specifications

This study used a two-level HLM model to assess the effect of teacher practices on the mathematics self-efficacy of suburban high school students. All student-level variables were grand mean centered as recommended in previous studies of hierarchical linear modeling (Raudenbush & Bryk, 2002). By centering the prediction at the grand mean, the Y-intercept (β_{0j}) represents the adjusted teacher *j* mean score which is considered a measure of teacher effectiveness.

Student-Level Model

$Y_{ij} = \beta_{0j} + \beta_{1j}(GENDER_{ij}) + \beta_{2j}(FAMILYSTATUS_{ij}) + \beta_{3j}(BLACK_{ij}) + \beta_{4j}(WHITE_{ij}) + \beta_{5j}(OTHER_{ij}) + \beta_{6j}(NUMBEROFSIBLINGS_{ij}) + \beta_{7j}(SIBLINGS_{ij}) + R_{ij}$ where,

Y_{ij} = Mathematics self-efficacy of student *i* of teacher *j* ,

β_{0j} = adjusted mean mathematics self-efficacy for teacher *j,*

β_{1j} = effect of gender on the mathematics self-efficacy of students of teacher *j,*

β_{2j} = effect of family status on the mathematics self-efficacy of students of teacher *j,*

β_{3j} = effect of being black on the mathematics self-efficacy of students of teacher *j,*

β_{4j} = effect of being white on the mathematics self-efficacy of students of teacher *j,*

β_{5j} = effect of another ethnicity on the mathematics self-efficacy of students of teacher *j,*

β_{6j} = effect of the number of siblings on the mathematics self-efficacy of students of teacher *j,*

β_{7j} = effect of having siblings on the mathematics self-efficacy of students of teacher *j,*

R_{ij} = residual error for student *i* of teacher *j.*

It is assumed that R_{ij} is distributed normally with mean zero and some variance which is the same across teachers.

A different student model was used for each of the five output variables based on the results of each variable's stepwise regression model.

Teacher-Level Model

$\beta_{0j} = \gamma_{01}$ (TEACHING_COMPETENCE$_j$) + γ_{02} (STUDENT_ENGAGEMENT$_j$) + γ_{03} (FLEXIBILTY_AND_ACCOMODATION$_j$) + γ_{04} (RELATIVE_COMPETENCE$_j$) + γ_{05} (COMFORT$_j$) + μ_{0j} ,

where, β_{0j} = predicted mean mathematics self-efficacy for teacher *j,*

($\gamma_{01}, \gamma_{02}, \gamma_{03}, \gamma_{04}, \gamma_{05}$) are the regression coefficients associated with the teacher-level predictors (TEACHING_COMPETENCE, STUDENT_ENGAGEMENT, FLEXIBILTY_AND_ACCOMODATION, RELATIVE_COMPETENCE, and COMFORT) respectively, μ_{0j} = unique random effects associated with teacher *j*.

A similar teacher level model is specified for each of the student level parameters (i.e. $\beta_{1j}, \beta_{2j}, \beta_{3j}, \beta_{4j}, \beta_{5j}, \beta_{6j}, \beta_{7j, \ldots}$).

CHAPTER IV

RESULTS

The purpose of this study was to investigate the link between teacher practices, characteristics, and efficacy and students' mathematics self-efficacy when students' characteristics are accounted for in an urban setting. It was hoped that the results of this study would identify specific teacher practices, characteristics, and efficacy that relate to students' mathematics self-efficacy. It is important that such practices be determined so teachers can work at improving their students' self-efficacy beliefs and, by extension, can help improve the mathematics achievement of urban students.

Description of the Student and Teacher Samples

Student Participants

The student sample included 582 high school students who responded to the survey. As presented in Table 1, 260 (44.7%) of the subjects were males and 322 (55.3%) were females. Student participants came from grades 9 through 12 in the following frequency: 188 (32.3%) were ninth graders, 140 (24.1%) were tenth graders, 160 (27.5%) were eleventh graders and 94 (16.2%) were twelfth graders. Family status varied among the students where 393 (67.5%) came from traditional families (families with two parents) while the other 189 (32.5%) students came from non-traditional families. The majority of the students, 297 (51.0%), were Black, while 224 (38.5%) were white and 61 (10.5%) were classified as "other."

Table 1.

Breakdown of Student Participants by Selected Student Characteristics (N=582)

Demographic Information	**Category**	**Frequency**	**Percent**
Gender	Male	260	44.7
	Female	322	55.3
Grade	9^{th}	188	32.3
	10^{th}	140	24.1
	11^{th}	160	27.5
	12^{th}	94	16.2
Age	14 and under	86	14.8
	15	164	28.2
	16	170	29.2
	17	112	19.2
	18 plus	50	8.5
Family status	Traditional	393	67.5
	Non-traditional	189	32.5
Race	Black	297	51.0
	White	224	38.5
	Other	61	10.5

Teacher Participants

A total of 30 teachers participated in the study. As indicated in Table 2, 14 (46.7%) were males and 16 (53.3%) were females. The average age of the teachers was 39.8, and the teachers in this survey averaged 12.3 years of teaching experience. Twenty-seven (90%) of the teachers only taught math while the other 3 (10%) taught at least one other subject. Seventeen (56.7%) of the teachers surveyed give homework assignments daily. Even though students are assigned homework daily, none of the teachers (0%) indicated that the quality of the homework assignments that they receive from the students is excellent. However, teachers indicated that 76.7% of received homework assignments were of either good or very good quality. Twenty-seven (90%) of the teachers put students in groups to facilitate learning.

Table 2

Breakdown of Teacher Participants by Selected Teacher Practices and Characteristics

Teacher Practices and Characteristics	**Category**	**Frequency**	**Percent**
Gender	Male	14	46.7
	Female	16	53.3
Age	20 – 29	4	13.3
	30 - 39	13	43.4
	40 – 49	7	23.3
	50 – 59	6	20.0

Teacher Practices and Characteristics	**Category**	**Frequency**	**Percent**
Years of teaching	0 – 10	14	46.7
	11 – 20	12	40.0
	21 – 30	2	6.7
	31 – 40	2	6.7
Teach other subjects?	Yes	3	10.0
	No	27	90.0
Homework frequency	Daily	17	56.7
	3 to 4 times a week	9	30.0
	twice a week	2	6.7
	once a week	2	6.7
	less than weekly	0	0.0
Quality of homework received	Excellent	0	0.0
	very good	9	30.0
	good	14	46.7
	fair	5	16.7
	poor	1	3.3
	very poor	1	3.3

(N = 30)

Table 3 lists the percent of time that the surveyed teachers gave various types of assignments. The vast majority of the math teachers in the survey (93.3%) used textbook questions when giving assignments to their students. The teachers also often used worksheets (70%). More than half of the teachers (53.3%) used questions that they themselves make up. Forty percent of the teachers give the students study assignments and 3.3% give them assignments other than those already mentioned.

Table 3.

Rank Order of Types of Mathematics Assignments given by Teachers

Type of Assignment	**Percent**	**Rank**
Textbook questions	93.3	1
Worksheets	70.0	2
Teacher-made questions	53.3	3
Study assignments	40.0	4
Other assignments	3.3	5

The problems that teachers face are summarized in Table 4. As indicated in the table, 63.3% of the teachers experience low student mathematics achievement. A majority of the teachers, 60%, also note that student attendance is unsatisfactory for reasons other than financial. Less than half of the teachers (46.7%) experience difficulty with disciplining students. The same percent of teachers (46.7%) feel overworked. The teachers do not appear to have to deal with economic hardships since only 10% indicate that they face bad student attendance due to non-pay, 6.7% face a lack of resources other than books, and only 3.3% deal with an insufficient number of textbooks.

Table 4.

Rank Order of the Problems Facing Teachers

Challenges That Teachers Face	**Percent**	**Rank**
Low student achievement	63.3	1
Poor student attendance for non-financial reasons	60.0	2
Difficulty with disciplining students	46.7	3.5
Being overworked	46.7	3.5
Student math anxiety	36.7	5
Poor student attendance due to financial reasons	10.0	6
Lack of resources other than text books	6.7	7.5
Poor curriculum from administration	6.7	7.5
Lack text books	3.3	9

Research Findings

Research findings in relation to the research questions are presented in the remainder of this chapter. The research findings will be presented according to each of the specific dimensions of students' mathematics self-efficacy.

Research Question 1

What are the dimensions of teacher and student mathematics self-efficacy?

The purpose of the questionnaire for teachers was to gather specific information regarding their efficacy, practices, and characteristics. The questionnaire is divided into three sections. The first section contained items related to teacher's mathematics self-efficacy, the second section gathers information about the teacher's practices, and the third section gathers information about the teacher's demographic characteristics.

Participating teachers responded to a 60-item Likert-type questionnaire. The factor analysis with Varimax Rotation identified the following four dimensions of teacher mathematics self-efficacy: a) Teacher belief of self competence in math; b) How accommodating and engaging teachers are; c) Teacher flexibility; and d) Teacher Competency relative to their peers. The Cronbach's Alpha was used to assess their internal consistency of reliability for each of the dimensions. The results are listed in Table 5.

From Table 5, we see that all of the Chronbach Alphas are greater than .800 (between .822 and .909, inclusive). This indicates a very high level of internal consistency of the items of each construct. A comparison of the mean of perceived teacher relative competency (3.28) and the mean of perceived teacher competency (2.34) shows that teachers feel more competent in their ability to teach mathematics relative to their peers than they do in their own mathematics teaching ability.

Table 5.

