Fostering Accurate Self-Efficacy Beliefs in Middle School Mathematics Students

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ABSTRACT

What effect does self-efficacy have on middle school mathematics students and what factors influence those self-efficacy beliefs? Albert Bandura asserted that one's belief in the ability to be successful (self-efficacy) is a better predictor of behavior than actual ability. The questions of this paper are important if educators wish to battle students' mathematical anxiety. The research suggests that students with accurate self-efficacy beliefs tend to be more mathematically successful and that the main factors that influence students' self-efficacy beliefs are demographics and pedagogical practices. Therefore the classroom implications are that social learning communities in which students have mastery experiences and are given opportunities to reflect upon their self-efficacy beliefs are ideal. However, there is a need for further research in how socioeconomic factors influence self-efficacy and how demographic variables interact with pedagogical practices to influence self-efficacy beliefs.

TABLE OF CONTENTS

TITLE PAGE i

APPROVAL PAGE ii

ACKNOWLEDGEMENTS iii

ABSTRACT iv

CHAPTER 1: INTRODUCTION 1

Introduction 1

Rationale. 2

Description of Controversies 3

Historical Background 5

Definitions 8

Limitations. 9

Statement of Purpose. 10

Summary. 11

CHAPTER 2: CRITICAL REVIEW OF THE LITERATURE 12

Introduction 12

Human Capital/Demographic Variables 13

Pedagogical Practices/Classroom Environment . . . . ….28

Summary 77

CHAPTER 3: CONCLUSION. 78

Introduction. 78

Summary of Findings. 79

Classroom Implications. 86

Further Research 89

Conclusion 91

REFERENCES 94

CHAPTER 1: INTRODUCTION

Introduction

Believing in one's self can be a daunting task, especially if those attempting to do so have no prior success surrounding the task at hand. The perceived confidence and/or competence about the ability to successfully accomplish something is referred to as self-efficacy. At the start of this project, the author made the assertion that higher self-efficacy would lead to higher achievement. However, the research suggests otherwise. Rather, high-achieving students tend to have accurate self-efficacy beliefs and are more accurate in their performance predictions. This document will focus on the self-efficacy beliefs of middle school students. Middle school is a period of transition. In adolescence, Jean Piaget suggested, students move into a stage he called *formal operations*. Piaget asserted that during this stage students begin working with abstract thought and begin to form hypotheses that could be tested against reality (Miller, 2011). It is important to note the developmental stage of most of the participants included in the studies discussed in this literature review, because self-efficacy is a self-reported, internalized belief. Developmentally, according to Piaget, middle school students have only begun to think abstractly and therefore may never have thought about their own efficacy or what determines their confidence in doing something. The aim of this document is to examine the factors that influence self-efficacy and determine how self-efficacy affects performance and motivation in middle school students.

Rationale

Repeated mathematical successes lead to higher mathematics self-efficacy which leads to motivated learning. However, it is not always easy to create mathematical successes in a middle school classroom. One reason is that middle school classrooms are filled with students who are going through a mentally and physically intense transition period. Students are trying to prove their cognitive worth, fit in with different social groups, and develop their own identity based on gender, ethnicity, and socioeconomic status (Schunk, 1985). Efficacy beliefs are also affected by mastery experience, vicarious experience, social persuasions, and emotional states.

Furthermore, mathematical anxiety is a common entity in schools around America and provides a barrier for feelings of efficacy in many math students (Pajares and Urden, 1996). Several factors seem to cause mathematical anxiety, such as lessons taught by teachers who themselves were unsure of their mathematical ability, or the a fear of not getting the right answer, or peers and trusted adults who have had negative experience with mathematics. Unfortunately, mathematical anxiety leads to mathematics avoidance which means that students take fewer math classes and do minimal work in those they are required to take (Hembree, 1990). The outcome is that students graduate with limited college and career choices because the job market is filled with technologically and mathematically based jobs. And the fewer students America has to fill these jobs, the more outsourcing takes place.

Moreover, standardized tests oftentimes work against teachers in terms of lowering students' self-efficacy. For students who do not feel efficacious in mathematics and/or who do not use or were never taught strategies to maintain their self-efficacy when confronted with challenge, standardized tests may lower students' self-efficacy beyond their actual abilities which can then lead to lower test scores (Ryan, Ryan, Arbuthnot, & Samuels, 2007). At a time when standardized tests are the only measures of students' cognition and teachers' ability to teach, the pressure for students to pass the tests is overwhelming. By 2015, in order for a Washington state high school student to graduate, he or she must pass exams in reading and writing, as well as two end-of-course math tests and one end-of-course biology test (Office of Superintendent of Public Instruction, 2011). For students with low self-efficacy, the idea of being required to pass the standardized tests could overwhelm them with anxiety. And anxiety correlates with poor performance on math achievement exams (Hembree, 1990).

Description of Controversies

Differing opinions on how to or if an educator can increase students' self-efficacies are numerous. Some researchers believe that if an instructor had a higher sense of self-efficacy, then students would, too. Research has found that many elementary teachers have low self-efficacy and high anxiety about teaching mathematics. One solution would be to design more effective professional development activities that enhance the math self-efficacies of the teachers (Stevens, Harris, Aguirre-Munoz, & Cobbs, 2009).

On the other hand, some researchers argue that ethnicity plays a vital role in the attitudes students have towards mathematics and therefore on their self-efficacy. The argument is that different ethnic groups place different values on the importance of mathematics, and therefore students are influenced by their parents' attitudes toward math. One suggestion for teachers to increase mathematical achievement, and therefore self-efficacy, is to be culturally sensitive when working with ethnically diverse students. This may mean that teachers should tailor certain elements of their lessons to the demographic or cultural profile of their class (Der-Karabetian, 2004).

Gender too has been found to play a role in mathematical self-efficacy. Findings have shown that males typically have higher self-efficacy, they take more math classes, and they choose mathematically related careers more often than women. One of the arguments as to why this exists is because of societal expectations and beliefs about women and girls. Parents may encourage their daughters to take classes other than mathematics because they believe that girls are simply not designed to be as good at math as boys. Also, schools who practice ability tracking may limit the options of math classes available to students. And it has been found that girls who are in low-ability tracks often develop low self-efficacy beliefs. For boys the opposite is true. This is because boys concentrate on the fact that they can outperform their peers, and therefore boys in low-ability tracks develop higher self-efficacy beliefs (Linver & Davis-

Kean, 2005). This research then suggests that the best way for teachers to increase their students' self-efficacies is to make math classes available to students of all abilities.

Pedagogical approaches can also influence students' self-efficacies. From the way a teacher presents a concept to the comments he or she gives on a homework assignment, teachers have a direct impact on their students' self-efficacy. The current literature is filled with differing ideas about how a teacher can effectively teach to improve the self-efficacy of his or her students. One of the current popular methods for this is problem-based instruction, because it requires students to be engaged with the material and work cooperatively to develop an answer. Furthermore, this teaching model generally requires problems to be of some tangible importance to the students, and therefore solutions to the problem hold more importance (Cerezo, 2004).

Historical Background

Humans have a long history of interest in the self, from prehistoric drawings that illustrate an interest in how one perceives the self to Greek philosophers who wrote about the self in terms of the soul. In more recent history, self-beliefs have been associated with motivation and achievement. This forms the basis for why it is important for teachers to understand how to boost their students' self-beliefs.

The conscious self was an idea that arose early on in American psychology. William James was one of the first psychologists to think about the self as the knower and the self as known. He did not mean that *I* and *me* were separate entities but rather that they were differentiated facets of self. James was also the first to define the term *self-esteem* (in 1890). He suggested that how individuals feel about themselves depends on their accomplishment of the things they want to accomplish (Kelly, 1998-2006). Therefore, if a student did not accomplish the things he or she wished to, then James would argue that his or her self-esteem would suffer.

Charles Horton Cooley added the idea of the “looking-glass self” in 1902. He said that people also developed self-beliefs based on how others perceived them. Cooley asserted that children internalized what parents, family members, teachers, and others conceptualized them to be and then based their definition of themselves on that information (*New World Encyclopedia*, 2008). This meant that if students are surrounded by people who have little confidence in their ability, then students would also have little confidence in their own ability.

Although James asserted that children develop their sense of self through imitation of influential people in their lives and not through messages received about themselves from those influential people (as Cooley believed), James and Cooley shared an overarching belief. Both psychologists believed that a student’s sense of self was determined by the beliefs and actions of the influential people in the student’s life (Pajares & Schunk, 2002).

Sigmund Freud’s ideas about the id, ego, and superego continue to influence research on the self. Freud’s theory was aimed at explaining the psychic struggle between a person’s instinctual drives, sociocultural norms, and the environment. In essence, Freud asserted that a person’s sense of self or identity develops out of the internal struggle between the id, ego, and superego. Freud made the argument that the ego was also partly unconscious, which distinguished Freud's theory from other notions of the self. Freud was also different from other psychologists in that he did not make the self a prominent factor in human development. Instead, Freud argued that biology played the biggest role in a person's destiny (Miller, 2011).

In the belief that the self was not an observable, measureable behavior, psychologists began to move away from it with the insurgence of behaviorist perspectives. Pavlov, Thorndike, Watson, and Skinner were critical theorists in the new psychology, and they argued for scientific inquiry which studied observable stimuli and responses. This phase lasted until about the 1950s when what is now called the humanistic revolt in psychology took place (Pajares & Schunk, 2002).

Abraham Maslow, who is credited as the father of modern humanistic psychology, asserted that the goal of all people is to reach self-actualization (reach full potential, inner peace, contentment, and self-fulfillment). Carl Rogers, another leader in this movement, suggested that the self was the main component of personality. He also believed that influential people as well as one's self greatly influence a person's self-actualization and growth.

Schools during the 1960s and 1970s were not immune to the developing research on the self. Pedagogical practices and strategies were aimed at developing healthy self-concepts and positive self-regard. This was due to the fact that many schools believed that if students' self-beliefs were enhanced, then academic achievement would also improve. Studies at the time, however, showed mixed results. While some studies showed that high self-esteem led to academic achievement, others found that it led to aggression. Due to the inconsistency of the research, people began to question and ridicule humanistic psychology (Pajares and Schunk, 2002).

Out of this time came the cognitive revolution in psychology, which was greatly influenced by the computer. Theorists emphasized cognitive events but mostly focused on encoding and decoding human thinking, information processing, problem-solving, and memory processes. Schools took this to mean that they could raise standardized test scores of students by developing the values of hard work and by paying no attention to the emotional state of students. Soon after, though, this approach began to seem unethical.

In the last three decades, psychology has again begun to shift back to the self. Albert Bandura, who was trained as a behaviorist, rejected the idea that self-processes were unimportant and rekindled the focus on the self in his social cognitive theory. From Bandura's perspective, people were seen as proactive and self-regulating. He also argued that the beliefs people have about their abilities are better predictors of their behavior than their actual abilities, which is the general foundation for the idea of self-efficacy (Pajares & Schunk, 2002).

Definitions

Bandura developed the term *self-efficacy* to describe the beliefs that people hold about their ability to succeed at a given task. These beliefs become particularly important when examining the goals that people choose to pursue and the level of effort they choose to put into achieving those goals.

Bandura defined four sources of efficacy: (a) mastery experience, which is the most influential and relies on the success or failure of prior experiences; (b) vicarious experience, which occurs when one observes the success or failure of others at similar tasks; (c) verbal persuasions, which come about when one is talked into believing he or she has the ability to succeed; and (d) physiological and affective states, which can affect efficacy beliefs either positively or negatively depending upon the state (Miller, 2011).

It is important not to confuse self-efficacy beliefs with self-concept beliefs, which are descriptions about one's self in addition to a perceived level of self-worth. Also, sociocultural factors greatly impact one's sense of self-worth and therefore one's self-concept beliefs; however sociocultural factors are not necessarily tied to one's self-efficacy. Although both self-concept and self-efficacy beliefs influence motivation and achievement, the questions one asks oneself in relation to each are very different. For example, self-efficacy beliefs center around the word *can*, whereas self-concept beliefs tend to be related to feelings or states of being (Pajares & Schunk, 2001).

Limitations

The aim of this literature review is to assess the factors that influence self-efficacy and examine how self-efficacy affects the performance and motivation of middle school students. One of the main limitations of this paper is that it is a review of the literature; this paper is limited by the scope of studies done on self-efficacy. Further, the author limited the range of this paper to the self-efficacy beliefs of middle school students only. Subjects of these studies were students in Grades 3-10. Lastly, although the author acknowledges that multiple demographic variables influence self-efficacy, this paper focuses mainly on gender, race, and giftedness.

Statement of Purpose

The personal agenda of this paper stems from a time in the author's life when she struggled with her own self-efficacy in the subject of math. Between fifth and sixth grade, the author went from a home-school situation to public school. This meant that her classroom shrunk from a 66-acre farm to a regular-size classroom. All at once, math went from concrete examples, such as using fractions to build a fence, to abstract lessons, such as how much gas does the airplane use to travel from A to B. In addition to the cognitive confusion, she was unsure of her social identity. The author lived with her parents and had very few friends aside from the animals on the farm. The first mathematics class she had after being introduced to public school did not go well. She was frequently confused, began to dislike the subject, and started to show signs of anxiety. However, the following year, when she was placed in a different class, with a different teacher, she began to regain her confidence. The author attributes this positive change to increased social efficacy, the approachability and self-efficacy of the teacher, and the teacher's use of cooperative learning and problem-based activities. It is because of this experience that the author is interested in the subject of self-efficacy, and she has a desire to highlight the impact that educators have on their students' futures.

Summary

The aim of chapter one was to introduce the concept of self-efficacy as a person's belief in their ability to successfully achieve a given task. Along with this, the chapter highlighted the developmental stages of middle school students and why some struggle with inaccurate self-efficacy beliefs. Self-efficacy beliefs of math students have been the main focus of several research projects but not all of the findings have been in agreement. Chapter one outlined the main controversies in the research, largely concerning what the greatest contributor to efficacy beliefs is. Another section in chapter one focused on the history of the concept of self-efficacy highlighting its roots in psychology. The final sections in chapter one focused on the importance of this research topic and the limitations of the paper.

Chapter two's investigation of middle school students' mathematical self-efficacy beliefs will be guided by two main questions: What effects does self-efficacy have on mathematical motivation in middle school students? And what are the factors affecting self-efficacy in middle school students? Each study in chapter two will be summarized and organized to develop two main themes and several subthemes. The two main themes focused on in chapter two will be human capital/demographic variables and pedagogical practices/classroom environment.

CHAPTER 2: CRITICAL REVIEW OF THE LITERATURE

Introduction

In chapter one, the concept of self-efficacy was introduced as being the perceived confidence and/or competence that one has about one's ability to successfully accomplish a given task. Moreover, middle school students are at a developmental stage where they are just starting to think abstractly and are grappling with the idea of their own capabilities and limitations. Understanding this developmental process provides insight into why some middle school students may struggle with inaccurate self-efficacy beliefs. Chapter one also went on to discuss controversies in the research over which was the greatest contributor to students' mathematical efficacy beliefs: gender, ethnicity, and/or pedagogical practices. The history of the concept of efficacy is deeply rooted in psychology, grounded in William James' theory of the different facets of self, Freud's theory that the self develops out of an internal conflict between the different facets of self, and Bandura's assertion that peoples' beliefs about their abilities are better predictors of their behavior than their actual abilities. Chapter two continues to examine mathematical self-efficacy beliefs as explored in recent research. The research in this chapter is organized into two main sections: demographic variables and pedagogical practices/classroom environment. Under each main section, several subsections will be addressed: gender, ethnicity, giftedness, strategies, and pedagogy. Each study's methods and conclusions are outlined and critiqued here.

Human Capital/Demographic Variables

The studies chosen for this section examine the correlation between specific demographic variables and self-efficacy beliefs. Rather than combine all variables, each demographic variable will be considered separately in order to develop the three subcategories of gender, race, and giftedness.

Gender

Two studies looked specifically at gender in relation to mathematical self-efficacy beliefs. Lloyd, Walsh, and Yailagh (2005) conducted a quantitative study using 161 fourth- and seventh-grade students which concluded that girls tended to be underconfident while boys were overconfident in their mathematical self-efficacy beliefs. And, in a quantitative study using 486 sixth-grade students, Usher and Pajares (2006) found that social persuasions and invitations were particularly important sources of girls' and African American students' mathematical self-efficacy beliefs.

Lloyd et al. (2005) investigated the differences in how self-efficacy beliefs are related to mathematical achievement for boys and girls. In this quantitative study, participants were 62 fourth-graders and 99 seventh-graders, of whom approximately half were boys and half were girls. The students were drawn from seven public schools in one of British Colombia's suburban school districts. All students were given nine questions from the Foundation Skills Assessment; the questions covered different content for fourth and seventh graders. Students were not asked to answer the questions but rather to rate their confidence in their ability to answer each question correctly on a scale of 1 (*not confident*) to 7 (*very confident*). The researchers designed this scale to match (in terms of proportion of test items dedicated to numbers, patterns and relationships, shape and space, and statistics and probability) the Foundation Skills Assessment that each student also took as a standardized test given in fourth and seventh grades.

Based upon research by Pajares and Kranzler (as cited in Usher & Pajares, 2006), which asserted that self-efficacy scales must be administered as closely to the performance task as possible in order for the most accurate responses, the researchers administered the self-efficacy scale within one or two weeks of the Foundation Skills Assessment, which gives this study credibility. Furthermore, the reliability ratings of the self-efficacy scales and the Foundation Skills Assessment were acceptable to good. Cronbach's alpha coefficient for the fourth-grade self-efficacy scale was 0.77 while it was 0.85 for the seventh-graders. For the Foundation Skills Assessment, the ratings were 0.85 and 0.86 for fourth and seventh graders respectively.

A t-test of the boys' and girls' Foundation Skills Assessment performance showed that their scores were basically the same, $t(156) = 1.09$, $p>0.05$). However, another t-test using students' relative self-efficacy revealed that girls tended to be underconfident while boys were overconfident, $t(156) = -1.98$, $p < 0.05$. Furthermore, negative correlation between students' relative self-efficacy and their Foundation Skills Assessment scores suggested that students with higher or lower self-efficacy beliefs in comparison to their ability level had lower achievement than students who held accurate self-efficacy beliefs.

In conclusion, this study indicated that, although girls tend to be just as capable as boys in mathematical achievement, they do not have the sense that they are good at mathematics. Previous research by Paris and Oka (as cited in Usher & Frank, 2006) found a similar result, which adds to the strength of this study's credibility. Furthermore, the research suggested that in order to maximize student achievement in mathematics, boys and girls need to develop accurate self-efficacy beliefs.

Weaknesses of this study are that the sample size was relatively small and there was no mention of the ethnic or racial makeup of the sample. These limitations weaken the generalizability of this study.

In two public schools in southeastern United States, Usher and Pajares (2006) conducted a quantitative study that examined the sources of self-efficacy beliefs for 468 sixth-grade students; 238 of the participants identified themselves as girls and 230 as boys. Students were given the testing instruments during one class period. The researchers administered the Sources of Self-Efficacy scale which includes six items that address students' perceived mastery experience, six about vicarious experience, five about social persuasions, and seven relating to physiological/affective factors (alpha coefficients for these scales were 0.84, 0.81, 0.83, and 0.83 respectively). The researchers also administered the Inviting/Disinviting Index-Revised, which assessed the extent to which participants relied on invitations (self-perceived messages about themselves based on the social persuasions they have received or sent to others) to determine their self-efficacy beliefs (alpha coefficients were 0.78 for self and 0.77

for inviting others). Next the researchers administered the Children's Self-Efficacy Scale which had an alpha coefficient of 0.85. Additional data examined for this study were students' grades in language arts, reading, and mathematics, which were averaged on a 0-100 scale.

A hierarchical regression analysis revealed that when invitations were included, the predictability of self-efficacy beliefs for both boys and girls increased ($\beta = 0.194$ and $\beta = 0.195$ respectively). Interestingly, the introduction of invitations eliminated the significance of social persuasions in the prediction of boys' self-efficacy beliefs, whereas it remained a prominent factor in girls' ($\beta = 0.190$). This finding suggests that girls' academic confidence is influenced more by social contexts than boys' academic confidence.

The strength of this article's credibility rests in the fact that the results were similar to those found in other studies. For example, Zeldin and Pajares (as cited in Usher & Pajares, 2006) found that women tended to embrace other's beliefs about their capabilities more than even their own mastery experience. Further, Erik Erikson asserted that girls were more likely to be influenced by the people around them because they are largely concerned with relationships and their satisfaction with them (as cited in Usher & Pajares, 2006).

Weaknesses of the study involve its internal validity due to the fact that it was conducted as a one-shot case study. This type of research design does not account for history, maturation, testing, regression, or mortality. Further, only two schools were involved in the study which suggests that the transferability of this study is limited.

The research studies chosen for this section support the idea that self-efficacy beliefs are different for boys than they are for girls. Lloyd et al. (2005) found that girls tended to be underconfident in their mathematical self-efficacy beliefs, while boys were overconfident. Usher and Pajares' (2006) study was in agreement with this finding and added that girl's self-efficacy beliefs tended to be based more on social persuasions and invitations, which implied that girls are more likely to be influenced by social messages than boys.

Race

Three studies compared students of color to White students in terms of mathematical self-efficacy beliefs. Using a quantitative study done with 107 eighth-grade students, McCoy (2005) found that students who classified themselves as poor or non-White had more difficulty mastering the skills of algebra. A qualitative study done by Lim (2008) indicated that minority students are at a disadvantage because White teachers tend to design lesson plans based on their own cultural experiences, and this works to negatively impact minority students' confidence in mathematics. And Keck-Staley (2010) found, using a qualitative study of 9 eighth-grade students of color, that when teachers give voice to Black and Latino students in the classroom, the students create more meaningful, relevant connections to their mathematics learning experience and therefore develop stronger confidence.

McCoy (2005) conducted a quantitative study to determine how ethnicity influenced the self-efficacy beliefs of 107 eighth-grade students. The participants of McCoy's study were 46 boys and 61 girls, whom 53 identified themselves as

White and 54 as non-White. For instruments, the researcher employed a modified version of Fennema-Sherman Mathematics Scales as a way to determine student attitudes toward mathematics (the three subtests reported reliabilities ranging from 0.88 to 0.93). This questionnaire was given at the beginning of the school year and at the end. Then the researcher collected mathematical achievement data from two statewide tests (the North Carolina State End-of-Course Algebra 1 Test and the North Carolina State End-of-Grade Test for Eighth Grade).

Using an ANOVA test, McCoy determined that ethnicity had a significant effect for the end-of-course test, $F(1,89) = 81.628$, $p < 0.05$, as well as for the end-of-grade test scores, $F(1,90) = 62.785$, $p < 0.05$. Furthermore, the findings indicated the attitude scores dropped significantly over the course of the class regarding confidence in using mathematics, $t(91) = 5.130$, $p < 0.01$. Overall, findings from this study suggest that ethnicity alone, as well as in connection with attitude, has an impact on algebra achievement. Students who were non-White tended to have more struggles when it came to algebra achievement.

The methods of this study are not without flaw. In particular, because the researcher grouped all non-white students together, it is unclear whether specific ethnicity plays a role in confidence or achievement. Further, without the breakdown of ethnicity, these findings are not generalizable.

Strengths of the study exist in the fact that the results support other studies. Peng and Hall concluded that race and ethnicity were strong influential factors in a student's success or failure in mathematics (as cited in McCoy, 2005). Also, Singh and Granville determined that the socioeconomic status of non-White students was a main determining factor in whether or not those students would enroll in algebra classes (as cited in McCoy, 2005).

In a qualitative study, Lim (2008) studied how sociocultural factors influenced the motivation and academic identities of two African American girls in middle school mathematics. The participants were both sixth graders at a rural, Southeastern public school. The school had a student population of 26% Black and 70% White, with a small percentage of Hispanic students. The participants were enrolled in two different mathematics classes (one regular and one advanced) but had the same teacher. The researcher collected data by means of participant observation, collection of school records, and repeated interviews with the teacher and two students (the researcher used pseudonyms for the teacher and students in the report). At least one of the interviews with each student was conducted at the student's home. Once the data was collected, the researcher then used thematic analysis to compare and contrast information from participants and other data sources.

The teacher was a White, middle-aged woman (Mrs. Oliver) who believed in strict classroom management and traditional classroom instruction; she also believed that students who seemed to not care about learning came from families with little support or supervision. Stella was a high-achieving student who was only one of three Black girls who had the potential to enter pre-algebra in seventh grade. She described herself as loud, sociable, and wild, but she appeared very quiet and withdrawn in her math class. She claimed that in order to abide by the rules, she needed to create a different identity for herself in the math class. However, her new identity gave her feelings of difference, inadequacy, and inferiority. Stella was not aware of the different math tracks within the school and did not understand the value of mathematics for her future goals. Rachel, on the other hand, was outspoken and seemed confident in her ability. She was in the lowest track of regular mathematics and often finished assignments faster than other students, which gave her a lot of free time. Rachel did not feel that she needed to adopt a different identity for math class and she did not see value in academic success or in mathematics.

The teacher viewed Stella as unmotivated and passive, and therefore she did not recommend Stella for seventh-grade pre-algebra. Mrs. Oliver also did not push Rachel to pursue a different mathematics track, because she viewed Rachel as being comfortable in her current track. This study suggests that White teachers may provide inadequate support for non-white students in terms of motivation and/or academic guidance. This study also suggests that perhaps there is institutionalized prejudice working against students which keeps non-White students out of advanced-level mathematics classes or even from feeling efficacious in mathematics.

The fact that this study's findings are similar to those seen in different studies gives this research credibility. However, the small sample size and confinement to Black females makes the findings limited in their transferability.