Chronbach Alphas for the Teachers' Mathematics Efficacy Constructs

Teacher Efficacy Construct	Number of items	Alpha	Mean*	SD
Teacher Competence - How Competent a Teacher Feels He is in Math	15	.909	2.34	0.55
Accommodating and Engaging - How Accommodating and Engaging of Students is He	14	.888	2.98	0.49
Teacher Flexibility -	15	.822	2.81	0.29
Relative Competence - Competence Relative to Other Teachers	11	.834	3.28	0.36

* The mean is between 1.00 and 4.00.

The student questionnaire was designed to gather specific information regarding students' mathematics self-efficacy and their individual demographic characteristics. The questionnaire is divided into two sections. The first section gathers information about the student's mathematics self-efficacy and the second section gathers information about the student's characteristics.

The factor analysis with Varimax Rotation identified the following five students' mathematics self-efficacy dimensions: a) Math competence, b) Math anxiety, c) Math interest, d) the Importance of math, and e) how at ease the student is with Math. The

Cronbach's Alpha was also used to assess the internal consistency of reliability for each of the dimensions of students' mathematics self-efficacy. The results are shown in Table 6.

Table 6.

Chronbach Alphas for the Students' Mathematics Self-Efficacy Constructs

Student Math Self-Efficacy Aggregate Variable	**Number of items**	**Alpha**	**Mean***	**SD**
How Competent the Student Feels He is in Math	13	.949	3.86	1.08
Student Math Anxiety	12	.913	3.88	1.07
How Interested the Student is in Math	10	.893	3.36	1.05
The Importance of Math to the Student	4	.740	4.46	1.00
Comfort or How at Ease the Student is with Math	8	.909	2.72	0.73

* The mean is between 1.00 and 6.00

From Table 6, we see that all of the Chronbach Alphas are high enough to indicate a high level of internal consistency of the items of each construct. The mean of 4.46 for the importance of math to students is the highest mean and shows that students acknowledge the importance of mathematics. Students are not very at ease with mathematics as indicated by the relatively low mean of 2.72 for that dimension.

Research Question 2

To what extent do individual student variables such as tutoring, family structure, gender, race, and educational aspirations predict the dimensions of student's mathematics self-efficacy?

A multiple linear regression model was used to determine the extent to which certain student variables such as tutoring, family structure, gender, race, and educational aspirations can predict aspects of their mathematics self-efficacy. The results associated with students' math competency are presented in Table 7.

Table 7.

Multiple Linear Regression Results for the Prediction of Students' Mathematics Competency by Selected Student Variables

Student Variable	**Standardized (β)**	**Unstandardized (B)**	**P-value**
Gender	0.07	0.16	
(1=male, 0=female)			0.022*
Age	0.01	0.01	0.662
Any siblings	0.02	0.05	0.657
(1=yes, 0=no)			
Number of siblings	- 0.03	- 0.02	0.403
Grade point average	0.15	0.28	0.000**

Student Variable	Standardized (β)	Unstandardized (B)	P-value
Amount of tutoring received	0.10	0.05	0.003**
Family status (1=traditional, 0=non-traditional)	- 0.03	- 0.06	0.443
Race (1=white, 0=non-white)	- 0.10	- 0.23	0.002**
Expected race	0.57	0.67	0.000**

* $p < 0.05$ ** $p < 0.01$

Results from Table 7 shows that gender ($\beta = 0.07$, $p < 0.05$), GPA ($\beta = 0.15$, $p < 0.01$), amount of tutoring ($\beta = 0.10$, $p < 0.01$), Race ($\beta = -0.10$, $p < 0.01$), and expected grade ($\beta = 0.57$, $p < 0.01$) were significant predictors of students' mathematics competency.

In this case, males were found to have a significantly higher level of perceived math competence than females. Students' grade point averages and the amount of tutoring that they receive were each positively related to their perceived competence in math. White students were found to have a lower perceived competent in math than non-white students. Students' expected grades in mathematics was positively related to their perceived math competency.

A different multiple linear regression model was used to determine the extent to which certain student variables such as expected grade, gender, and educational aspirations can predict students' mathematics anxiety. Results are presented in Table 8.

Table 8.

Multiple Linear Regression Results for the Prediction of Students' Mathematics Anxiety by Selected Student Variables

Student Variable	**Standardized (β)**	**Unstandardized (B)**	**P-value**
Gender (1=male, 0=female)	0.14	0.30	0.000**
Age	0.06	0.05	0.110
Any siblings (1=yes, 0=no)	0.00	0.00	0.973
Number of siblings	- 0.04	- 0.03	0.366
Grade point average	0.14	0.25	.001**
Amount of tutoring received	0.11	0.06	.003**
Family status (1=traditional, 0=non-traditional)	- 0.03	- 0.06	0.446
Race (1=white, 0=non-white)	- 0.11	- 0.24	.005**
Expected race	0.43	0.49	.000**

* $p < 0.05$ ** $p < 0.01$

Results for Table 8 shows that gender ($\beta = 0.14$, $p < 0.01$), GPA ($\beta = 0.14$, $p < 0.01$), amount of tutoring ($\beta = 0.11$, $p < 0.01$), Race ($\beta = -0.11$, $p < 0.01$), and expected grade ($\beta = 0.43$, $p < 0.01$) were significant predictors of students' mathematics anxiety. In this case males were found to have a significantly higher level of math anxiety than females. The higher a student's grade point average, the higher the math anxiety. Students' math anxiety increased as the amount of tutoring students receive increased. White students had less math anxiety than non-white students. Students' expected grade in mathematics was positively related to their math anxiety.

Table 9 presents the results of a multiple linear regression model that was used to determine the extent to which certain student variables such as tutoring, gender, race, and educational aspirations can predict students' mathematics interest.

Table 9.

Multiple Linear Regression Results for the Prediction of Students' Mathematics Interest by Selected Student Variables

Student Variable	**Standardized (β)**	**Unstandardized (B)**	**P-value**
Gender (1=male, 0=female)	0.06	0.13	0.108
Age	0.01	0.01	0.822
Any siblings (1=yes, 0=no)	0.02	0.05	0.680
Number of siblings	0.04	0.03	0.386

Student Variable	Standardized (β)	Unstandardized (B)	P-value
Grade point average	0.07	0.13	0.090
Amount of tutoring received	- 0.05	- 0.03	0.164
Family status (1=traditional, 0=non-traditional)	- 0.08	- 0.18	0.032*
Race (1=white, 0=non-white)	- 0.11	- 0.25	0.003**
Expected race	0.47	0.49	0.000**

* p < 0.05 ** p < 0.01

Results from Table 9 shows that Family Status (β = -0.08, $p < 0.05$), Race (β = -0.11, $p < 0.01$), and expected grade (β = 0.47, $p < 0.01$) were significant predictors of students' mathematics interest.

Students from traditional households were less interested in mathematics than those from non-traditional households. White students were found to have a lower perceived interest in mathematics than non-white students. Students' expected grade in mathematics was positively related to how interested that they were in mathematics.

A different multiple linear regression model was used to determine the extent to which certain student variables such as family structure, gender, and race can predict students' mathematics importance. Those results are presented in Table 10.

Table 10.

Multiple Linear Regression Results for the Prediction of Students' Mathematics Importance by Selected Student Variables

Student Variable	**Standardized (β)**	**Unstandardized (B)**	**P-value**
Gender (1=male, 0=female)	0.06	0.13	0.108
Age	0.01	0.01	0.822
Any siblings (1=yes, 0=no)	0.02	0.05	0.680
Number of siblings	0.04	0.03	0.386
Grade point average	0.07	0.13	0.090
Amount of tutoring received	- 0.05	- 0.03	0.164
Family status (1=traditional, 0=non-traditional)	- 0.08	- 0.18	0.032*
Race (1=white, 0=non-white)	- 0.11	- 0.25	0.003**
Expected race	0.47	0.49	0.000**

* $p < 0.05$ ** $p < 0.01$

Results from Table 10 shows that GPA ($\beta = 0.20$, $p < 0.01$), family status ($\beta = -0.08$, $p < 0.05$), Race ($\beta = -0.16$, $p < 0.01$), and expected grade ($\beta = 0.44$, $p < 0.01$) were significant predictors of students' mathematics importance.

Table 10 presents the average coefficients for the effects of the student-level variables on student math importance. The higher a student's grade point average, the more importance the student will place on mathematics. Non-white students realize the importance of mathematics more than white students do. Students' expectations of their mathematics grade is positively related to the importance they place on mathematics.

A different multiple linear regression model was used to determine the extent to which certain student variables such as tutoring, family structure, gender, race, and educational aspirations can predict students' mathematics comfort. Table 11 shows those results.

Results from Table 11 shows that gender ($\beta = 0.10$, $p < 0.01$), age ($\beta = 0.08$, $p < 0.05$), GPA ($\beta = 0.13$, $p < 0.01$), amount of tutoring ($\beta = 0.14$, $p < 0.01$), and expected grade ($\beta = 0.41$, $p < 0.01$) were significant predictors of students' mathematics comfort.

Table 11 presents the average coefficients for the effects of the student-level variables on student math comfort. The results show that males are more at ease with mathematics than females are. As students grow older they become more comfortable with mathematics. Students' grade point averages, the amount of tutoring that they receive, and their expectation of their mathematics grade are all positively related to their perceived comfort with mathematics.

Table 11.