A qualitative study conducted by Keck-Staley (2010) explored how Black and Latino students develop mathematical identities as well as how those identities influence their engagement in the mathematics classroom. The researcher used a middle school with a student population of 474 students, 93% of whom identified themselves as either Latino or Black. Data taken from the Mathematics End-of-Grade test showed that 67% of the Black students and 70% of the Latino students were below grade level. Keck-Staley selected nine eighth-grade students to participate in her research study. Five of the students identified themselves as Black (three girls and two boys) and four as Latino (two boys and two girls). All of the participants were enrolled in the same mathematics class, which the researcher observed for three 45-minute classes. The researcher also set up individual as well as focus-group interviews with the participants in order to question participants on specific observations and their own personal insights. In addition, Keck-Staley collected data by having the participants keep weekly journals in which they described their engagement in the class and how they viewed their engagement.

From the data, the researcher identified two overarching themes as places where human resource capital is developed: sociocultural capital and personal capital. Sociocultural capital was identified using the indicators of collaboration, communication, community, social networks, and relevance indicators. In general, the participants agreed that it was important to work in groups and develop good working relationships so that they could be successful in mathematics. Personal capital was identified by the indicators of extrinsic and intrinsic motivation. Most of the participants expressed a strong desire to do well in math and developed self-regulation strategies in order to be successful. Also, many of the students agreed that their families' expectations, cultural norms, and future career goals pushed them to be successful in mathematics.

Interestingly, the participants in this study were able to transcend the traditional, lecture-style atmosphere of their mathematics class and develop social relationships with their classmates, even though they were only allotted about 15% of the class time to work with others. This finding suggests that students used individual and collective human resource capital as resources to resist the traditional classroom structure and empower themselves. In essence, this study seems to suggest that, when they are given the social opportunities, Black and Latino students are able to establish meaningful connections between their human resource capital and mathematics.

The researcher used triangulation to add to the credibility of the study by allowing participants and outside researchers to cross-check the findings. Also, the findings from the study were consistent with a study done by Cobb (as cited in Keck-Staley, 2010) who found that student engagement and multiple ways of contributing to the mathematics community made students feel more comfortable and competent in their ability to succeed in mathematics. However, due to the fact that all of the participants were taken from one class, the transferability of this study should be questioned.

Studies chosen for this section suggest that ethnicity plays a role in students' self-efficacy beliefs. This claim is supported by McCoy (2005), Lim (2008), and Keck-Staley (2010). However, whereas McCoy's study simply asserted that non-White students were not as successful in mathematics as

White students, Lim and Keck-Staley found that the use of traditional teaching methods severely limited non-White students' access to the information. They stressed the idea of using human resource capital in the form of groups or social learning communities in order to provide non-White students with successful learning opportunities.

Giftedness

Examining gifted students' self-efficacy beliefs can give educators a glimpse into the thought processes of high-achieving students which may be able to benefit pedagogical practices for all students. Three studies are analyzed in this section. Pajares (1996) conducted a quantitative study on 297 eighth-grade students and found that gifted students seemed to have a more accurate understanding of their performance ability (self-efficacy) than regular education students. In a quantitative study, Zimmerman and Martinez-Pons (1990) studied 90 fifth-, eighth-, and eleventh-grade students to find that student perceptions of their verbal and mathematical efficacy were significantly correlated with strategy use. A quantitative study done by Pajares and Graham (1999) using 273 sixth-grade students indicated that although there were no differences in the mathematical self-efficacy beliefs of boys and girls, gifted students had more accurate self-efficacy beliefs than regular education students, who tended to be overconfident.

A quantitative, one-shot case study by Pajares (1996) examined how self-efficacy beliefs influence the mathematical problem-solving of gifted students in comparison to regular education students. The researcher studied 297 eighth-grade students, of whom 66 were identified as mathematically gifted while 231 were identified as regular education. Participants attended a public middle school located in southern United States. The researcher administered testing instruments over the course of two days. Students completed a self-efficacy instrument that required them to report their confidence about successfully solving algebra problems (Cronbach's coefficient was 0.94). Students then completed the Mathematics Anxiety Scale designed to assess student apprehension with math (Cronbach's coefficient was 0.87). Next, participants completed the Self-Efficacy for Self-Regulated Learning Scale which assessed students' confidence in their ability to use self-regulated learning strategies (Cronbach's coefficient was 0.87). Lastly, students completed a performance task which contained algebra problems that were similar but not identical to the problems on the self-efficacy instrument.

The researcher then conducted a MANOVA which revealed that gifted students reported stronger mathematical efficacy beliefs (94.41 for gifted students and 77.30 for regular education), stronger self-efficacy for self-regulated learning (53.50 for gifted and 49.94 for regular education), and less anxiety than regular education participants (24.71 for gifted and 29.94 for regular education). Also, the gifted students outscored regular education students on the performance task (14.92 for gifted and 10.45 for regular education). Furthermore, the results also showed that gifted students tended to be more accurate in their self-efficacy beliefs than regular education students, $F(1,293) = 12.79$, $p = 0.0004$ for under-confidence and $F(1,293) = 13.4$, $p = 0.0003$ for overconfidence.

In summary, self-efficacy beliefs seemed to predict anxiety in both regular education students and gifted students. In turn, anxiety corresponded with mathematical problem-solving performance for both groups, which is consistent with other research studies. A difference in the groups, however, arose in the accuracy of self-efficacy beliefs. Gifted students tended to be more accurate in their self-efficacy beliefs than regular education students.

The reliability of the study seems to be quiet strong due to the fact that all of the instruments reported high Cronbach's coefficients. However, because this was a one-shot case study, it does not account for several factors, including history, maturation, regression, testing, or mortality. Also, the generalizability is questionable since the researcher did not report the ethnicity or socioeconomic status of the participants.

Zimmerman and Martinez-Pons (1990) conducted a quantitative study to determine whether intellectually gifted students displayed greater academic self-efficacy than regular education students. Participants of this study were 60 intellectually gifted students (30 eighth graders and 30 eleventh graders) from highly selective schools in New York City, and 90 regular education students (30 fifth graders, 30 eighth graders, and 30 eleventh graders) from one nonselective public high school. First the researchers conducted interviews which were aimed at assessing several self-regulated learning strategies: self-evaluating; organizing and transforming; goal-setting and planning; seeking information; keeping records and monitoring; environmental structuring; self-consequating; rehearsing and memorizing; seeking peer, teacher, or adult assistance; and reviewing tests, notes, and texts. Participants were given scenarios or contexts and were then asked which strategies or methods they might use. Then the researchers instructed the participants to complete a verbal and mathematical efficacy survey. For each, students had to first rate their efficacy in defining a word or solving a problem.

At this point, the researchers then used univariate tests which revealed that gifted students showed greater verbal and mathematical efficacy than regular education students, $F(1,168) = 85.66$ $p < 0.01$, and $F(1,168) = 19.56$, $p < 0.01$, respectively. Furthermore, a multiple regression analysis was used to determine if self-regulated learning strategies could be used to predict mathematical efficacy. In general, all students' mathematical efficacy was correlated with self-regulated learning strategies, $F(14,165) = 2.31$, $p < 0.01$.

Zimmerman and Martinez-Pons' research concluded that gifted students tended to be more efficacious than regular education students. This finding is consistent with other studies. For example Cox (as cited in Zimmerman & Martinez-Pons, 1990) found that gifted students tended to exemplify great motivation and self-confidence. In Zimmerman and Martinez-Pons' study, gifted students were also greater users of the self-regulating strategies of organizing and transforming, self-consequating, seeking peer assistance, and reviewing notes than regular education students. Students' self-efficacy beliefs correlated with strategy use. These findings suggest that the more self-regulating strategies that students utilize, the stronger their self-efficacy beliefs will be.

Although the reliability of the measurements used in this study seemed to be strong and the results were consistent with findings in other studies, the one-shot case study approach imparts many weaknesses on the internal validity. Furthermore, the researchers did not report any data on the socioeconomic status or ethnicity of the study's participants, which limits the transferability.

In a quantitative study, Pajares and Graham (1999) questioned whether gifted placement had an effect on self-beliefs in the first year of middle school. Participants of the study came from one suburban school located in southern United States. Of the 273 sixth-grade participants (150 boys and 123 girls), 188 were identified as regular education and 85 as gifted. The researchers administered attitude measures during October and then again in April (Cronbach's coefficients were 0.94 and 0.93 respectively). The day after the attitude measures were administered, students completed the performance task. Students also completed the Mathematics Anxiety Scale (Cronbach's coefficient of 0.87), Academic Self-Description Questionnaire II (Cronbach's coefficients of 0.89 for the fall and 0.91 for the spring), and the Self-Efficacy for Self-Regulated Learning Scale (Cronbach's coefficients 0.80 in the fall and 0.82 for the spring).

Pajares and Graham then conducted multiple regression analyses. They found that gifted students outperformed regular education students in both the fall and the spring ($\beta = 0.174$ in the fall and $\beta = 0.164$ in the spring). Also, gifted students tended to be less overconfident than regular education students and had more accurate beliefs about their abilities. In comparison to gifted students, regular education students displayed lower performance, self-efficacy, and self-concept scores, and were more likely to hold inaccurate self-efficacy perceptions than the gifted students.

The findings of this study are supported by similar studies such as Bandura's research from 1986 and 1997 (as cited in Pajares & Graham, 1999) research that found that self-efficacy beliefs predicted academic outcomes, which adds to the credibility of the study. A weakness of the study rests in the fact that no mention was given to how the study site or the participants were chosen, which indicates a flaw in the random-selection aspect of the study's design.

The studies from this section found that students identified as gifted tend not only to have higher self-efficacy beliefs than regular education students, but also to have efficacy beliefs that more accurately represent their capabilities. Since all three studies, Pajares (1996), Zimmerman and Martinez-Pons (1990), and Pajares and Graham (1999), reported similar results, the credibility of this claim is strengthened. Furthermore, Zimmerman and Martinez-Pons found that gifted students seem to use more self-regulation strategies, which researchers claimed led to stronger, more accurate self-efficacy beliefs. The use of self-regulation strategies will be addressed again later in this chapter.

Pedagogical Practices/Classroom Environment

This section examines the effect of different classroom variables on the mathematical self-efficacy beliefs of students. This section is arranged in the following subsections: problem-based instruction, social environment, technology, student perceptions, strategies for student empowerment, and balancing challenge with ability.

Problem-Based/Discovery Instruction

Allowing students to construct their own learning by way of problem-based instruction can positively influence students' self-efficacy beliefs. Four studies were included in this branch of the paper. Lubienski (2000) looked at the effects of the Connected Mathematics Projected on students. Cerezo (2004), as well as Ried and Roberts (2006), examined how problem-based instruction influenced middle school girls identified as at-risk. And Higgins (1997) studied the confidence of students taught in heuristic classrooms in comparison to students taught in non-heuristic classrooms.

In a medium-sized, socioeconomically diverse Midwestern city, Lubienski (2000) conducted a qualitative study of 30 seventh-graders' experiences with the Connected Mathematics Project (CMP). All of the participants of the study identified themselves as White with the exception of two African Americans and one Latina. Also, 15 of the participants were boys and 15 were girls. Lastly, the class consisted of an even mix of students from upper-middle, middle, working, and lower class socioeconomic backgrounds.

CMP is designed to teach students problem solving skills rather than procedural knowledge and is aimed at encouraging students to see patterns and relationships in mathematical problems. The typical lesson included a *launch* where the teacher introduces the class to the problem, *exploration* where the students work in groups to work with the problem, and *summarize* where the class discusses the students' explorations. Throughout the project, the researcher collected data in the form of observations, interviews, surveys, student work, and journal entries.

Findings from the interviews and surveys suggest that higher socioeconomic-status (SES) students enjoyed the CMP materials more than typical books, whereas lower socioeconomic-status students did not. However, all students agreed that CMP required them to think about the math problems longer and harder and that it helped them see the relationships between math and life outside of school. The researcher suggested that difference in preference may come from the fact that the CMP curriculum is based around real world problems, some of which may pose inequality issues if students of lower SES lack access to the relevant contextual information. Interestingly, the lower socioeconomic-status girls tended to be the most frustrated with the class, and even when they put forth great effort, they still weren't able to conceptualize math in a way that would help them be successful on tests. At the end of the year, the researcher had the students identify the top three students in the class. None of the lower socioeconomic-status girls nominated themselves, including one who was nominated by nine of her peers.

The fact that the lower socioeconomic-status girls lacked confidence is consistent with other studies that found that girls tended to underestimate their mathematical self-efficacy, which adds to the dependability of the study. However, the fact that only three of the participants were non-White makes the transferability of this study questionable.

Cerezo (2004) conducted a qualitative study involving 14 middle school females, all of whom were identified as at-risk of failing either math or science. Of the participants, 36% identified themselves as White and 64% identified themselves as Black. The participants were enrolled in a urban school in the southeastern United States. The study was aimed at finding out if and how problem-based instruction changed the students' self-efficacy beliefs.

The teachers of the participants were trained in problem-based instruction, after which they then taught their lessons using problem-based instruction. For all of the classrooms, the problem-based learning cases and structure were similar. Students were given a problem and divided into groups, and then they had to decide what they were going to research and how to research it. A typical problem-based lesson started with the students in a whole-group participation activity for the first day or two; then they would move to research for the middle days, with the last day reserved for presentations.

After the students had completed the problem-based learning case, the researcher interviewed the participants using 18 questions that focused on students' perceptions of problem-based learning, changes to their learning process, and changes to their self-efficacy beliefs. From these interviews, the researcher used content analysis to identify themes.

The findings from this study showed that students found problem-based instruction to be beneficial to their learning processes because they were more motivated to learn the material and the group work involved with problem-based learning helped them to develop respect for their peers. The problem-based instruction also increased the students' confidence, interest, and understanding of the material, which suggests that problem-based instruction seemed to increase the participants' self-efficacy beliefs.

Due to the fact that the findings from this study are consistent with similar studies, the dependability of this study is strong. Also, the confirmability of this study is strong because the researcher presented the findings to the teachers who participated as the problem-based instructors so that they could question any of the data. One weakness, which even the researcher noted, is that the study is limited in generalizability. These limitations exist because the participants were drawn from one school, they were identified as at-risk by their teachers, they represented only two ethnicities and one gender, and their socioeconomic status was not identified.

Reid and Roberts (2006) conducted a similar study about the effects of problem-based instruction which was based on a program called Gaining Options: Girls Investigate Real Life (GO-GIRL) which targeted at-risk adolescent girls. Reid and Roberts used a blend of qualitative and quantitative research methods to gain insight into how the program increased the participants' mathematical confidence and skills. The participants of the program were 74 seventh-grade girls who were recruited by teachers, ministers, and community groups, or who found out about the program through the local university newsletter. In order for the students to be selected for the program, they had to submit a letter of reference from an adult as well as a personal statement. Of the participants, 70% attended urban public schools and 30% either went to public suburban schools or to private schools. Thirty-eight of the girls identified themselves as African American, 15 as European American, five as Asian American, one as Latina, and 15 as Multiracial. In the end, 71 of the participants completed the program.

The program took place over the course of 10 Saturdays at a research university and, although the parents were responsible for transportation to and from the university, lunch was provided for the participants. At the beginning of the program, participants took a 32-question assessment which was used to place the participants in one of three ability groups. In addition to the assessment, students took a survey adapted from the Fennema-Sherma Mathematics Attitudes Scale to assess the mathematical attitudes of the participants. The researchers gained information from these measures as well as from the learning journals that participants kept and from interviews with the participants.

The three ability groups were then further broken down into groups of three or four which were then paired with two university student mentors. The mentors designed lessons that focused on developing the participants' skills so that they could complete an integrated social studies and mathematics project that required them to construct a survey, collect data, and then use statistical techniques to interpret the data. Once the program was complete, the students took the same assessment and attitudes survey that they completed at the beginning of the program.

Results from the Fennema-Sherman Mathematics Attitudes Scale showed that there was a significant increase in participants' confidence in mathematics, $F(l, 73) = 4.36$, $p < .05$.. Also, the participants demonstrated a significant increase in their mathematical abilities based on the pre- and post-assessment, $F(l, 70) = 45.5$, $p < .000$. Additionally, the learning journals indicated that the participants had positive attitudes toward the collaborative nature of the program (90% of participants mentioned this). Themes that emerged from this included the beliefs that problem-based learning groups foster equal participation, encourage sharing of ideas, and allow people to learn from one another. In general, the GO-GIRL program seemed to have a positive impact on the participants' mathematical attitudes and confidence.

The internal validity of this study was compromised because the researcher did not include alpha coefficients for the pre-assessment, post-assessment, or the Fennema-Sherman Mathematics Attitudes Scale. Also, the transferability of the study is questionable because the researcher did not disclose the selection process for participants other than that they had to be referred by an adult and submit a letter of interest. On the other hand, the study was strong in reliability because the results were consistent with similar studies. The researchers even commented that the results were similar to those found in other GO-GIRL program studies.

Higgins (1997) studied a pedagogy similar to problem-based instruction: heuristic instruction. Heuristic instruction involves discovery, trial and error, and experimentation. The qualitative study examined the experiences 137 students from three different schools in Oregon state to see what differences in mathematical attitudes would appear for students taught in a heuristic classroom when compared to those taught in a nonheuristic classroom. Three of the teachers involved with the study had received instruction in how to teach mathematical problem-solving as well as how to engage students, and they taught their classes using problem-solving instruction. These were the teachers and students who the researcher referred to as *heuristic*. The other three teachers had not received formal training in problem-solving and taught in a more traditional manner only teaching a few problem-solving strategies when they came to problem based questions in the textbook. The researcher referred to these teachers as *non-heuristic*.

The participants were taught in either the heuristic or non-heuristic fashion. Heuristic teachers began the school year by using direct instruction to teach five problem-solving skills: guess and check, look for a pattern, make a systematic list, make a drawing or model, and eliminate possibilities. After each skill was taught the students got five days to practice the skill. Once students were taught all of the skills, the heuristic teachers established weekly challenge problems. These problems were typically open-ended and allowed students to come up with multiple solutions. The class would discuss possible solutions and methods for solving the problem. Higgins then gave the participating students a survey in April and May which included 39 questions answered on a Likert-type scale about their perceptions of math, views of school mathematics, and motivation. The researcher then randomly selected 18 students (9 from each kind of class) and conducted interviews with them in August and Septemeber. Counting and clustering were used to analyze the content and to derive themes from the interviews.

Results from the survey showed that students taught in the heuristic classroom viewed mathematics as relatable to real problems and that those problems were solvable with common sense. When compared to the non-heuristic students, heuristic students also thought it was more important to do well in mathematics. Interestingly, the nonheuristic students indicated that when they could not answer their teacher right away, the teacher would answer the question for them. The heuristic students also indicated that they relied heavily upon their textbook or their teachers to tell them that they had the wrong answer to a problem. The interviews showed similar results, and all but one of the heuristic students outperformed the nonheuristic students on the four nonroutine math problems given to the students by the researcher. Overall, the heuristic students' knowledge of problem-solving skills gave them confidence when they didn't immediately know the answer to a mathematics problem and therefore increased their mathematical self-efficacy.

Strengths of this study rest in the fact that the researcher established triangulation: teachers read through the researcher's data and verified findings. Also, the researcher had an outside mathematics educator listen to the interview recordings to draw out themes that could then be compared to the researcher's. Weaknesses, however, are apparent in this study's transferability, because there is no indication of the participants' gender, socioeconomic status, or ethnicity.

Also, the classes were not randomly selected and the researcher had prior connections to all but one of the teachers involved with the study.

In summary, the studies included in this section indicate that problem-based and discovery instruction allows students to construct their own mathematical understanding, which positively influences their self-efficacy beliefs. All four studies, Lubienski (2000), Cerezo (2004), Ried and Roberts (2006), and Higgins (1997), indicated that problem-based instruction not only increased students' confidence but also helped them to see the relevance of mathematics in their lives outside of school, which suggests that these pedagogies can positively influence mathematical self-efficacy as well as mathematical attitudes.

Social Environment

Silent classrooms can no longer be recognized as the most productive, at least not in terms of self-efficacy beliefs. Five studies outline this argument. Boaler and Staples (2008) conducted a longitudinal study using 700 California high school students and found that students of teachers who employed complex instruction and emphasized effort over ability, experienced more enjoyment, higher achievement, and had plans to pursue more mathematics classes. In a qualitative study of 602 fifth-grade students, Patrick, Ryan, and Kaplan (2007) found that social classroom environments promoted feelings of success and gave students feelings of mastery. Ryan and Patrick (2001) conducted a quantitative study with 233 middle school students and found that in classroom environments where students were expected to interact with and help their peers, greater mathematical confidence and self-efficacy beliefs were reported. Streitmatter (1997) developed a qualitative study observing 24 seventh-grade students (14 were also interviewed) who participated in a girls-only math class for two years; results from the study showed that the students experienced higher levels of mathematical confidence and were more likely to ask questions. Papanastasiou and Bottiger (2004) conducted a quantitative study using 107 fifth- through eighth-grade students who were involved with a school math club. The findings suggested that most of the students had positive views of math and that these views significantly correlated with students' mathematical self-efficacy and grades.

Boaler and Staples (2008) conducted a longitudinal, mixed-methods research study that took place over the course of four years. The study was aimed at identifying how students experienced equitable teaching practices, how students' mathematical attitudes and achievement differed for students taught using complex instruction, and what a successful detracked mathematics classroom looked like. The study included 700 students who went to one of three high schools in California. The schools were all similar in size but differed in demographics. Railside school had a student population of 40% Latino, 20% African American, 20% European American, and 20% Asian/Pacific Islander, with 30% of the students being on free or reduced lunch. Hilltop school had a student population of 60% European American and 40% Latino with 20% of the students being on free or reduced lunch. And Greendale school had a student population of 90% European American and 10% Latino with 0% of the students being on free or reduced lunch.

Boaler and Staples (2008) observed over 600 hours of lessons over the four-year study. The researchers also conducted interviews with at least 60 students each year, distributed questionnaires with Likert-type and open-ended questions, and administered content-aligned tests. Observations at the schools revealed that Hilltop and Greendale mathematics teachers spent an average of 21% of the class time on teacher lecture, 15% of the time on teacher questioning the class, 48% of the time on students working on problems in the book, and 0.2% of class time on presented work. The researchers did not address how the other 15.8% of the time was spent. By comparison, at Railside teachers spent only 4% of the class time on teacher lecture, 9% of time on teacher questioning the class, 72% of the time checking in on students working in groups, and 9% of class time on presenting work. Again, the researchers did not mention what the other 6% of the time was spent on. In addition, 99% of the problems Hilltop and Greendale students worked on were procedural, whereas 62% of the problems Railside students worked on were procedural, 17% were conceptual, 15% were probing, and 6% were of other types.

Comparison of mean test scores at the beginning of the first year showed that Railside students were achieving at the lowest level of the three schools ($t = -9.141$, $p < 0.001$, $n = 658$). By the end of the first year Railside's mean test scores were showing improvement in comparison to the other schools ($t = -2.04$, $p = 0.04$, $n = 637$). Then, when students took the test again at the end of their second year, results showed that the Railside students were significantly outperforming the students at the other two schools ($t = -8.304$, $p<0.001$, $n = 512$). The last test that the researchers administered at the end of year three revealed that the Railside students were still outperforming students from the other schools but not by as much as they had a year before ($t = -1.75$, $p < 0.082$, $n = 420$). Additionally, the California Standards Test results showed that 50% of the Railside students met or exceeded the basic level compared to only 30% of the students at Greendale and 40% of the students at Hilltop. Moreover, by the fourth year of the study, 41% of the Railside students were enrolled in either pre-calculus or calculus in comparison to only 27% of the students at the other two schools.

Interviews with the students showed similar findings. In the second year of the study, 71% of Railside students reported that they enjoyed math class, compared to only 46% of the students at the other two schools. Again, in the third year, 54% of the Railside students said that they enjoyed mathematics all or most of time, while only 29% of students at the other schools said the same. By year four, 39% of the students at Railside said that they had plans to pursue a future in mathematics, compared to only 5% of the students at the other two schools.

Observations within Railside demonstrated to the researchers that the entire mathematics department was different from the other two schools. Mathematics teachers at Railside worked collaboratively, they all employed complex instruction with heterogeneous grouping, they employed high cognitivedemand curriculum, and they emphasized effort over ability. Results from this study suggest that collaborative classrooms, where diversity is promoted and multiple access points are allotted to problems, positively influence students' mathematical attitudes and confidence, which helps to build up their mathematical self-efficacy beliefs.

The objectivity of this study is questionable since the researchers did not mention how access was gained to the three schools or what their own biases were. However, the credibility of the study seems strong since the researchers had a multitude of data sources, shared their analyses with the teachers for member-checking, and enlisted a team of researchers in order to offer triangulation.

A one-shot, quantitative case study by Patrick, Ryan, and Kaplan (2007) looked at the perceptions of 602 fifth-grade students concerning how the classroom social environment related to their classroom engagement. Participants came from 31 classes in six different elementary schools located in three different school districts in Illinois. For each school the student population consisted mainly of European American students with 0-12% of the students being on free or reduced lunch.

Researchers administered surveys to each of the classes in the spring and told students that it was not a test, and that the researchers were simply collecting information about the students' school and schoolwork. The surveys included Likert-type questions that referred to perceptions of academic efficacy (Cronbach's alpha 0.78), social efficacy (Cronbach's alpha 0.72), and social goals (Cronbach's alpha 0.77). The researchers also collected information about the students' achievement as evidenced by their fourth- and fifth-grade math grades which the researchers coded from A+ = 13 to E = 1.

Patrick et al. (2007) found that student's perceived academic efficacy significantly correlated with their prior math grades ($r = 0.22$, $p < 0.01$). Also, they found significant positive correlations between social efficacy and academic efficacy ($r = 0.26$, $p < 0.01$). In other words, findings from the study suggest that when students feel they have support from their peers and encouragement from their teacher to discuss their work, they are more likely to engage in classroom tasks. The positive engagement then motivates the students to aim for mastery of skills, which in turn gives the students feelings of efficacy. Therefore, the researchers concluded that social classroom environments were beneficial in improving student's self-efficacy beliefs.

The reliability of this study is strong in that the findings were consistent with similar studies and the Cronbach's coefficients for the measures were fairly high. However, because it was a one-shot case study, the methodology didn't account for maturation, history, mortality, or testing.