Multiple Linear Regression Results for the Prediction of Students' Mathematics Comfort by Selected Student Variables

Student Variable	Standardized (β)	Unstandardized (B)	P-value
Gender (1=male, 0=female)	0.10	- 0.07	0.005**
Age	0.08	0.15	0.032**
Any siblings (1=yes, 0=no)	0.00	0.05	0.924
Number of siblings	- 0.05	- 0.02	0.251
Grade point average	0.13	0.16	0.003**
Amount of tutoring received	0.14	0.05	0.000**
Family status (1=traditional, 0=non-traditional)	0.01	0.02	0.708
Race (1=white, 0=non-white)	- 0.05	- 0.04	0.194
Expected race	0.41	0.32	0.000**

* $p < 0.05$ ** $p < 0.01$

Research Question 3

To what extent does teacher efficacy predict the dimensions of student's mathematics self-efficacy?

In order to identify important student level variables to be used in the HLM model, a stepwise regression analysis was used. Students expected grade was used in all of the models because it was assumed to be a significant aspect of student mathematics self-efficacy.

Mathematics Competence

The student-level variables that were identified to be significant predictors of their perceived mathematics competency were race, gender, and expected grade. A series of two-level HLM were used with these students' variables as level-1 predictors and each of the dimensions of teachers' mathematics self-efficacy as predictors at level-2. The student-level model coefficients associated with race, gender, and expected grade were treated as dependent variables in the teacher-level model. Through this process, the relationship between student-level variables and teacher-level variables on the outcome were modeled.

Table 12 shows the results of the teacher-level model for the relationship between teacher characteristics and practices on the classroom adjusted average (β_0) of student perception of mathematics competency. The data shows that teacher competency ($\gamma = 1.53$, $p < 0.01$), teacher relative competency ($\gamma = 1.14$, $p < 0.01$), engagement and accommodation ($\gamma = 1.24$, $p < 0.01$), flexibility ($\gamma = 1.34$, $p < 0.01$), gender ($\gamma = 3.67$, $p < 0.01$), experience ($\gamma = 0.21$, $p < 0.01$), homework frequency ($\gamma =$

1.78, $p < 0.01$), and grouping students ($\gamma = 1.03$, $p < 0.01$) all have significant positive relationships with the classroom adjusted average (β_0) of student perceived mathematics competency. For example, as a teacher's belief in their math competence increases so does their students' beliefs in their math competence. Students perceived mathematics competence also increases when teacher perceived relative competency increases. In fact, increases in: teacher engagement of their students, teacher flexibility, teaching experience, homework assignments, and grouping of students all have the effect of increasing students perceived math competence. Classrooms taught by male teachers have students whose judgment of their math competence is 3.67 points higher than those classrooms taught by female teachers.

Table 12.

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Classroom Adjusted Average (β_0) of Students' Perceived Mathematics Competency

Teacher Characteristic or Practice	**Coefficient**	**P – value**
Competency	1.53	0.000
Relative competency	1.14	0.000
Engagement and accommodation	1.24	0.000
Flexibility	1.34	0.000
Gender	3.67	0.000
Experience	0.21	0.000
Homework frequency	1.78	0.000
Grouping students	1.03	0.000

Table 13 presents the results of the teacher-level model for the relationship between teacher characteristics and practices on the gender gap (β_1) in students' perceived mathematics competency. The data shows that teacher competency (γ = 0.08, $p < 0.05$), teacher relative competency (γ = 0.05, $p < 0.05$), engagement and accommodation (γ = 0.06, $p < 0.05$), flexibility (γ = 0.06, $p < 0.05$), gender (γ = 0.26, $p < 0.01$), experience (γ = 0.01, $p < 0.05$), and grouping students (γ = 0.06, $p < 0.01$) all have significant positive relationships with the gender gap (β_1) of students' perceived mathematics competency. For example, teacher competence results in a gender gap between male and female students that is wider as it relates to belief in their competence in math. As a teacher's belief that they are more competent relative to their teaching peers' increases, the gender gap between male and female students becomes wider concerning their belief that they are competent in math. In fact, the gap also widens with increases in: engagement of students, flexibility, experience, and grouping. Classrooms taught by male teachers have a gender gap between male and female students that is wider with respect to belief in their math competence than classrooms taught by female teachers. What occurs in each case is that both males and females have a higher perception of their competence in mathematics but the gap between their perceptions of that competence becomes wider.

Table 13.

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Students' Gender Gap (β_1) in Perceived Mathematics Competency

Teacher Characteristic or Practice	**Coefficient**	**P – value**
Competency	0.078	0.013
Relative competency	0.05	0.036
Engagement and accommodation	0.06	0.014
Flexibility	0.06	0.031
Gender	0.26	0.005
Experience	0.01	0.021
Homework frequency	0.08	0.058
Grouping students	0.06	0.004

The results of the teacher-level model for the relationship between teacher characteristics and practices on the racial gap between white and non-white students (β_2) in perceived mathematics competency are listed in Table 14. The data shows that none of the teacher-level variables have significant relationships on the racial gap between white and non-white students (β_2) in perceived mathematics competency.

Table 14.

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Racial Gap Between White and Non-white Students (β_2) in Perceived Mathematics Competency

Teacher Characteristic or Practice	**Coefficient**	**P – value**
Competency	0.04	0.605
Relative competency	- 0.01	0.877
Engagement and accommodation	0.00	0.993
Flexibility	0.01	0.888
Gender	0.14	0.626
Experience	0.00	0.924
Homework frequency	0.09	0.275
Grouping students	- 0.02	0.710

Math Anxiety

The student-level variables that were identified for mathematics anxiety were race, gender, and expected grade. A series of two-level HLM were used with students' race, gender, and expected grade as level-1 predictors and each of the teachers' mathematics dimensions as predictors at level-2.

The student-level model coefficients associated with race, gender, and expected grade were used as dependent variables in the teacher-level model. Through this process, the effects of both student-level variables and teacher-level variables on the outcome were accurately modeled.

Table 15 displays the results of the teacher-level model for the relationship between teacher characteristics and practices on the classroom adjusted average (β_0) of student mathematics anxiety. The data shows that teacher competency ($\gamma = 1.52$, $p < 0.01$), teacher relative competency ($\gamma = 1.14$, $p < 0.01$), engagement and accommodation ($\gamma = 1.24$, $p < 0.01$), flexibility ($\gamma = 1.33$, $p < 0.01$), gender ($\gamma = 3.66$, $p < 0.01$), experience ($\gamma = 0.21$, $p < 0.01$), homework frequency ($\gamma = 1.79$, $p < 0.01$), and grouping students ($\gamma = 1.03$, $p < 0.01$) all have significant positive relationships on the classroom adjusted average (β_0) of student mathematics anxiety. For example, as a teacher's feelings about their competence in math increases, so does student math anxiety. Increases in relative teacher competency have the same effect. Likewise, increases in: teachers' engagement of students, flexibility, experience, homework, and grouping are all accompanied with an increase in the math anxiety of students. Classrooms taught by male teachers have higher student math anxiety than those classrooms taught by female teachers by 3.66 points.

Table 15.

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Classroom Adjusted Average (β_0) of Student Mathematics Anxiety

Teacher Characteristic or Practice	**Coefficient**	**P – value**
Competency	1.52	0.000
Relative competency	1.14	0.000
Engagement and accommodation	1.24	0.000
Flexibility	1.33	0.000
Gender	3.66	0.000
Experience	0.21	0.000
Homework frequency	1.79	0.000
Grouping students	1.03	0.000

Table 16 displays the results of the teacher-level model for the relationship between teacher characteristics and practices on the gender gap (β_1) of student mathematics anxiety. The data shows that teacher competency ($\gamma = 0.13$, $p < 0.01$), teacher relative competency ($\gamma = 0.10$, $p < 0.01$), engagement and accommodation ($\gamma = 0.11$, $p < 0.01$), flexibility ($\gamma = 0.11$, $p < 0.01$), gender ($\gamma = 0.42$, $p < 0.01$), experience ($\gamma = 0.02$, $p < 0.05$), homework frequency ($\gamma = 0.15$, $p < 0.01$), and grouping students ($\gamma = 0.10$, $p < 0.01$) all have significant positive relationships on the gender gap (β_1) of student mathematics anxiety. For example, increases in teacher competency, relative teacher competency, accommodation of their students, flexibility, teaching experience, assigning of homework, and student grouping all have the effect of widening the gender gap between male and female students with respect to their anxiety with mathematics. Also, classrooms taught by male teachers have a gender gap between male and female students that is wider with respect to math anxiety. What occurs in each case is that gender gaps widens with respect to student mathematics anxiety.

Table 16.

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Students' Gender Gap (β_1) in Student Mathematics Anxiety

Teacher Characteristic or Practice	**Coefficient**	**P – value**
Competency	0.13	0.000
Relative competency	0.10	0.000
Engagement and accommodation	0.11	0.000
Flexibility	0.11	0.000
Gender	0.42	0.000
Experience	0.02	0.000
Homework frequency	0.15	0.002
Grouping students	0.10	0.000

Table 17 displays the results of the teacher-level model for the relationship between teacher characteristics and practices on the racial gap between white and non-white students (β_2) in student mathematics anxiety. The data shows that none of the teacher-level variables have significant relationships on the racial gap between white and non-white students (β_2) in student mathematics anxiety.