Ryan and Patrick (2001) conducted a similar quantitative study that examined the change in students' mathematical motivation and engagement as they moved from seventh grade to eighth grade. The participants of the study were 233 students, of whom 57% were girls and 43% were boys, from three different middle schools in two school districts in the midwestern United States.

The participants completed a Likert-type survey in the spring of their seventh-grade year and then again in the fall of their eighth-grade year.

The measures of the survey included perceptions of the classroom and social environment (Cronbach's alpha 0.82-0.9), student motivation (Cronbach's alpha 0.86-0.9), social efficacy with teacher and peers (Cronbach's alpha 0.69-0.79), student engagement (Cronbach's alpha 0.75-0.76), and student disruptive behavior (Cronbach's alpha 0.82-0.89). The researchers then used factor analysis, paired sample t-tests, and an ANOVA to examine the survey results.

The findings from this study highlight the importance of the classroom environment on the efficacy beliefs of middle school students. One finding from the survey revealed that student perceptions of the teacher promoting mutual respect, support, and student interaction were related to increased academic efficacy ($\beta = 0.31$, $p < 0.001$). Increased self-regulated learning was also associated with student perceptions of the teacher promoting respect and support ($\beta = 0.35$, $p < 0.001$). In contrast, student perceptions of the teacher as supportive led to a decrease in disruptive behavior ($\beta = -0.21$, $p < 0.001$). Furthermore, paired sample t-tests demonstrated that while students' social efficacy with peers increased from seventh to eighth grade, their motivation and engagement in mathematics remained stable. In general, the results of the study suggest that classrooms which are set up to encourage students to respect each other's ideas, interact, and provide peer support, tend to predict positive academic efficacy beliefs as well as positive attitudes toward mathematics.

One strength of this study is that the findings were consistent with similar studies, and therefore the reliability seems strong. Another strength of this study rests in the fact that the Cronbach's alpha coefficients were consistently high for each section of the survey measures. However, because there was no mention of how the participants were selected, the interval validity of the study remains questionable.

A qualitative two-year study by Streitmatter (1997) similarly examined the social environment of math students but chose to look specifically at the academic risk-taking of girls in a girls-only math class. Participants of the study were 24 seventh-grade girls who ended the study as eighth graders; the researcher also interviewed 14 of the participants.

Streitmatter (1997) carefully outlined the background of the study by pointing out that the principal of the school had read an article over the summer about the benefits of all-girls math classes and then took it upon himself to select 24 girls to be enrolled in an experimental, all-girls math class. He chose the 24 students based on their high test scores and grades. The principal then randomly selected one of the four math teachers to be the experimental class's instructor. The principal informed the teacher of his choice two weeks before school started and asked that she keep the girls-only factor of the class a secret for fear of gender discrimination litigation. By the end of the first quarter, parents and students knew that they were part of an experimental class and, to the principal's surprise, there was overwhelming support for the class.

The researcher conducted over 30 hours of observation in the classroom over the two years, held group discussions with the whole class at the end of their seventh grade year, interviewed 14 of the students (two were African-American, two were Latina, two were Asian-American, and the rest were European-American) individually using the same questions for each interview at the beginning of their eighth grade year, re-interviewed four of the students at the end of their eighth grade year, and formally interviewed the teacher three times over the course of the two years. Interview questions related to the students' thoughts about the girls-only format of the class, their sense of achievement in the class, aspirations for the future, and parental aspirations. In the final interview, students were asked to summarize their feelings about the girls-only experience and to explain whether they would take the class again if they were given a choice.

Observations revealed that the teacher typically introduced new material and then immediately engaged one student in an understanding or computation of the problem. If the student responded incorrectly, the teacher would push her to work through the problem verbally in front of the class or to collaborate with another student. The researcher noted that there was rarely a time in the class when the students were not asking questions, which resulted in a lot of math-related conversation. Also, oftentimes the teacher would think through problems aloud, which seemed to encourage students to do the same. The researcher compared these findings to the instructor's mixed-gender classes and found that those students were more reluctant to ask questions.

Interviews with the 14 students revealed similar findings. Three themes seemed to emerge. The girls said that they felt more comfortable asking questions without having to be certain that their answers were correct, they had greater confidence in their mathematical abilities, and they enjoyed a classroom climate that created a sense of greater personal freedom. In comparison to the mixed-gender classes, the all-girls math class participants said that there wasn't an expert in their class and the students could not identify a student who significantly outperformed the other students. The mixed-gender classes, however, included several males who claimed to be experts, yet their performance did not match this status.

In general, the findings from this study suggest that the all-girls math class made the students feel good about math. Many claimed that they had more confidence in their mathematical abilities because of the class. And because they had such good experiences in the class, they were looking forward to taking higher-level math classes. These findings seem to imply that the social, respectful, exploratory nature of the all-girls math class helped to improve the participating students' mathematical self-efficacy.

One weakness of the study is that the participants were selected by the principal for their high mathematical performance. This significantly limits the transferability of this study, as does the fact that the researcher did not indicate where the study was conducted. Furthermore, the researcher never indicated any collaboration with outside sources, which calls into question the confirmability of the study. On the other hand, the results of the study are consistent with similar studies and therefore the dependability of the study is strong.

A quantitative study conducted by Papanastasiou and Bottiger (2004) explored the effects of a math club on 107 fifth- through eighth-grade students. Of the participating students, about 60% were female and 40% male. The students attended an Episcopal school in Kansas City, Missouri. The voluntary math club was taught by two middle school mathematics teachers once each week for one hour on Wednesday mornings.

A typical club began with the students and selecting a donut for breakfast as well as a card with a number 1-10 on it. The number on the card informed the students of what group they would be working in for the morning. The students then participated in a math contest, math bingo, or thinker math activity. For the study, these students completed a questionnaire that included questions relating to their motivation for participating in math club. The researchers then used descriptive statistics and an ANOVA to analyze the questionnaires.

Results from the questionnaire revealed that 60% of the participants were earning an A in their mathematics class, 33% were earning a B, and about 7% were earning a C. Furthermore, the top two motivators for math club attendance that the participants identified were (1) being with their friends (71% strongly agreed with this statement) and (2) the relaxed learning environment (60% strongly agreed with this statement). Moreover, results showed that 33% of the students claimed to love math, 61% said they liked math, 5% said they disliked math, and 1% said they hated math. The research also found a significant correlation between students' mathematics grades and their response to how good they were in mathematics ($r = 0.486$, $p = 0.00$), and also a significant correlation between being good in mathematics and liking mathematics ($r = 0.595$, $p = 0.00$).

The researchers suggested that the results from this study indicate that the students in the math club attended because they generally had positive attitudes toward math and enjoyed the relaxed, social nature of the atmosphere. Also, the results of the study seemed to indicate that these positive attitudes toward math helped students to see themselves as good at mathematics, which would suggest that the math club helped to build the student's self-efficacies.

Although this study seems reliable, given that the results are consistent with similar studies, the internal and external validity of the study are weak. The external validity is flawed in that the participants of the study were relatively high-achieving math students, no information was given about ethnicity, and the students attended an Episcopal school. This calls into question the value of generalizing the results of the study to other contexts. Lastly, because this was a one-shot case study, the internal validity of the study is also questionable in that the design does not account for history, maturation, instrumentation, regression, selection, testing, or mortality.

These five studies show that the social atmosphere of a mathematics learning environment seems to be essential for building students' mathematical confidence and self-efficacy. The five studies in this section explored the use of cooperative learning groups, complex instruction, encouraged peer interaction, and whole-class discussion. In general, the studies found that social learning environments are beneficial for students' overall mathematical understandings, attitudes, confidence, and efficacy.

Technology

Two studies focused on the effects of learning mathematical concepts by way of technology to enhance confidence and motivation. Gillispie, Martin, and Parker's (2010) quantitative study using 28 middle school students enrolled in a visual mathematics class based on a 3-D video game revealed that students felt that the video game had helped them to become better mathematicians. And Zydney, Diehl, Grincewicz, Jones, and Hasselbring (2010) conducted a quantitative study on 40 tenth and eleventh graders and determined, using a computer game, that students who were interested in mastering the content worked at a slower pace and gradually increased their challenge level, whereas performance-oriented students worked faster and avoided hard questions.

Gillispie, et al. (2010) explored the effects of a 3-D video game on middle school students' achievement and attitudes in mathematics in this quantitative study. Participants of the study were 28 students who were enrolled in a remedial math class called Visual Math. The students attended a rural, public middle school in North Carolina and the class was taught by a math tutor. Participants in the study were 21 females and seven males. Of those students, 13 identified themselves as European American, nine as African American, four as Hispanic, one as Native American, and one as multi-racial.

The research took place over the course of five days. On the first day, students went over class expectations and procedures. Then on the second day, prior to viewing the video game, the participants completed a survey that addressed students' mathematical attitudes; then they were given a pretest that assessed student knowledge of prime numbers, even and odd expressions, and perfect squares. For the remainder of the week, excluding the last 20 minutes on the fifth day which were dedicated to a post-assessment and exit survey, students completed "missions" in the video game. The students received no mathematical instruction other than what they got from the video game over the five-day period.

The video game, called Dimension M, required the student to take on the role of a college student who lands on a deserted island that was formerly home to a bio-technology lab. When things go astray on the island, the college student must fix problems using pre-algebra and algebra skills. Students also completed a math journal and quiz at the end of each "mission," which required students to review the math concepts which were addressed.

By comparing pretest and posttest scores, the researchers found that student achievement did improve. The mean score on the pretest was 46% with a standard deviation of 15.92, whereas the mean score on the posttest was 63% with a standard deviation of 19.74. Also, data collected from the survey revealed that students reported higher self-efficacy beliefs when it came to video games than mathematics ($M = 3.57$ versus $M = 2.61$ respectively). Students also reported that they believed video games could help with their learning of mathematics (M = 3.18) and that they preferred to play such games at school (M = 3.25) rather than at home (M = 2.64).

Furthermore, the researchers observed students as they played the video game and found that, at the beginning of the video game, students appeared to take a trial and error approach to just get through the game, but students soon started to refer to the math journal in order to look up mathematical concepts. Moreover, interviews with the math tutor and students indicated that the students' mathematical understandings were improving and that the students were beginning to see themselves as better math students. Overall, participants seemed to have a positive attitude toward the video game and improved mathematical confidence because of this change in attitude.

The internal validity of this study was strong because of the pretest/posttest design. Selection and mortality of the study were controlled for, maturation was not likely to have occurred because the time in between the tests was so small, and the history was controlled for because the math tutor relied only on the video game for student instruction. However, the design of this study did not control for regression or testing, and because the pretest was identical to the posttest, it seems probable that some students achieved better scores simply because they were familiar with the test.

A similar quantitative study conducted by Zydney et al. (2010) examined the motivational goals of students' navigational patterns in a mathematical computer game called Math Pursuits. Participants of this study were 40 10^{th} and 11^{th} graders from a large city in the Midwest. Of the participants, 75% were female and 25% were male; 43% of participants did not identify their ethnicity, but among those who did, 41% identified themselves as African American, 32% as European American, 4% as Hispanic, 14% as Asian American, and 9% as multiracial.

Researchers began the study by having participants complete a math achievement test (Cronbach's coefficient 0.78). Then the students began working with the Math Pursuits program for 3 days per week. On these days, students received 10 minutes of instruction based on a specific problem-solving area, and then they worked with the computer program for 35 minutes. Researchers told the participants on the second day of the study how they could choose the difficulty of the questions that they worked on in the program. Much like the video game Dimension M, Math Pursuits guided students through a series of "missions" which focused on a specific math concept.

The researchers were able to analyze computer log files that recorded student progress and monitored the difficulty selection throughout the missions. Results showed that for the Division Mission, 75% of the students who said they had low prior knowledge chose to begin with an easy question, and then 100% of these students chose to increase their challenge to a medium difficulty level for the second question. Of the students who identified themselves as having a high level of prior knowledge in the area, 36% chose to begin at an easy question and 64% started with a medium or hard question. For the second question 50% of the students who chose hard questions for their first, chose to lower the challenge to medium and the rest maintained a hard challenge level. The majority of students seemed to use the automatic, system-provided feedback to select their challenge level for the next question (63% of the low prior-knowledge students and 73% of the high prior-knowledge students). The results were similar for the Multistep Mission.

Analysis of students' navigational patterns seemed to suggest that students were either operating under mastery-goal orientation or performance-goal orientation. The researchers asserted that students who were interested in mastery worked at a slower pace and seemed to have a desire to earn points based on hard work and mastery of the content, which the researchers attribute to intrinsic motivation. In contrast, students who were more performance-goal oriented tried to avoid failure by selecting easy questions that allowed them to complete the missions quickly. Researchers attributed these patterns to an external motivation to outperform others. In general, the researchers argue that it is important for students to have an accurate view of their abilities to succeed mathematically and that Math Pursuits can help students develop accurate self-efficacy beliefs by giving students the ability to control the challenge of their learning experiences.

Although the results of this study seem to be consistent with similar studies, the credibility of this study is questionable since the researchers relied on navigational patterns only to draw conclusions about the data. A stronger study would have conducted interviews with the students to confirm or correct research assumptions. Furthermore, although the researchers claimed that the study was quantitative, researchers presented no statistics other than descriptive statistics which gave the percentages of students who selected different challenge levels.

In conclusion, there is a place for technology in the mathematics classroom. The studies in this section show that the computer programs used were able to give instant feedback to students, which helped them to develop more accurate self-efficacy beliefs, and that students tended to see the programs as helping them to develop more positive mathematical attitudes.

Student Perceptions

Two research studies were selected for this section because they indicate that student perceptions of success or failure in previous mathematical settings influence their performance and feelings of efficacy in current and future mathematics classes. Usher and Pajares (2009) conducted a three-phase study of students in Grades 6-8; the overall findings suggested that students who felt they had mastered skills and who had experienced success at challenging assignments experienced stronger self-efficacy beliefs. And in a longitudinal study conducted by Meece, Eccles, and Wigfield (1990), using 860 fifth- through twelfth-grade students the first year and 250 seventh- through ninth-grade students the second year, researchers found that students' self-efficacy beliefs influenced students' performance and academic choices in mathematics.

Usher and Pajares conducted a quantitative study in three phases. Phase one involved 1,111 sixth and seventh graders; phases two and three included 824 and 803 sixth through eighth graders respectively. Roughly half of the participants in each phase identified themselves as girls and the other half identified as boys. The participants came from public middle schools located in the southeastern United States. The general goal of the study was to identify whether or not Bandura's four theorized sources of self-efficacy influence students in middle school mathematics.

The researchers used a survey for each phase which participants and exploratory factor analysis in phase one and two helped to revise. In phase one the survey consisted of questions about mastery experience (21 questions), vicarious experience (23), social persuasions (20), and physiological and affective states (20). Cronbach's coefficients ranged from 0.85 to 0.95. During this phase, participants were also asked to give feedback on the clarity and wording of the survey items. Using the feedback, researchers created a revised survey for phase two that included 12 questions on mastery experience, 30 on vicarious experience, 28 on social persuasions, and 16 on physiological states (Cronbach's coefficients ranged from 0.89 to 0.94). Again, the researchers asked participants to give feedback on the wording and clarity of the items. Phase three used a survey which included 15 mastery, 22 vicarious experience, 18 social persuasion, and 18 physiological state questions (Cronbach's coefficients ranged from 0.84 to 0.88).

The researchers analyzed the survey results using four simultaneous multiple-regression analyses. This analysis found that mastery experience explained variance in grade self-efficacy and in skill self-efficacy (20% variance). Vicarious experience was found to be a predictor of self-efficacy for self-regulated learning (16% variance). Social persuasions predicted grade and course self-efficacy (4% variance). And physiological state appeared to relate to self-efficacy for self-regulated learning (1% variance). In summary, the study supported Bandura's claim that mastery experience was the greatest source of self-efficacy in students and that this theory could in fact be applied to middle school mathematics students.

Strengths of this study are that the reliability of the surveys ranged from very good to excellent. Also, the external validity of the study seems strong in that a large number of students participated in the study and results of the study seem consistent with similar studies. However, the researchers did not identify how selection of participants was achieved or how access was gained to the research site, which calls into question the objectivity of the study.

Meece et al. (1990) also used a quantitative study to examine the influence of different variables on students' mathematical efficacy, grades, and course enrollment. The first year of this study included 860 students in Grades 5-12, and the second year included 250 seventh- through ninth-grade students. Participants were predominantly White, middle class, and from suburban communities. Roughly half of the students identified as male and half as female.

During the spring of the first year, the researcher administered questionnaires that contained items pertaining to students' perceived mathematical ability (Cronbach's coefficient was 0.86 overall), expectancy for mathematical achievement (Cronbach's coefficient was 0.79 overall), and importance of mathematical achievement (Cronbach's coefficient was 0.67). The researchers also collected data on students' mathematical achievement as represented by final math grades.

The researchers analyzed the data and found that the first year grades significantly correlated with students' perceived mathematical abilities ($r = 0.65$, $p = 0.01$). Furthermore, the research revealed that students' perceived abilities during year one significantly correlated with their year-two mathematical expectancies ($r = 0.41$, $p = 0.01$) and perceptions of the importance of doing well in mathematics ($r = 0.40$, $p = 0.01$). In a more general sense, results from this study indicate that students' efficacy-related beliefs do influence their mathematical performance and achievement, and also that students' prior perceived mathematical achievement influences their mathematical efficacy beliefs.

The Cronbach coefficients for the measures used in this study show relatively good ratings, which is a strength of this study's internal validity. Furthermore, this study's findings are consistent with similar studies which adds to the strength of the external validity. However, the generalizability of this study is questionable since the researchers did not identify the ethnic or socioeconomic statuses of the participants. Nor did the researchers report how the participants were selected for the study.

This section of chapter two took a closer look at student perceptions and how their self-efficacy beliefs are influenced by different factors, as well as how self-efficacy beliefs can be predictors of future mathematics performances. The two studies in this section suggest that self-efficacy beliefs are most strongly influenced by mastery experiences which allow the students to feel that they have succeeded at challenging assignments.

Strategies for Student Empowerment

Teaching specific strategies such as goal setting, self-regulation, and self-correction works to empower students, to let them take control of their own learning, and to help students to develop accurate self-efficacy beliefs. Seven studies focused on this topic. Meyer, Turner, and Spencer (1997) conducted a mixed-methods study on 14 fifth- and sixth-grade students and found that when mathematical projects are developed at an appropriate challenge level for the ability of students and the students are taught strategies for dealing with challenge, self-efficacy beliefs can be increased. In a quantitative study, Bandura and Schunk (1981) studied 40 students aged seven to ten who experienced different goal-setting strategies; researchers found that students who set proximal goals developed stronger mathematical self-efficacy beliefs than students who set distal or no goals. Falco, Summers, and Bauman (2010) directed a quantitative study using 153 sixth-grade students who, after experiencing intervention lessons which taught planning, goal setting, and specific learning strategies, had higher math achievement scores as well as higher self-efficacy beliefs. Using a longitudinal study, Middleton, Kaplan, and Midgley (2004) studied 475 sixth-grade students over the course of a year and found that sixth-grade task and achievement goals in mathematics correlated positively with seventh-grade mathematical self-efficacy. A quantitative study done by Ramdass and Zimmerman (2008) using 42 fifth- and sixth-grade students revealed that students who were taught self-correction strategies held more accurate self-efficacy beliefs than the control group. A quantitative study done by Patrick, Hicks, and Ryan (1997) with 753 fifth-grade students indicated that students who had goals of behaving responsibly in the classroom tended to have higher academic self-efficacy beliefs. A qualitative study done by Pape, Bell, and Yetkin (2003) using 29 seventh-grade students in an advanced mathematics class and 25 seventh-grade students from a regular mathematics class found that, after teaching students self-regulation strategies, students were better able to communicate their mathematical reasoning and understanding and were able to see how the strategies were related to their grades and feelings of efficacy.

Meyer et al. (1997) explored how students' attitudes toward challenge and risk-taking related to their mathematical goals, self-efficacy, and strategy use. The researchers conducted this study using mixed quantitative and qualitative methods. Participants of the study were 14 Caucasian fifth and sixth graders of average mathematical ability, of whom half were boys and half were girls. The researchers did not mention where the study took place other than in a school in the United States.

The researchers administered two surveys to the participants six weeks prior to the start of a project-based lesson called the Kite Project. The first survey was the Failure Tolerance Scale, which questioned affect after failure, preferred difficulty, and action after failure (Cronbach's coefficients ranged from 0.89 to 0.94). The second survey was the Patterns of Adaptive Learning Survey, which examined learning-focused academic goals, ability-focused performance goals, student self-efficacy, use of surface learning strategies, and the use of deeper learning strategies (Cronbach's coefficients ranged from 0.62 to 0.85). Then the researchers observed and conducted interviews with the participants over the course of the Kite Project.

The Kite Project was a geometry unit that required students to design, test, and evaluate their own kites. The main question behind the unit was: What makes a kite aerodynamic? The students worked on their kites in pairs; as a means of individual assessment the teacher used a student's rationale for the kite design and the student's ability to interpret the success of the kite's flight based on angles, length of sides, and surface area.

ANOVA results from the two surveys showed that there was a high positive correlation between difficulty and action ($r = 0.87$, $p < 0.01$). Difficulty and action also related to high ratings of self-efficacy (difficulty = 0.69, $p < 0.01$; action = 0.74, $p < 0.01$) and deep strategy use (difficulty = 0.73, $p < 0.01$; action = 0.57, $p < 0.05$). In other words, based on the surveys, about half of the students exemplified challenge-seeker qualities and the other half showed challenge-avoider characteristics.

The interviews and observations provided researchers with further evidence of qualities that help students to overcome mathematical challenge and increase efficacy beliefs. One group of students (identified as the seekers) monitored and evaluated their mistakes and used self-explanation to block their discouragement and support mathematical persistence. These students viewed mistakes as something from which to learn and make adjustments to their project. Meyer et al. (1997) determined that these students were also the most efficacious. On the other hand, the other group of students (identified as the avoiders) set their level of challenge low so that they could maintain a feeling of competence. When faced with more difficult challenges, these students became overwhelmed with negative thoughts and developed feelings of anxiety. The researchers determined this group to be the least efficacious.

Together, the results of this study suggest that when students learn to challenge themselves, see mistakes as learning opportunities, learn to apply strategies, and develop learning-focused performance goals, they are more equipped to overcome perceived challenges which leads to increased feelings of self-efficacy. The mixed-methods approach to this research adds credibility to the study and strengthens the internal validity. Also, one of the researchers was not allowed to observe the class and was used only for identifying patterns in the data, which increases the confirmability of the study. However, it is somewhat troubling that the researchers did not mention where the study took place, and because all of the participants were Caucasian, the external validity or generalizability of the study is questionable.

A quantitative study by Bandura and Schunk (1981) also examined student perceptions and goal use in relation to self-efficacy beliefs. The design of this study was a four-group pretest/posttest control-group model. The participants of this study were 40 seven- to ten-year-old students (21 boys and 19 girls) from middle-class backgrounds. The students came from six different elementary schools and were chosen based on their teachers identifying them as students with deficits in mathematical skills and interest.

The pretest was a mathematical performance test with 25 subtraction problems. Students who successfully solved more than four of the problems were taken out of the study. The researchers then assessed efficacy by showing students 25 different subtraction problems and asking students to rate on a point-scale (0-100) how certain they were that they could successfully solve the problem (100 being *certain*). Students were then given packets of instructional material that taught students how to solve subtraction problems. The students were given several sessions to complete their packets, but they were to learn the material through self-instruction.

The participants were randomly assigned to one of four groups who all went to the same place to work on the math packet each time. One group, the proximal goal group, was told to consider setting a goal of completing at least six pages of the materials each session. That was the only time goals were mentioned. Another group, the distal goal group, was told to consider completing the entire packet by the end of the seventh session. Yet another group, the no-goal group, was told to complete as many pages as possible. And the last group, the no-treatment (control) group, was given the assessment procedures without exposure to the instructional materials. The participants completed the performance and efficacy posttests at the end of the seventh session.

Using an analysis of variance, Bandura and Schunk (1981) found that the students did not differ on any items during the pretest. However, the proximal goal group showed substantial gains on the posttest in terms of self-efficacy, $t = 4.69$, $p < 0.01$, in comparison to the other groups (distal goals $t = 2.93$, $p < 0.05$; no goal $t = 2.16$, $p < 0.10$; control group $t = 0.01$, $p < 0.001$). Furthermore, the proximal goal group demonstrated a significantly better mathematical performance on the posttest, $t = 12.62$, $p < 0.001$, than the other groups (distal goal $t = 3.17$, $p < 0.01$; no goal $t = 4.27$, $p < 0.01$; control $t = 1.01$, $p < 0.001$). In summary, the results of this study suggest that students need to be taught to use proximal goals so that their mathematical persistence will be cultivated and their self-efficacy beliefs enhanced.

The internal validity of this study seems to be strong based on the pretest/posttest design, which accounts for history, maturation, testing, instrumentation, regression, selection, and mortality. Also, the objectivity of the researchers was kept intact because the researcher who conducted the posttest was not told which groups the participants had been in. The external validity or generalizability of the study, however, is questionable since the researchers were not forthcoming with the ethnic or racial makeup of the participants, where the study took place, or how the six schools were chosen for participation in the study.

A quantitative study conducted by Falco et al. (2010) had findings similar to those in Bandura and Schunk's research. Falco et al. examined the use of a school-counselor-led curricular intervention on the efficacy, performance, and overall attitudes of 153 sixth-grade math students (75 girls and 78 boys). The study was conducted using a pretest/posttest design with two groups, an experimental group and a control group. The participants were randomly assigned to their groups. (Due to ethical obligations, the control group received the intervention the next semester.)