Table 17

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Racial Gap Between White and Non-white Students (β_2) in Student Mathematics Anxiety

Teacher Characteristic or Practice	**Coefficient**	**P – value**
Competency	- 0.02	0.740
Relative competency	- 0.04	0.390
Engagement and accommodation	- 0.05	0.398
Flexibility	- 0.03	0.561
Gender	0.04	0.882
Experience	- 0.01	0.487
Homework frequency	0.00	0.988
Grouping students	- 0.06	0.175

Math Interest

The student-level variables that were identified for mathematics interest were race and expected grade. A series of two-level HLM were used with students' race and expected grade as level-1 predictors and each of the teachers' mathematics dimensions as predictors at level-2.

The student-level model coefficients associated with race and expected grade were used as dependent variables in the teacher-level model. Through this process, the effects of both student-level variables and teacher-level variables on the outcome were accurately modeled. Table 18 displays the results of the teacher-level model for the relationship between teacher characteristics and practices on the classroom adjusted average (β_0) of student mathematics interest. The data shows that teacher competency ($\gamma = 1.42$, $p < 0.01$), teacher relative competency ($\gamma = 1.06$, $p < 0.01$), engagement and accommodation ($\gamma = 1.16$, $p < 0.01$), flexibility ($\gamma = 1.24$, $p < 0.01$), gender ($\gamma = 3.30$, $p < 0.01$), experience ($\gamma = 0.21$, $p < 0.01$), homework frequency ($\gamma = 1.60$, $p < 0.01$), and grouping students ($\gamma = 0.97$, $p < 0.01$) all have significant positive relationships on the classroom adjusted average (β_0) of student mathematics interest. For example, as a teacher's belief in their math competence increases, student math interest increases. Student mathematics interest also increases as a teacher's belief that they are competent relative to their teaching peers' increases. Teacher engagement of their students also has the effect of producing students who are more interested in mathematics. Students are more interested in math when teachers are more flexible and accommodating. Classrooms taught by male teachers have students who are more interested in math than those classrooms taught by female teachers. As teachers become more experienced, they are better able to keep students interested in math. The more often homework is assigned the more interested students will be in mathematics. In a similar vein, frequent student grouping produces students who are more interested in math. What occurs in each case is that students are more interested in mathematics.

Table 18.

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Classroom Adjusted Average (β_0) of Student Mathematics Interest

Teacher Characteristic or Practice	**Coefficient**	**P – value**
Competency	1.42	0.000
Relative competency	1.06	0.000
Engagement and accommodation	1.16	0.000
Flexibility	1.24	0.000
Gender	3.30	0.000
Experience	0.21	0.000
Homework frequency	1.60	0.000
Grouping students	0.97	0.000

Table 19 displays the results of the teacher-level model for the relationship between teacher characteristics and practices on the racial gap between white and non-white students (β_2) in student mathematics interest. The data shows that none of the teacher-level variables have significant relationships on the racial gap between white and non-white students (β_2) of student mathematics interest.

Table 19

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Racial Gap Between White and Non-white Students (β_2) in Student Mathematics Interest

Teacher Characteristic or Practice	**Coefficient**	**P – value**
Competency	- 0.02	0.742
Relative competency	- 0.04	0.322
Engagement and accommodation	- 0.05	0.336
Flexibility	- 0.02	0.595
Gender	0.02	0.950
Experience	- 0.02	0.128
Homework frequency	0.02	0.809
Grouping students	- 0.06	0.240

The Importance of Math

The student-level variables that were identified for the importance of mathematics were race, gender, and expected grade. A series of two-level HLM were used with students' race, gender, and expected grade as level-1 predictors and each of the teachers' mathematics dimensions as predictors at level-2.

The student-level model coefficients associated with race, gender, and expected grade were used as dependent variables in the teacher-level model. Through this process, the effects of both student-level variables and teacher-level variables on the outcome were accurately modeled.

Table 20 displays the results of the teacher-level model for the relationship between teacher characteristics and practices on the classroom adjusted average (β_0) of the importance of mathematics to students. The data shows that teacher competency ($\gamma = 1.74$, $p < 0.01$), teacher relative competency ($\gamma = 1.29$, $p < 0.01$), engagement and accommodation ($\gamma = 1.40$, $p < 0.01$), flexibility ($\gamma = 1.51$, $p < 0.01$), gender ($\gamma = 4.28$, $p < 0.01$), experience ($\gamma = 0.24$, $p < 0.01$), homework frequency ($\gamma = 2.06$, $p < 0.01$), and grouping students ($\gamma = 1.16$, $p < 0.01$) all have significant positive relationships on the classroom adjusted average (β_0) of the importance of mathematics to students. For example, as a teacher's belief that they are competent increases so does the importance of mathematics in their students' minds. Increases in teacher relative competency have the same effect. Students believe that math is more important when teachers engage their students more often and are more accommodating of them. Greater teacher flexibility leads to students who are more interested in mathematics. Students are more interested in math in classrooms taught by male teachers. More experienced teachers have more interested math students. Frequent homework assignments increase students' beliefs in the importance of math. When teachers place their students in groups often, students tend to be more interested in mathematics.

Table 20

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Classroom Adjusted Average (β_0) of Importance of Mathematics to Students

Teacher Characteristic or Practice	Coefficient	P – value
Competency	1.74	0.000
Relative competency	1.29	0.000
Engagement and accommodation	1.40	0.000
Flexibility	1.51	0.000
Gender	4.28	0.000
Experience	0.24	0.000
Homework frequency	2.06	0.000
Grouping students	1.16	0.000

Table 21 displays the results of the teacher-level model for the relationship between teacher characteristics and practices on the racial gap between black and non-black students (β_1) of the importance of mathematics to students. The data shows that teacher competency ($\gamma = 0.12$, $p < 0.05$), teacher relative competency ($\gamma = 0.09$, $p < 0.05$), engagement and accommodation ($\gamma = 0.10$, $p < 0.05$), flexibility ($\gamma = 0.10$, $p < 0.05$), experience ($\gamma = 0.02$, $p < 0.05$), homework frequency ($\gamma = 0.13$, $p < 0.05$), and grouping students ($\gamma = 0.10$, $p < 0.01$) all have significant positive relationships on the effect of the racial gap between black and non-black students (β_2) in the importance of mathematics to students. For example, increases in a teacher's belief in their math competence widen the racial gap between black and non-black students with respect to their students' beliefs in the importance of math. Increases in a teacher's belief in their relative math competence produce the same result. The more the teachers are engaging of their students, the wider will be the racial gap between black and non-black students with respect to their belief in the importance of math. An increase in teacher flexibility produces a wider racial gap between black and non-black students concerning the importance of math. As teachers become more experienced, the racial gap between black and non-black students as far as their view of the importance of math gets wider. More frequent homework leads to the same result. In fact, grouping students more often also produces a wider racial gap between black and non-black students concerning the importance of math. What occurs in each case is that racial gap is widened with respect to the realization of the importance of mathematics.

Table 21.

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Racial Gap between Black and Non-black Students (β_2) in the Importance of Mathematics to Students

Teacher characteristic or Practice	**Coefficient**	**P – value**
Competency	0.12	0.013
Relative competency	0.09	0.018
Engagement and accommodation	0.10	0.015
Flexibility	0.10	0.016
Gender	0.29	0.189
Experience	0.02	0.043
Homework frequency	0.13	0.042
Grouping students	0.10	0.002

Comfort with Math

The student-level variables that were identified for mathematics comfort were gender and expected grade. A series of two-level HLM were used with students' gender and expected grade as level-1 predictors and each of the teachers' mathematics dimensions as predictors at level-2.

The student-level model coefficients associated with gender and expected grade were used as dependent variables in the teacher-level model. Through this process, the effects of both student-level variables and teacher-level variables on the outcome were accurately modeled.   Table 22 displays the results of the teacher-level model for the relationship between teacher characteristics and practices on the classroom adjusted average (β_0) of student mathematics comfort. The data shows that teacher competency ($\gamma = 1.07$, $p < 0.01$), teacher relative competency ($\gamma = 0.80$, $p < 0.01$), engagement and accommodation ($\gamma = 0.87$, $p < 0.01$), flexibility ($\gamma = 0.93$, $p < 0.01$), gender ($\gamma = 2.64$, $p < 0.01$), experience ($\gamma = 0.15$, $p < 0.01$), homework frequency ($\gamma = 1.26$, $p < 0.01$), and grouping students ($\gamma = 0.71$, $p < 0.01$) all have significant positive relationships on the classroom adjusted average (β_0) of student mathematics comfort. For example, increased self-belief in teacher competence increases student comfort with math. When teachers improve in their feeling of competence relative to their teaching peers, students become more comfortable with math. By increasing their engagement of students, teachers will cause their students to be more comfortable with mathematics. The same result occurs when teachers become more flexible. Classrooms taught by male teachers have students who are more comfortable with math than those classrooms taught by female teachers. As teachers become more experienced, their students become more comfortable with mathematics. Increasing the frequency of homework assignments also leads to students who are more likely to be comfortable with mathematics. Students who are placed in groups more often are also more likely to have a high amount of comfort with math.

Table 22.