Participants completed a pretest one week prior to the intervention which included items from the Attitudes Toward Mathematics Instrument (Cronbach's alpha 0.96), a self-efficacy measure (Cronbach's alpha 0.97), and the Mathematics Performance Instrument (Cronbach's alpha 0.71). The intervention consisted of nine 30-minute lessons taught by the school counselor once each week. The intervention was given in addition to the students' regular mathematics lesson. The intervention lessons were designed to foster skills in planning, goal-setting, and strategy use. Specifically, students learned about time management, goal-setting, mathematics study skills, and help-seeking skills. The counselor focused on creating opportunities for students to have experiences using these skills and encouraged the students to use their skills in other areas of their lives as well. The posttest, given after the ninth intervention, was similar but not identical to the pretest.

Results of the hierarchical linear models showed that the experimental group had significantly higher growth in performance than the control group ($\beta = 0.16$, $p < 0.01$). Furthermore, although the girls in the study began with significantly lower mathematical self-efficacy beliefs, girls showed the highest rate of growth in self-efficacy ($\beta = 0.25$, $p < 0.01$). In a more general sense, the results of this study suggest that the intervention program helped students to remain interested and engaged with mathematics and, at the very least, prevented a decline in girls' mathematical self-efficacy beliefs. The researchers assert that this study gives evidence of why it is important for teachers of mathematics to teach students self-regulation, self-correction, goal-setting, and time-management techniques in addition to the regular curriculum.

The pretest/posttest design of the study added to the strength of this study's internal validity. Also, the reliability of the study seems strong in that the results were consistent with similar research. However, the researchers gave no mention of how the study site or the participants of the study were chosen.

A longitudinal, quantitative study conducted by Middleton et al. (2004) examined students' achievement goals over time in relation to academic self-efficacy beliefs. Conducted in southeastern Michigan, this study followed 475 students from sixth into seventh grade. The participants included 51% males and 49% females; of the participants 51% identified as African American, 37% as European American, 9% as Hispanic, and 3% as other races. Participants completed two 40-minute surveys (one at the beginning of sixth grade and one at the beginning of seventh grade) that included items from the Pattern of Adaptive Learning Survey designed to assess task goals, performance-approach goals, performance-avoid goals, and academic efficacy.

The researchers then used a LISREL8 test to see if efficacy and achievement goals in sixth grade could predict efficacy and achievement goals in seventh grade. According to the results of the test, sixth grade task goals positively and significantly correlated with seventh grade task goals ($r = 0.57$, $p < 0.01$) and performance-approach goals in sixth grade also seemed to predict performance-approach goals in seventh grade ($r = 0.55$, $p < 0.01$). In addition, students who felt academically efficacious in sixth grade seemed to continue to do so in seventh grade ($r = 0.38$, $p < 0.01$). Furthermore, a multiple-regression analysis test revealed that while task goals in sixth grade were a positive predictor of academic self-efficacy in seventh grade, performance-avoid goals were not. The researchers interpreted this to mean that students with high efficacy respond to change in a way that lets them adapt in positive ways, whereas students with low efficacy may see new environments as threatening. The researchers also argued that some students who were familiar with demonstrating their ability and who felt they had high abilities may take steps to avoid demonstrating a lack of ability in order to maintain the image of competence.

In other words, the researchers of this study took the question of student goals and their relationship to feelings of efficacy a step further than any of the other researchers in this section. These researchers found that simply feeling efficacious in mathematics could not necessarily be associated with engagement or a desire to learn. In fact, the findings seemed to suggest that feeling academically efficacious and upholding performance-approach goals was predictive of the more negatively associated performance-avoid goals when students moved on to a different learning environment.

Due to the fact that this was a longitudinal study, the internal validity of the study is strong. Also, the results of the study seem consistent with similar studies which suggest that the reliability is also strong. However, the objectivity of the study is questionable since the researchers did not mention how access was granted to the schools involved with the study, nor did the researchers divulge information pertaining to how students were chosen as participants in the study.

Ramdass and Zimmerman (2008) conducted a quantitative study to explore the effects of teaching students to use self-correction strategies on their mathematical self-efficacy, self-evaluation, and performance. The design of this study was a pretest/posttest model with one experimental group and one control group. (The control group participants were taught the same lesson as the experimental group after the study for ethical reasons.) Random assignment to the groups was done using SPSS. The participants of the study were 21 fifth graders and 21 sixth graders (20 males and 22 females) from a parochial school in an urban Northeastern city.

The researchers first administered the pretest, which required the participants to solve long-division problems. Then students received instruction in a step-by-step fashion. The experimental group however, was taught an additional strategy that taught students how to self-check their answers. Next, students solved three more problems (the experimental group got a check list for the self-correction strategy). And during the final phase of the research session, students were asked to rate their perceived capability of solving a given problem (self-efficacy instrument Cronbach's alpha = 0.70). At this point, students then solved the problems and again rated their level of ability to successfully solve the given problem.

The researchers then used a MANCOVA to analyze the results of the study. Researchers found that self-efficacy correlated positively with math performance ($r = 0.49$) as did self-efficacy accuracy ($r = 0.75$). In other words, the researchers found that students not only need to see themselves as capable in mathematics but hold accurate perceptions of their self-efficacy. Furthermore, the researchers found that self-efficacy bias was negatively correlated with math performance ($r = -0.75$), which supports the argument that students need to see themselves as mathematically efficacious in order to successfully perform. Researchers also concluded that the self-regulation strategies improved the experimental group's mathematical self-efficacies as well as their mathematical performance.

The nature of the pretest/posttest design strengthens the internal validity of this study in terms of instrumentation, selection, history, maturation, regression, testing, and mortality. The reliability of the study also seems strong in that the findings of the study were consistent with similar studies. However, the researchers gave no mention of the demographics of the participants, which weakens the study's external validity or generalizability.

Patrick et al. (1997) conducted a quantitative study to explore how students' goals for acting responsibly related to their academic efficacy beliefs. This study included 753 fifth-grade students from three different school districts in southeastern Michigan. Of the participants, 380 were boys and 373 were girls; 47% were African American, 38% European American, and 7% Hispanic.

The researchers used a one-shot case study with several different measures employed on two surveys given on two different days. The measure for perceived academic efficacy was adapted from the Patterns of Adaptive Learning Survey and asked for student judgments about their capability to successfully do the work in their current math class (Cronbach's coefficient was 0.78). Students were also asked to make judgments about their social interactions, which were aimed at measuring their perceived social efficacy. These questions were adapted from the Perceived Social Competence Scale (Cronbach's alpha was 0.72). Researchers also assessed the participant's social goals using questions taken from The Responsibility Goal Scale (Cronbach's alpha was 0.77). Information on students' prior academic achievement was collected from students' fourth-grade final grades or scores.

The next step was for researchers to analyze the data for correlations. The researchers found that there was significant positive correlation between prior academic achievement and academic efficacy ($r = 0.22$, $p < 0.01$), which is consistent with other studies included in this paper. Furthermore, the results of the study demonstrated that academic efficacy and social efficacy with peers were positively correlated ($r = 0.26$, $p < 0.01$) and that academic efficacy also correlated with socially responsible goals ($r = 0.3$, $p < 0.01$). In other words, this study found that students who had goals aimed at behaving responsibly in the classroom tended to have higher academic efficacy beliefs. Patrick et al. also found that there was no conflict between students being socially efficacious and academically efficacious.

Although the results of this study seem to be fairly consistent with similar studies, suggesting that the reliability is strong, the design of this study was a one-shot case study. Therefore, the design of this study does not account for several internal validity factors such as maturation, regression, testing, instrumentation, selection, or history. Furthermore, even though it seems as if the researchers selected a wide range of participants, the subjects were chosen only from southeastern Michigan and the researchers didn't specify how they were selected, which calls into question the transferability of this study.

The last study in this section was conducted by Pape et al. (2003) using qualitative methods. The goal of this study was to find out if a mixture of instructional strategies grounded in National Council of Teachers of Mathematics (NCTM) standards, sociocultural theory, and self-regulated learning theory could develop students' mathematical thinking and self-efficacy feelings. The study was conducted over a one-year period in which the researchers observed the participants, implemented a treatment (the instructional strategies), and then observed the participants further. The participants of the study were from a medium-sized middle school in a Midwestern city. The school was a magnet school for the arts, and enrollment was based on lottery. Of the students attending the school, 58% were African American, 41% were European American, and 1% were Hispanic, American Indian, or Asian. The participants included 29 seventh graders enrolled in pre-algebra and 25 seventh graders enrolled in a regular education math class.

Once the researchers made their initial observations in the classroom, they began implementing mathematical tasks that required students to work in groups with hands-on activities designed around different mathematical concepts. To encourage students to explain their reasoning, researchers implemented think-alouds, in which the students would share the multiple strategies they used when solving the mathematical problems. Furthermore, the researchers explicitly taught students different mathematical strategies, had whole-class discussions about which strategies students used for different problems, and encouraged students to keep track of the strategies they used or learned about with a daily Strategy Observation Tool. The ten strategies that the researchers explicitly taught were self-evaluation, organizing and transforming, goal-setting and planning, seeking information, keeping records and monitoring, environmental structuring, self-consequences, rehearsing and memorizing, seeking social assistance, and reviewing records.

Pape et al. (2003) found that, for the most part, students did not choose to be strategic. However, most students voiced their appreciation of the self-regulation strategies because they could now monitor their own behaviors and identify relationships between the strategies they used and their grades. Moreover, although the number of students who seemed to show considerable growth was limited, all of the students said that they had a greater awareness of their choices and decisions when it came to studying, and felt more mathematically competent or efficacious because of this. One explanation for the finding that most students chose not to be strategic was that student growth in self-regulating behavior is slow and develops over a longer period of time than the researchers could observe.

The credibility of this study seems to be a strength in that the researchers outlined the procedures of their study and used extensive collaboration amongst one another to verify their observations. Furthermore, the findings of the study are congruent with similar studies, which adds to the dependability. However, since the study was conducted at a magnet school for the arts, transferability is questionable.

This section of chapter two included articles that tested the idea that teaching students strategies for self-management would improve self-efficacy beliefs. The kinds of strategies that the researchers tested were goal setting, self-regulation, self-correction, time-management, and organization. All of the studies found that the teaching of self-management strategies did indeed improve students' confidence in their abilities and helped to increase their efficacy beliefs. However, studies disagreed about the length of time required for students to employ those strategies.

Balancing Challenge with Ability

Math teachers need to be acutely aware of the level at which each student is capable of performing in order to employ developmentally appropriate tasks. Two research articles explored this assertion in depth and are included in this section. In a two-part study, with one part quantitative and one part qualitative, Schweinle, Turner, and Meyer (2006) studied 42 fifth- and sixth-grade students and seven teachers and found that a balance between challenge and perceived skill level was necessary for positive efficacy and value of mathematics. And in a quantitative study, Chen and Zimmerman (2007) studied 107 American seventh graders and 188 Taiwanese sixth graders to find that higher achieving students were more accurate in their efficacy beliefs but when the items became more difficult, all of the students lowered their self-efficacy beliefs.

In the mixed methods study done by Schweinle et al. (2006), the researchers studied how student affect and motivation fluctuated depending upon the learning environment. The researchers explored this question from two different angles. For one part of the study the researchers examined 42 fifth and sixth-grade students (21 boys and 21 girls) from three mainly European American public elementary schools in Pennsylvania. The other part of the study looked at the students' teachers (seven in all) who ranged in teaching experience from one to 22 years.

The researchers first had the students complete an Experience Sampling Form at the end of their math class for four days in the fall. Items on the form addressed student attitudes toward mathematics, their perceived challenge, perceived mathematical importance, perceived success, and student motivation. Students then completed the same form after their math class for four days in the spring. For the other part of the study the researchers audio-taped the teacher's lesson and took detailed notes about the lesson and student-teacher interactions. The audiotapes were then transcribed and coded for affect, autonomy, feedback, challenge, competence, and importance.

After submitting student responses to the ESF to factor analysis, the researchers found that efficacy positively correlated with both importance to the student ($r = 0.23$, $p < 0.01$) and importance to others ($r = 0.34$, $p < 0.01$) but negatively with challenge ($r = -0.23$, $p < 0.01$). These results seemed to be supported by the observations that the researchers made of the teachers. When teachers provided feedback to students that either elaborated on or clarified their response, it seemed to send the message that the students were learning and that it was something that was important. In a more general sense, the results of this study suggest that task importance is a much stronger influence on student motivation than challenge. Furthermore, challenge may actually threaten students' self-efficacy beliefs; therefore it is important to give students challenging assignments that they can succeed at in order for students to value those tasks.

The reliability of this study is strong because the results of the study were consistent with findings from similar studies. However, the reliability is not as strong as it would have been if the researchers would have identified Cronbach's coefficients for the ESFs. Moreover, the sample size was fairly small and homogeneous, and the researchers did not mention how access was granted to the research site, all of which jeopardizes the generalizability of the study.

Chen and Zimmerman (2007) broached this issue of providing a balance between ability and challenge from a quantitative, cross-national comparison approach.

Participants of the study were 107 seventh-grade students from four different schools in Nashville, Tennessee (most were European American and came from middle-class families) and 188 sixth-grade Taiwanese students from one school district in Kaohsiung Sixth-grade curriculum in Taiwan is similar to the seventh-grade curriculum in the United States, which allowed researchers to use comparable math curriculum with both groups. The researchers used Cohen's table to determine that the sample sizes could detect medium and large effect sizes at an alpha coefficient level of 0.05 with 80% power.