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Classroom Adjusted Average (β_0) of Student Comfort with Mathematics

Teacher Characteristic or Practice	**Coefficient**	**P – value**
Competency	1.07	0.000
Relative competency	0.80	0.000
Engagement and accommodation	0.87	0.000
Flexibility	0.93	0.000
Gender	2.64	0.000
Experience	0.15	0.000
Homework frequency	1.26	0.000
Grouping students	0.71	0.000

Table 23 displays the results of the teacher-level model for the relationship between teacher characteristics and practices on the gender gap (β_1) of student mathematics comfort. The data shows that teacher competency ($\gamma = 0.07$, $p < 0.01$), teacher relative competency ($\gamma = 0.05$, $p < 0.01$), engagement and accommodation ($\gamma = 0.06$, $p < 0.01$), flexibility ($\gamma = 0.06$, $p < 0.01$), gender ($\gamma = 0.16$, $p < 0.05$), experience ($\gamma = 0.01$, $p < 0.01$), homework frequency ($\gamma = 0.07$, $p < 0.05$), and grouping students ($\gamma = 0.05$, $p < 0.01$) all have significant positive relationships on the gender gap (β_1) in student mathematics anxiety. Increases in teacher competency, teacher relative competency, engagement and accommodation, flexibility, experience, homework frequency, and student grouping all widen the gender gap with respect to student comfort with mathematics. Classrooms taught by male teachers have a wider gender gap between male and female students concerning their comfort with math than those classrooms taught by female teachers. What occurs in each case is that the gender gap widens with respect to student comfort with mathematics.

Table 23

HLM Results for the Relationship Between Teacher Characteristics and Practices on the Gender Gap (β_1) in Student Mathematics Comfort

Teacher characteristic or Practice	**Coefficient**	**P – value**
Competency	0.07	0.001
Relative competency	0.05	0.000
Engagement and accommodation	0.06	0.001
Flexibility	0.06	0.000
Gender	0.16	0.010
Experience	0.01	0.000
Homework frequency	0.07	0.037
Grouping students	0.05	0.000

CHAPTER V

SUMMARY, DISCUSSION,

AND IMPLICATIONS FOR PRACTICE

Chapter five is divided into five sections. The first section provides a summary of the findings. Section two discusses the key findings of the study. Section three provides implications and recommendations based on the findings. The fourth section gives recommendations for future research. Section five lists the limitations of the study.

Summary of the Findings

Research Question 1

What are the dimensions of teacher and student mathematics self-efficacy?

In order to improve student math performance it was first necessary to identify the dimensions of teacher and student mathematics self-efficacy. Research question one addressed this issue. The study found that there are practices that teachers would do well to implement in order to positively affect the math self-efficacy of their students. The effected self-efficacy variables are: a) student perceived mathematics competence, b) student math anxiety, c) the interest of the student in math, d) how important math is to the student, and e) how at ease a student is with math. The teacher practices that were found to affect these math self-efficacy variables include: a) engaging and accommodating students, b) being flexible when dealing with students, c) giving homework assignments frequently, and d) placing students in groups.

Research Question 2

> *To what extent do individual student variables such as tutoring, family structure, gender, race, and educational aspirations predict the dimensions of student's mathematics self-efficacy?*

Research question two sought to determine the extent to which student variables predicted student mathematics self-efficacy. These practices will be discussed in the context of the five student math self-efficacy variables.

Student gender, grade point average, the amount of tutoring that students receive, students' race, and students' expected math grade were all determined to be significant predictors of students' perception of their math competence. All except race were found to be positively related with students' perceived math competence. Boys have a higher perceived math competence than girls. Being white was found to be negatively related with students' perceived math competence. This means that white students have a lower perception of their math competence than non-white students.

Student gender, grade point average, the amount of tutoring that students receive, students' race, and students' expected math grade were also the student variables that were determined to be significant predictors of students' mathematics anxiety. All except race were found to be positively related with students' perceived math anxiety. Boys have a higher level of math anxiety than girls. Being white was found to be negatively related with students' math anxiety. This means that white students have a lower level of math anxiety than non-white students.

When it comes to how interested that students are in mathematics, family status, students' race, and students' expected math grade were all determined to be significant predictors of students' perception of their math competence. Students' expected math grade is positively correlated with students' interest in mathematics. Both family status and race were found to be negatively correlated with students' math interest. This means that students from traditional families are less interested in mathematics than those from non-traditional families and white students are less interested in mathematics than non-white students.

Grade point average, family status, students' race, and students' expected math grade were all determined to be significant predictors of how much importance students place on mathematics. GPA and students' expected grade were found to be positively correlated with the importance of mathematics to students while family status and race were found to be negatively correlated with students' feeling of how important math is. This means that students from traditional households have a lower perception of the importance of mathematics than those from non-traditional households. White students do not feel that mathematics is as important as non-white students do.

Student gender, age, grade point average, the amount of tutoring that students receive, and students' expected math grade were all determined to be significant predictors of students' perception of their math comfort. All except age were found to be positively correlated with students' perceived math comfort. Boys are more comfortable with mathematics than girls. The higher a student's GPA is the more comfortable he will be with mathematics. More tutoring raises the comfort level of students with mathematics. The higher that students' expectation of their math grade is the more at ease they will be with math. The older students become the less comfortable they are with mathematics.

Research Question 3

To what extent does teacher efficacy predict the dimensions of student's mathematics self-efficacy?

Research question three investigated the extent to which teacher practices and characteristics predict students' mathematics self-efficacy. These practices and characteristics will be discussed in the context of the five student math self-efficacy variables.

Teachers' perceived competency, perceived relative competency, engagement of students, flexibility, gender, experience, homework frequency, and student grouping were all found to predict students' perceived mathematics competency. Each is positively related with students' perceived math competency. An increase in each variable increases the perceived math competence of students. Students have a higher perception of their mathematics competency in classrooms that are taught by male teachers. All of the practices and characteristics, except homework frequency, have significant positive relationships with the students' gender gap in perceived mathematics competency. An increase in each variable increases the perceived math competence of both boys and girls. The increase is greater with boys, thus widening the gender gap in perceived mathematics competency since boys already have a higher perceived math competence than girls. Concerning teacher gender, this means that in classrooms where the teacher is a male the aforementioned result occurs. None of the teacher variables, however, were found to have significant relationships with the racial gap between white and non-white students in perceived mathematics competency.

Teachers' perceived competency, perceived relative competency, engagement of students, flexibility, gender, experience, homework frequency, and student grouping were all found to predict students' mathematics anxiety. Each is positively related with students' math anxiety. An increase in each variable increases the math anxiety of students. Students have more anxiety in classrooms that are taught by male teachers. All of the practices and characteristics have significant positive relationships with the students' gender gap in mathematics anxiety. An increase in each variable increases the math anxiety of both boys and girls. The increase is greater with boys, thus widening the gender gap in mathematics anxiety since boys already have a higher level of math anxiety than girls. Concerning teacher gender, this means that in classrooms where the teacher is a male the aforementioned result occurs. None of the teacher variables, however, were found to have significant relationships with the racial gap between white and non-white students in mathematics anxiety.

Teachers' perceived competency, perceived relative competency, engagement of students, flexibility, gender, experience, homework frequency, and student grouping were all found to predict students' mathematics interest. Each is positively related with how interested students are in mathematics. An increase in each variable increases students' interest in mathematics. Students are more interested in mathematics in classrooms that are taught by male teachers. None of the teacher variables were found to have significant relationships on the racial gap between white and non-white students in mathematics interest.

Teachers' perceived competency, perceived relative competency, engagement of students, flexibility, gender, experience, homework frequency, and student grouping were all found to predict the importance students give to mathematics. Each is positively related with students' math importance. An increase in each variable increases the importance of math to students. Students feel that math is more important in classrooms that are taught by male teachers. All of the practices and characteristics, except teacher gender, have significant positive relationships with the students' racial gap in mathematics importance. An increase in each variable increases the importance of math to both black students and non-black students. The increase is greater with black students, thus widening the racial gap in mathematics importance since black students already place a higher level of importance on mathematics than non-black students.

Teachers' perceived competency, perceived relative competency, engagement of students, flexibility, gender, experience, homework frequency, and student grouping were all found to predict students' mathematics comfort. Each is positively related with how comfortable students are with mathematics. An increase in each variable increases the comfort level of mathematics students. Students are more at ease in classrooms that are taught by male teachers. All of the practices and characteristics have significant positive relationships with the students' gender gap in mathematics comfort. An increase in each variable increases the math comfort of both boys and girls. The increase is greater with boys, thus widening the gender gap in mathematics comfort since boys are already more at ease than girls are with mathematics. Concerning teacher gender, this means that while both boys and girls are more at ease in classrooms where the teacher is a male, the benefit is greater for boys.

Discussion

There is a definite decline in the mathematics performance of United States students. Teachers are confronted with the difficult task of meeting the needs of these mathematics students. School teachers, whose positions lend them considerable influence and power over a student's experiences, are very important to the success of high school students in mathematics. Unfortunately, they can also unwittingly contribute to a student having low self-efficacy and a resulting poor performance in math. Researchers have demonstrated that the beliefs of teachers influence both their classroom behavior and student outcomes. Some researchers have suggested that teachers would be well served by paying as much attention to their students' perceptions of competence as they do to their actual competence (Hackett & Betz, 1989).

The study finds that there are practices that teachers would do well to implement in order to positively affect the math self-efficacy of their students. The effected self-efficacy variables are: a) Student competence; b) student math anxiety, c) how interested in math the student is, d) how important math is to the student, and e) how at ease a student is with math. The teacher practices that were found to be significant predictors of these math self-efficacy variables include: a) engaging and accommodating students; b) being flexible when dealing with students, c) giving homework assignments frequently, and d) placing students in groups. These practices will be discussed in the context of the five student math self-efficacy variables.

Student Mathematics Competency

Student math competency refers to how competent students believe that they are in mathematics. The results show that all four of the aforementioned teacher practices are significant predictors of the student expectation of the grade that they will receive in the course and the amount of tutoring predicts student math competence. Student engagement, flexibility, and grouping significantly predict how student grade point average affects student competence in math. These three teacher practices also moderate the effect of gender on student competence. In other words, it would be a good idea for teachers to be engaging of their students, flexible, and group their students in order to narrow the gender gap in mathematics. By implementing these practices, the study shows that teachers will help high school both boys and girls perform at a higher level but boys will receive the greater benefit.

Student Mathematics Anxiety

Anxiety is often blamed for poor student performance on math tests. Research studies have shown that anxiety has an inverse relationship with student performance. Other researchers, however, reveal that anxiety can be one of the positive motivational factors (Wolters et al, 1996). This apparent discrepancy can be explained by the realization that while low and high levels of anxiety are detrimental to performance in mental tasks (Hopko et al., 2003), medium levels of anxiety enhance student performance (Warwick, 2008). In fact, anxiety has a curvilinear relationship with performance as well as with self-efficacy (Keeley et al., 2008).

In the context of this study we expected the levels of anxiety to be at the medium level because recent studies have shown that this is usually the case in the United States (Yenilmex, 2007). We therefore, expected to see a positive relationship between anxiety and math self-efficacy if a significant relationship existed at all.

The results of this survey support our expectations by showing that student anxiety with math is positively related to math self-efficacy. The results show that teachers can raise student anxiety by engaging their students, by being flexible, by assigning homework often, and by frequently grouping their students. When teachers employ these practices, they raise their students' expectations of their final grade. This brings with it more student anxiety which results in the students performing better in math. In much the same way, the employment of these practices results in the student seeking more tutoring and also earning a higher grade point average. Both result in higher anxiety and better performance in math. Perhaps the most important finding in this area is that the four aforementioned practices narrow the gender gap in this area. Girls are shown to perform better from the anxiety that results from these practices.

Student Mathematics Interest

How interested a student is in mathematics is another indicator of student success in math. When individuals are not interested in a subject, they do not usually perform well in it. The results of this study show that student engagement, teacher flexibility, homework frequency, and student grouping all affect student expectation of their final grade which raises their interest in mathematics. A very interesting finding of the study is that grouping students significantly affects the impact of family status on a student's interest in math. In other words, grouping students who all come from families that do not have both a father and mother makes them more interested in math.

Importance of Mathematics to Students

How important math is to the student is a predictor of student success in mathematics. If a teacher does what the results of this study suggest and begins utilizing all four of the previously mentioned practices, student success will improve. The affected student math self-efficacy variables are the student's expected grade and grade point average and being black. An important finding is that black students will realize how very important math is when these four practices are used. It is only when they consider math important that they will perform to their ability. Since the majority of student participants in this survey (51%) and in most urban schools are black, this is a very important finding. It is a well known and well documented fact that most urban students of color perform poorly in school mathematics (McWhorter, 2000; Ysseldyke, 2003). Teachers who value their black students would greatly benefit them by engaging them, being flexible with them, giving out homework assignments often, and putting them in groups. By so doing, teachers can narrow the gap between non-black students and black students in mathematics.

Student Comfort Level in Mathematics

Another student math self-efficacy variable that emerged from this study is how at ease a student is with math. The goal of the educator is to increase their student's comfort level without compromising the rigor of the course. When this is done correctly, student performance is positively affected. The results of this study show that student engagement, flexibility, frequent homework, and student grouping all positively affect a student's expected grade and amount of tutoring received. If a teacher employs these practices, their students will expect higher grades and seek tutoring more often. The result is that they will be more comfortable with math. Girls benefit greatly when teachers use all four practices because these practices narrow the gender gap as it applies to student comfort. Another finding of the study is that teacher flexibility, frequent homework, and student grouping also affect the impact of grade level on student comfort. Thus, we see that as students progress in math by grade level their comfort with math increases when these three practices are employed by teachers.

Implications and Recommendations for Practice

The results of this study show that teacher efficacy and practices have a significant effect on the mathematics self-efficacy of their students. Four teacher practices have been identified that will have a positive impact on student performance. They are the engagement and accommodation of students, teacher flexibility, frequent assigning of homework, and grouping students. It is important that teachers take heed of the results of this study and begin implementing programs that utilize the identified practices.

By implementing these practices, teachers will have a great impact on the lives of their students. The direct result will be that their students will have greater mathematics self efficacy which will cause them to have better performance in their math class; moreover, the benefits do not stop there. Betz (1992) wrote about the important role of mathematics preparation in shaping student careers. She noted that mathematics proficiency is required for entry into a wide range of college majors and occupations. By implementing the aforementioned practices, teachers can help urban students avoid the pitfall of "mathematics avoidance." Urban students will continue to take math courses through the twelfth grade and will not limit their choices concerning college majors and occupations.

In order to implement the identified practices, it is necessary for teachers to receive training in utilizing the findings of this dissertation. Professional development should be a requirement in order to enhance these important teacher practices. Teachers would then be better qualified to help students develop a greater interest in mathematics, which would lead to better student performance in math.

Limitations of the Study

Two limitations should be considered when interpreting the results of this study:

1. Due to the number of teacher respondents (N = 30) teacher-level models did not include γ_{00} which refers to the expected intercept for a teacher with values of zero for all teacher predictors.
2. Due to the number of teacher respondents (N = 30) teacher-level models include only one predictor variable per equation.

Recommendations for Further Research

The following recommendations are made for further research related to this study:

1. A similar study could be conducted that uses a three-level hierarchical linear model. This would allow for the identification of school-level variables that would help explain the differences in the student level variables that became output variables at the teacher level.
2. A similar study could be conducted at the middle school level. This would allow for the identification of significant teacher practices that affect student performance in mathematics at an earlier stage of a child's life.
3. The schools in this study did not lack resources necessary for student success. A similar study could be conducted that includes teachers and students in schools that lack such resources.
4. Further research could be conducted to identify other practices that might be significant predictors of student success in math.

5. Other methodologies -- interviews, parental attitude questionnaires, and longitudinal studies could be designed to follow this research line further.

Conclusion

This study utilized a hierarchical linear model to examine the effect of teacher characteristics and practices on the mathematics self-efficacy of high school students. Results of the study indicate that there are teacher characteristics and practices that positively impact student success in mathematics. The student-level variables of expected grade, amount of tutoring, grade point average, gender, being black, grade level, and family status were found to be significantly impacted by teachers' engagement of their students, teacher flexibility, homework frequency, and the grouping of students. Student-level variables that are not significantly impacted by teacher practices include a student's age; whether or not the student has siblings; and the number of siblings on the student's mathematics self-efficacy.

It is important for teachers to utilize educational research findings to improve the academic success of their students. Therefore, teachers of mathematics should think seriously about including the practices identified by this study. By doing so, they have the privilege of impacting the futures of their students. Students may no longer avoid math classes, and as a result they will not limit their college major options. This will lead to the potential employment of students in a wider range of occupations. The influx of often overlooked students into the workforce will create a better economy for the United States and, as a result, a better world economy.

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APPENDICES

APPENDIX A

MATHEMATICS TEACHERS QUESTIONNAIRE

Introduction :
The purpose of the survey is to collect information on mathematics teachers' self-efficacy and classroom practices that may have an impact on their students' mathematics self-efficacy and educational aspirations. Since you are a mathematics teacher in the upper secondary school, I am interested in your responses to the survey along with the responses of students in your classroom. It is estimated that the survey will take 10 - 15 minutes to complete. Your responses will be anonymous. Please do not indicate your name on the questionnaire. Your responses along with those from other teachers and students will provide insight on factors that are associated with secondary students' mathematics self-efficacy and educational aspirations.

Directions: Please use the following scale to respond to the following statements. Read each statement carefully and answer as honestly as you can. You can select any number between 1 and 4.

Scale: (1) Strongly Disagree (SD) (2) Disagree (D) (3) Agree (A) (4) Strongly Agree (SA)

	SD	D	A	SA
If a teacher has adequate skills and motivation, he/she can get through to a student with low mathematics skills.	1	2	3	4
Compared to mathematics teachers in my school, I am a very effective teacher.	1	2	3	4
Compared to teachers in my school, I am a very effective teacher.	1	2	3	4
Compared to mathematics teachers in my district, I am a very effective teacher.	1	2	3	4
Helping students solve math problems is interesting to me.	1	2	3	4
I have adequate training to teach mathematics to students of varying abilities.	1	2	3	4
My teacher training program gave me the necessary skills to be an effective mathematics teacher.	1	2	3	4
My teaching experience has given me the necessary skills to be an effective mathematics teacher.	1	2	3	4
When a student is having difficulty understanding a mathematics concept, I am usually able to adjust my approach to his/her level.	1	2	3	4
When I really try, I can get through to a student who has difficulty in mathematics.	1	2	3	4
Teaching mathematics classes at this school is easy for me.	1	2	3	4

Teaching mathematics classes at the upper secondary school level is easy for me.	1	2	3	4
Some students are very difficult to motivate.	1	2	3	4
I have always done well in making students like mathematics.	1	2	3	4
I find mathematics very interesting.	1	2	3	4
When most of my students find math homework difficult, they usually give up.	1	2	3	4
My students enjoy doing mathematics homework.	1	2	3	4
Mathematics is boring.	1	2	3	4
I believe that many of my students will be a mathematician or a scientist when they grow up.	1	2	3	4
The hours students spend with me in my class has a significant influence on their mathematics achievement.	1	2	3	4
I dread having to teach mathematics.	1	2	3	4
The though of teaching advanced mathematics topics in higher level classes scares me.	1	2	3	4
When another teacher calls on me to help solve a math problem, I worry that I may not be able to solve the problem.	1	2	3	4
I find many mathematical problems interesting and challenging.	1	2	3	4
Teaching mathematics makes me feel inadequate.	1	2	3	4
I am quite good at mathematics	1	2	3	4
At school, my colleagues come to me for help in mathematics.	1	2	3	4
I know how to effectively help students use facilities such as calculators to solve mathematics problems.	1	2	3	4
I know how to help a student who fears mathematics to succeed in the subject.	1	2	3	4
Even a teacher with good teaching ability may not be able to effectively teach some students mathematics.	1	2	3	4
In my mathematics classroom, I set up group activities where students learn a significant amount from each other.	1	2	3	4
I usually assign students activities so they can learn mathematics on their own.	1	2	3	4
Assigning more homework is a very effective way of making students learn and understand mathematics.	1	2	3	4
Teachers are not a very powerful influence on student's achievement in mathematics when all other factors are taken into account.	1	2	3	4

Being good or poor in mathematics is typically inherited.	1	2	3	4
Individual differences among teachers account for a wide variation in student's mathematics achievement.	1	2	3	4
The extent to which a student can learn mathematics is primarily related to his/her family background.	1	2	3	4

Please answer the following questions about your class.

1. In a typical year, approximately what percent of your students pass mathematics with the following grades:

Grade	Approximate Percent
A	___________________
A- or B+	___________________
B	___________________
B- or C+	___________________
C	___________________
C- or D+	___________________
D	___________________
F or Fail	___________________

2. What type(s) of homework do you typically assign to your students in mathematics? (Check all that apply)

_____ Teacher-made questions _____ Textbook exercises
_____ Worksheets _____ Study assignments
_____ Other, specify

3. How frequently do you assign homework to your students in the mathematics class?

_____ About daily _____ 3-4 times a week
_____ Twice a week _____ Once a week
_____ Twice a month _____ Once a month

4. How would you rate the overall quality of homework returned by the students in your classroom?
_____ Excellent _____ Very good _____ Good
_____ Fair _____ Poor _____ Very poor

5. How frequently do you assign students projects, which they work in groups?

_____ Always _____ Frequently _____ Sometimes _____ Seldom _____ Never

6. Which of the following problems have you experienced in your current teaching position? (Check all that apply)

_____ Being overworked
_____ Difficulty with disciplining students
_____ Problems with low students mathematics achievement
_____ High student's mathematics anxiety
_____ Poor curriculum planning from the central administration
_____ Poor attendance of students due to non-payment of fees
_____ Poor attendance of students due to other reasons
_____ Lack of textbooks
_____ Lack of other resources
_____ Other, please specify ____________________________________

Please answer the following general questions about yourself and your class. Remember the information you provide will be anonymous and will only be used in aggregate form along with those from other teachers.

(1) What is your gender? _____ Male _____ Female

(2) What is your age in years? _____ 20-29 _____ 30-39 _____ 40-49 _____ 50-59
_____ 60 and over

(3) What is the name of your school? ____

(4) For how many years have you been teaching at this level? _________

(5) Do you teach other subjects besides mathematics? _____ Yes _____ No

If yes, which ones _______________________________________

(6) What college degree or certificate do you hold? __________________

APPENDIX B

MATHEMATICS SELF-EFFICACY SURVEY -- STUDENTS QUESTIONNAIRE

Directions: Please use the following scale to respond to the following statements.
Read each statement carefully and answer as honestly as you can. You can select any number between 1 and 6.

Scale: (1) Definitely False (DF) (2) False (F) (3) More False than True (MFT)
(4) More True than False (MTF) (5) True (T) (6) Definitely True (DT)

	DF	F	MFT	MTF	T	DT
It is important to me to get *good grades* in mathematics.	1	2	3	4	5	6
Compared to the ***boys in my math class***, I am good at mathematics.	1	2	3	4	5	6
Compared to the ***boys in my school***, I am good at mathematics.	1	2	3	4	5	6
Being good in mathematics is important to me.	1	2	3	4	5	6
Solving math problems is interesting to me.	1	2	3	4	5	6
Compared to the ***girls in my math class***, I am good at mathematics.	1	2	3	4	5	6
Compared to the ***girls in my school***, I am good at mathematics.	1	2	3	4	5	6
Compared to the ***all the students in my math class***, I am good at mathematics.	1	2	3	4	5	6
Compared to the other students my age, I am good at mathematics.	1	2	3	4	5	6
I get good grades in mathematics.	1	2	3	4	5	6
Work in mathematics classes is easy for me.	1	2	3	4	5	6
I'm hopeless when it comes to mathematics.	1	2	3	4	5	6
I learn things quickly in mathematics.	1	2	3	4	5	6
I have always done well in mathematics.	1	2	3	4	5	6
I find mathematics interesting.	1	2	3	4	5	6
When a math problem is difficult for me to solve, I just put more effort into solving it.	1	2	3	4	5	6
I will work as long as necessary to solve a difficult math problem.	1	2	3	4	5	6
When I find math homework difficult, I usually give up on it.	1	2	3	4	5	6

I enjoy doing mathematics homework.	1	2	3	4	5	6
Mathematics is boring.	1	2	3	4	5	6
I believe I could be a mathematician or a scientist when I grow up.	1	2	3	4	5	6
I have usually been at ease and relaxed during math tests.	1	2	3	4	5	6
Mathematics makes me feel uncomfortable and nervous.	1	2	3	4	5	6
I get really uptight during math tests.	1	2	3	4	5	6
I feel calm and relaxed when I work with mathematics.	1	2	3	4	5	6
When I am taking math tests, I usually feel nervous and uneasy.	1	2	3	4	5	6
It does not scare me to take a math test.	1	2	3	4	5	6
I dread having to do math.	1	2	3	4	5	6
The thought of taking advanced high school math courses scares me.	1	2	3	4	5	6
When the teacher calls on me in class to answer a math question or solve a math problem, I worry that I will do poorly.	1	2	3	4	5	6
I find many mathematical problems interesting and challenging.	1	2	3	4	5	6
I have generally done better in mathematics courses than in other courses.	1	2	3	4	5	6
Mathematics makes me feel inadequate.	1	2	3	4	5	6
I am quite good at mathematics.	1	2	3	4	5	6
I have trouble understanding anything that is based upon mathematics.	1	2	3	4	5	6
I have always done well in mathematics classes.	1	2	3	4	5	6
I never do well on tests that require mathematical reasoning.	1	2	3	4	5	6
At school, my friends come to me for help in mathematics.	1	2	3	4	5	6
I have never been very excited about mathematics.	1	2	3	4	5	6

Directions: Please read the following statements carefully. Think about how you feel about them and use the following scale to respond to them by circling the number corresponding to your response.

Scale: (1) Strongly Disagree (SD) (2) Disagree (D) (3) Agree (A) (4) Strongly Agree (SA)

	SD	D	A	SA
I have usually been at ease during math tests.	1	2	5	6
I have usually been at ease during math courses.	1	2	5	6
I usually don't worry about my ability to solve math problems.	1	2	5	6
I get really uptight during math tests.	1	2	5	6
I get a sinking feeling when I think of trying hard math problems.	1	2	5	6
My mind goes blank and I am unable to think clearly when I am doing mathematics.	1	2	5	6
Mathematics makes me feel uncomfortable and nervous.	1	2	5	6
Mathematics makes me feel uneasy and confused.	1	2	5	6

Please answer the following general questions about yourself.

(1) What is your gender? _____ Boy _____ Girl (2) What is your age in years? ______

(3) What is your race? ___________

(4) Please indicate your household type. ______ 1-parent ______ 2- parents

(5) What grade do you expect to get on your next mathematics test? A B C D F

(6) What grade do you expect to receive in math at the end of the term? A B C D F

(7) Approximately how often do you receive tutoring (extra help of preps or coaching) in mathematics?

_____ Daily _____ 2-4 times a week _____ Once a week _____ Once a month

_____ At the end of the term _____ Once a year _____ None

(8) Do you plan to attend college? _____ Definitely _____ Maybe _____ No

(9) As far as a career is concerned, what do you want to become? ________________________________

APPENDIX C

IRB PAPERWORK

CLEVELAND STATE UNIVERSITY
Institutional Review Board for Human Subjects in Research
Application for Project Review

I. Title Page

Date: (mm/dd/yy): 01/27/2006 **Transaction Number (office use only): ______________**
Project Title **THE EFFECT OF TEACHER AND SCHOOL PRACTICES ON MATHEMATICS SELF-EFFICACY AMONG HIGH SCHOOL STUDENTS: A MULTILEVEL ANALYSIS**

PRINCIPAL INVESTIGATOR OR ADVISOR
Name: (Last, First) **Bagaka's, Joshua** Degree Attained: PhD
Department: **C&F** Title: Assoc./Assist. Professor
Electronic Mail Address: **j.bagakas@csuohio.edu**
Campus Address: **RT 942**
Office Phone: **(216)687-4591** Home Phone: **(216)295-1992**

CO-PRINCIPAL OR STUDENT INVESTIGATOR
Name: (Last, First) **Johnson**, **Clarence** Degree Attained: MS
Department: **Doctoral Studies** Title: Assistant Professor
Electronic Mail Address: **clarence.johnson@tri-c.edu**
Office Phone: **(216)987-4554** Home Phone: **(216)481-2595**
If this is a student investigator, please indicate status: **Doctoral level student**
and level of involvement in the research: **Dissertation**

If there are more CSU investigators, please complete the "Additional CSU Investigators" form

PROPOSED PROJECT DURATION (research may not begin prior to IRB approval):
From (mm/dd/yy): **02/01/2006** To (mm/dd/yy): **01/31/2007** (date following anticipated approval; maximum one year later)

Type of funding or support: none

FOR IRB USE ONLY

Initial Evaluation	**Final IRB Action**
Approve as is	Exempt Status: Project is exempt under CFR 46.101 _______. **Protocol approval does not extend beyond the "expected duration" noted above**
Requires Revision before evaluation or final action	Expedited Review: Approval Category ________
Full IRB review required	Regular IRB approval
	Other: _________________________________

If Expected duration of project exceeds 12 months, continuation of IRB approval will require additional action by the IRB. Renewal requests will be sent to you prior to the expiration date.

Reviewer: ___________ Signature:________________________ Approval Date: _______

Institutional Review Board
Human Subjects in Research
Instructions and Checklist for Applicants

The Institutional Review Board (IRB) of Cleveland State University (CSU) is responsible for ensuring the protection and ethical treatment of human participants in research conducted under the auspices of the University. Accordingly, the IRB must evaluate all such research projects, in compliance with Federal Regulations. Your application to the IRB for permission to test human subjects should follow the guidelines provided below. *Proposed Departures from the guidelines should be justified thoroughly.*

Some protocols may be approved through one of the expedited or exempt categories in the Federal Regulations, and some require full Committee consideration. These determinations are made by the IRB, **not** by the researcher. If your protocol requires full Committee consideration, the University Office of Sponsored Programs and Research must receive it no later than one (1) full week prior to the IRB meeting; this will normally be during the first week of the month. Protocols should be submitted to the IRB, Office of Sponsored Programs and Research, 1621 Euclid Avenue Keith Building Suite 1150 Cleveland, OH 44115-2440 ATTN: IRB Coordinator.

Issues of Particular Concern to the IRB

- **Privacy** In most research, subjects' willingness to participate will depend on the researcher's explanation of the project and its purpose, the subject's understanding of risks and benefits, and the assurance that the specifics of their participation will not become known to other individuals. A mismatch between your assurance to the subjects and the procedures you explain in your Project Description will lead the IRB to request revisions before approval can be granted. Issues of anonymity and confidentiality are of special concern when subjects might divulge sensitive information, including situations in which their responses might place them in jeopardy (e.g., public embarrassment, threats to job security, self-incrimination). The care with which you address these issues in your procedures is very important to the IRB approval process

- **Risk** In much research, subjects' participation involves little or no risk. If this is genuinely the case, say so; e.g., "minimal risk," "no foreseeable risk," "no risks beyond those of daily living." If there is some risk, where physical, psychological, social, legal, or otherwise, the IRB will be particularly interested in the safeguards you implement to deal with these risks. The overall importance and soundness of the research project will be especially important if subjects are placed at some degree of risk by participating.

- **Special Populations** Testing minors, pregnant women, prisoners, mentally retarded or disabled persons, or other special populations raises serious issues regarding risk and informed consent, which your protocolmust address. On the other hand, recent federal guidelines mandate the inclusion of women and minorities in research. The nature of your subject population must be clear in your proposal, and you must provide your rationale for including/excluding identifiable subgroups based on gender and minority status.

- **IRB Procedures** CSU's IRB receives approximately 300 applications a year, each of which must be evaluated for adequate protection of the subjects against research risks. You will enhance the acceptability of your proposal, and the speed with which the IRB can evaluate it, if your protocol is concise, deals specifically with the issues discussed in these instructions, and shows your sensitivity to the overriding concerns of ethical treatment of human subjects. Please feel free to suggest any modifications or elaboration to these instructions that would be helpful to you as you write or revise your applications.

II. Participant Information

Total number of subjects: **(Teachers - 150, Approximately 70 Students per teacher)**
Age range (lower limit – upper limit): **14 - 50** Gender: Both Ethnic Minority: African-American
Inclusionary criteria: **Sample selection criteria include a diverse representation in terms of the following: for teachers -- number of years teaching in respective school; grade level of teacher; race, gender, and additional factors not yet recognized in the writing of this proposal. For parents -- that the participants are representative of the diversity of the parent body and vary in thier involvement with school activities and school leadership. For students -- that the participants are representative of the diversity of their respective school.**
Exclusionary criteria: **N/A**
Source of participants: **Through the Urban School Collaboration, permission will be sought from school districts and principals.**
Length of participation (x min/session, y sessions, over z months): Approximately 10-15 minutes during 1 session.
Participants in Special Consideration Categories: (Check all that apply.)

☐None
☑Children (age range: **14 - 18**)
☐Cognitively impaired persons
☐Prisoners
☐Pregnant or lactating women
☑Students
☐Other subjects whose life circumstances may interfere with their ability to make free choice in consenting to take part in research (please specify):

Military personnel
Wards of the State
Institutionalized individuals
Non-English speaking individuals
Blind Individuals

Site(s) of the research activity: Cleveland State University
Letters of approval from project site officials

*You ***MUST*** include letters of approval from appropriate administrative officials at the facility where you will be collecting data

III. Project Description

a. Give a concise statement of the area of research and briefly describe the purpose and objectives of your proposed research:

The purpose of the study is to identify teacher practices that impact students' mathematics self-efficacy conditional on their inherent demographic characteristics. In addition, the study will examine the influence of school characteristics, policies, and practices on the students' mathematics self-efficacy conditional on student and teacher characteristics. The hope is that by identifying such practices, students' math self-efficacy can be improved which will result in improved student achievement in mathematics.

b. Provide a detailed description of how participants will be recruited and used in the project. Please include a description of the tasks subjects will be performing, the circumstances of testing, and/or the nature of the subjects' involvement.

The superintendents of local school districts will be contacted in an effort to recruit teachers to participate in the study. Once the teachers who will participate in the study are found, we will attempt to gain the consent of the parents of the students of those teachers.

c. Make an explicit statement concerning the possible risks and benefits associated with participating in the research. Describe the nature and likelihood of possible risks (e.g., physical, psychological, social) as a result of participation in the research. Risks include even mild discomforts or inconveniences, as well as potential for disclosure of sensitive information. If a risk exists, how does it compare to those of daily living? What are your safeguards for avoiding risks, for protecting subjects' privacy, etc.?

The only foreseeable risks are that (1) students may worry that the information they share may jeopardize their relationships with teachers and their academic status, should it become public and (2) teachers may worry that the information they share may jeopardize their relationships with students and administrators should it become public.

<u>In terms of benefits, our research will provide feedback that will provide valuable information on teacher practices that have a positive impact on both students and teachers.</u>

d. Describe measures to be taken to protect subjects from possible risks or discomforts.

<u>Schools will be the only ones identified. Teachers and students will be anonymous.</u>

e. Describe precautions to ensure the privacy of subjects and confidentiality of information. Be explicit if data are sensitive. Describe coding procedures for subject identification. Include the method, location and duration of data retention. (Federal regulations require data to be maintained for at least 3 years)

<u>Participant names will not appear on their questionnaires. All data will be kept for at least 3 years and will be locked in a file cabinet at the office of either Dr. Joshua Bagaka's, Clarence Johnson or both. If transcribers are hired, there will be no way that they can associate any individuals with the data.</u>

IV. Informed Consent Form

Yes	No	N/A	**Does the Informed Consent Statement**
X			1. Introduce you and your research (including names and phone numbers).
X			2. Provide the subject with a brief, understandable explanation of the research.
X			3. Explain the risks and benefits.
X			4. Explain the details of the time commitment for participation.
X			5. Explain how your protocol either protects confidentiality or is anonymous.*
X			6. Mention that participation is voluntary, and that the subject may withdraw at any time.
X			7. Include the exact statement about contacting the IRB.**
X			8. Provide a phone number where the subject may contact you for further information (students should include a phone number for themselves and also for their supervising faculty member).
X			9. Have a signature/date block for the subject to complete.***

*	***Confidentiality and anonymity are not the same. Confidentiality means that the researcher will know the identity of specific subjects and their data. Anonymity means individuals' responses cannot be associated with the data they generate.***

**	***"I understand that if I have any questions about my rights as a research subject I can contact the CSU Institutional Review Board at (216)687-3630," or if a minor, "I understand that if I have any questions about my child's rights as a research subject I can contact the CSU Institutional Review Board at (216)687-3630."***

*** ***If you wish to dispense with a signed consent form, for either procedural or substantive reasons, be sure to include a clear statement of your reasons and your alternate procedure for obtaining consent.***

V. Copies of Instruments and Questionnaires

To complete this application, attach a copy of all questionnaires or other instruments. This application **MUST** include copies of instrumentation before approval can be granted.

VI. CERTIFICATION/SIGNATURE

I certify that the information contained in this protocol application and all attachments is true and correct. I certify that I have received approval to conduct this research from all persons named as collaborators and from officials of the project site(s). If this protocol is approved by the Cleveland State Institutional Review Board, I agree to conduct the research according to the approved protocol. I agree not to implement any changes in the protocol until such changes have been approved by The Cleveland State Institutional Review Board. If, during the course of the research, unanticipated risks or harm to subjects are discovered, I will cease collecting data and report them to IRB immediately.

____

Principal Investigator/Faculty Advisor Signature		Date

____

Co-Principal or Student Investigator Signature		Date

____

Co-Principal or Student Investigator Signature		Date

____

Co-Principal or Student Investigator Signature		Date

Forward this completed form to:
Cleveland State University
Office of Sponsored Programs and Research (IRB)
1621 Euclid Avenue
Keith Building Suite 1150
Cleveland, OH 44115-2440