In the study, the researchers administered measures during two class periods of one hour each. The math performance test adapted 15 conceptually diverse problems from the Trends in International Mathematics and Science Study (TIMSS); reliability measures were 0.88 for the American participants and 0.92 for the Taiwanese participants. The mathematics self-efficacy scale was also used, which had students rate their confidence to successfully solve each math problem (reliability for the American sample was 0.89 and 0.96 for the Taiwanese sample). The mathematics effort judgment scale required students to estimate the amount of effort they exerted to solve each problem (reliability of 0.94 for both samples). And the self-evaluation scale had students assess the effectiveness or correctness of their solutions (reliability ratings of 0.89 for American participants and 0.95 for the Taiwanese participants).

The researchers then subjected the findings from the measures to statistical analysis. Overall, the Taiwanese students seemed to outperform the American students (Taiwanese $M = 6.13$, $SD = 2.52$; American $M = 4.36$, $SD =$

2.25). A correlational analysis showed that the differences between the two groups in terms of correlation between accuracy and self-efficacy (Taiwanese $r = 0.31$; American $r = 0.01$) were statistically significant ($z = -2.54$, $p < 0.05$). This analysis showed that the Taiwanese students held more accurate self-efficacy beliefs than the American students. Moreover, a univariate test on the data showed that, in terms of mathematical item difficulty, significant linear trends appeared in self-efficacy, $F(1.94, 564.51) = 181.88$, $p < 0.01$, accuracy, $F(1.92, 557.26) = 161.31$, $p < 0.01$, and bias, $F(1.93, 560.67) = 113.48$, $p < 0.01$. In other words, as the mathematical items became more difficult, the students' self-efficacy beliefs, bias, and accuracy decreased. This was true for all students, both in Taiwan and in the United States.

The researchers accounted for the reliability of the instruments in this study by sending the instruments and instructions to three different translators who consulted with different middle school math teachers from Taiwan to ensure that the same language was being used. Furthermore, the instruments obtained high reliability ratings. However, the internal validity of the study is questionable given the static-group comparison design.

This final section of chapter two examined the importance of giving students' mathematical tasks which balanced challenge with student ability. Both studies indicated that student perceptions of problem difficulty influence their self-efficacy beliefs. Furthermore, one of the studies found that task importance was a greater component of students' self-efficacy beliefs and motivation than challenge.

Summary

Chapter two reviewed the research available about the mathematical self-efficacy beliefs of middle school students. The results of each study were examined, critiqued, and summarized. The studies that were reviewed for the Human Capital/Demographic Variables section indicated that high achieving students have accurate self-efficacy beliefs. Furthermore, in order for all students to have an accurate sense of self-efficacy and confidence in mathematics, their cultural capital needs to be acknowledged and valued. Research from the Pedagogical Practices/Classroom Environment section suggested that students gain confidence and develop accurate mathematical self-efficacy beliefs when they work in a social environment where everyone's perspective is valued. Moreover, the studies found that problem-based or project-based instruction was particularly useful in building students' mathematical confidence. Teaching students self-correction and goal-setting strategies was also viewed as empowering by students and helped to strengthen their self-efficacy beliefs. Chapter three outlines the summary of this chapter's findings in these two sections. Chapter three will also consider classroom implications based on the research, and give suggestions for future studies.

CHAPTER 3: CONCLUSION

Introduction

The concept of self-efficacy was introduced in chapter one as the perceived confidence in one's ability to successfully accomplish a given task. Controversy over what contributes to students' senses of mathematical efficacy and whether it is better to have high self-efficacy beliefs or accurate efficacy beliefs was also touched upon. Furthermore, the history of self-efficacy and its psychological roots were addressed in chapter one, beginning with William James' introduction to the idea of people having different selves and ending with Albert Bandura, who claimed that people's beliefs about their abilities were better predictors of their behavior than their abilities themselves.

Chapter two continued the investigation of middle school students' mathematical self-efficacy beliefs by examining the research surrounding the topic. Two initial questions that guided this literature review were: What effects does self-efficacy have on mathematical motivation in middle school students? What are the factors affecting self-efficacy in middle school students? Neither one of these questions is easily answered by students and therefore required researchers to develop strategic methods of eliciting student perceptions. Each study in this chapter was summarized and organized to develop two main themes and several subthemes. The two main themes focused on in chapter two were human capital/demographic variables and pedagogical practices/classroom environment. Under the first theme the subcategories of gender, race, and giftedness emerged as contributing factors to the discussion of what factors influence self-efficacy. Pedagogical practices/classroom environment, the second theme, included the subthemes of problem-based instruction, social environment, technology, student perceptions, strategies for student empowerment, and balancing challenge with ability.

Chapter three is the final chapter of this paper. This chapter will summarize findings on the question of what effects self-efficacy has on mathematical motivation in middle school students and what the factors are affecting self-efficacy in middle school students. These topics will be revisited with a summary of findings from chapter two, followed by implications for classroom practice and suggestions for further research on the subject.

Summary of Findings

The guiding question of this paper was: What effect do self-efficacy beliefs have on the mathematical motivation of middle school students and what factors contribute to these feelings of self-efficacy? This question is particularly important when one thinks about the intense mathematical anxiety that is felt by numerous students around the United States, which can lead to mathematics avoidance and eventually a shortage of mathematically capable people in the workforce (Pajares and Urden, 1996; Hembree, 1990). Based upon his research in the 1980s and 1990s, Albert Bandura asserted that one's self-beliefs are more predictive of behaviors than one's actual abilities. This would seem to imply that, when students are given opportunities to feel mathematically efficacious, they will be more successful. The research, however, suggests something different.

Human Capital/Demographic Variables

The research that was included in this section of chapter two was broken up into three sections: gender, race, and giftedness. The studies shed insight on some of the contributing factors to the self-efficacy beliefs of students. However, it was in no way an exhaustive review of the demographic variables that contribute to or limit students' mathematical self-efficacy beliefs.

The studies that were included in the gender subsection were in agreement that, while girls were typically underconfident in their mathematical self-efficacy beliefs, boys tended to be overconfident. Lloyd et al. (2005) supported this finding and took it a step further by showing that, although their efficacy beliefs differed, girls appeared to be just as mathematically capable as boys. However, in a broader sense, this study discovered that the highest achieving students were actually the ones with accurate self-efficacy beliefs. The weakness of this study rested in its generalizability simply because the sample size was small. The other study included in this section, by Usher and Pajares (2006), determined that boys' and girls' mathematical self-efficacy beliefs are influenced by different things. Whereas boys and girls seemed to be influenced by invitations, boys were not as influenced by social persuasions as girls, which implies that girls' efficacy beliefs are influenced more by social contexts than those of boys. The weakness of this study was that it was conducted as a one-shot case study and the sample size was relatively small.

The three studies that compared mathematical efficacy beliefs of students of color to those of White students demonstrated that it is feasible to assert that race plays a role in students' self-efficacy beliefs. However, while McCoy's (2005) research simply found that White students were more successful at mathematics and therefore had higher self-efficacy beliefs, Lim (2008) and Keck-Staley (2010) stressed the idea that it was the use of traditional teaching methods that severely limited non-White students' access or engagement with the material. The last two studies strongly asserted that social learning communities and family involvement were necessary learning environments for the success of non-White students in the mathematics classroom. One concern expressed in this section of the paper was how the researchers simplistically divided participants into one of two categories: they were either White or non-White; if they were non-White they were either Latino or Black.

Three studies were also included in the giftedness section of chapter two. Studies by Pajares (1996), Zimmerman and Martinez-Pons (1990), and Pajares and Graham (1999) confirmed that students who were identified as gifted not only had higher self-efficacy beliefs than other students but they had more accurate self-efficacy beliefs. The fact that these studies supported one another's finding suggests that the credibility of these studies is high. Furthermore, the studies in the gender section of chapter two also found that accurate mathematical self-efficacy beliefs were better predictors of performance than overconfident self-efficacy beliefs, which again added strength to the overall findings of these studies.

Pedagogical Practices/Classroom Environment

Classroom variables are essential components of students' mathematical self-efficacy beliefs. From the type of instruction that students receive to their own perceptions of themselves as mathematicians based on past experiences, students' self-efficacy beliefs are greatly influenced by their classroom experiences. This theme in chapter two was split into six subsections: problem-based instruction, social environment, technology, student perceptions, strategies for student empowerment, and balancing challenge with ability.

The four studies by Lubienski (2000), Cerezo (2004), Reid and Roberts (2006), and Higgins (1997) that were included in the problem-based/discovery subsection all suggested that problem-based instruction and discovery were useful in creating meaningful learning experiences that allow students to see relevance of mathematics to their lives outside of school. Additionally, because this type of instruction allowed students to construct their own mathematical understanding, they were able to have mastery experiences that increased their mathematical self-efficacy as well as attitude. The corroboration between the studies' results further strengthens these studies.

Five more studies were included in a section of chapter two that highlighted the benefits of social learning environments. Boaler and Staples (2008) stressed the use of complex instruction. Patrick et al. (2007) highlighted the importance of social environments to the engagement of students. Ryan and Patrick (2001) found that the use of collaborative classroom environments promoted feelings of confidence and mathematical efficacy. Streitmatter (1997), studying an all-girls math class, identified the social attributes of the classroom structure that have a positive effect on students' self-efficacy beliefs. Papanastasiou and Bottiger (2004) looked at a math club to see how a social environment instigated positive views of mathematics and students' perceptions of their ability to be successful at mathematics. Although the studies of this section approached the issue of mathematical efficacy in social contexts from different perspectives, they did provide consistency in the fact that they all found peer interaction to be beneficial in terms of mathematical understanding, attitude, confidence, and self-efficacy.

Technology was another subsection of chapter two and was explored in two studies. The studies, conducted by Gillispie et al. (2010) and Zydney et al. (2010), used mathematical computer games to determine the extent to which technology influenced students' motivation and self-efficacy beliefs. While Gillispie et al. (2010) found that students became more resourceful over time about the strategies they used within the computer game, which helped to improve their mathematical confidence. Zydney et al. (2010) found that students operated under either mastery-goal or performance-goal orientations and, although the use of a mathematical computer game was not enough to increase students' mathematical efficacies, their ability to control the challenge level of their learning experiences gave them more accurate self-efficacy beliefs. Unfortunately, the use of mathematical video or computer games in the classroom is still a relatively new topic, and at present there is limited research that can be compared to the findings in the two studies reviewed here.

Student perceptions are another influential factor in the realm of self-efficacy beliefs. This section of chapter two focused on two research studies carried out by Usher and Pajares (2009) and Meece et al. (1990). Both studies found that mastery experience was the biggest contributor to students' mathematical self-efficacy beliefs, and that efficacy beliefs influenced student performance and academic choices in mathematics. The large sample size of both studies suggests that the results of the studies could probably be generalized; however, neither study identified how the students or participating schools were chosen, which brings into question the objectivity of the research.

The largest section of chapter two was devoted to research surrounding the specific teaching of strategies for student empowerment. This section covered the teaching of self-regulation, goal-setting, self-correction, and other self-monitoring techniques. The seven studies included in this subsection were conducted by Meyer et al. (1997); Bandura and Schunk (1981); Falco et al. (2010); Middleton et al. (2004); Ramdass and Zimmerman (2008); Patrick et al. (19970; and Pape et al. (2003). The most prevalent strategy addressed in these studies was setting goals. Although the goals ranged from goals aimed at task completion to goals about responsible behavior, the students involved with the studies demonstrated a stronger sense of empowerment and mathematical self-efficacy than students who were not taught to set goals for themselves. The research seemed to be consistent in that the deliberate teaching of self-monitoring strategies helped students to feel more confident in their abilities to successfully do mathematics. However, there was an inconsistency in that some of the research suggested that students did not incorporate the strategies into their regular use unless specifically asked to, whereas other research studies observed students using the strategies on a regular basis of their own accord.

The last subsection of chapter two examined the balancing act of challenge and ability. More specifically, this section looked at the challenge level of mathematical tasks in comparison to the mathematical abilities of the students. Two articles provided research for this section. Schweinle et al. (2006) found that while it is important for students to be given challenging assignments that they can succeed at, it is just as important for students' motivation to give them tasks that they value. The other study, conducted by Chen and Zimmerman (2007), examined the balance of challenge and ability from a cross-national comparison of American and Taiwanese self-efficacy beliefs. The findings from this study found that as mathematical task difficulty increased, students' self-efficacy beliefs decreased regardless of nationality. Furthermore, the study demonstrated that the Taiwanese students outperformed and held more accurate self-efficacy beliefs than their American counterparts. This last finding is consistent with other research articles included throughout the literature review in chapter two.

In summary of chapter two, the research suggested something other than what Bandura asserted. While Bandura asserted that self-efficacy would be a better predictor of students' performance than their actual abilities, and therefore having high efficacy beliefs would be ideal, recent research shows that having accurate self-efficacy beliefs is actually a better predictor of students' performance, mathematical motivation, and attitude. Although other trends can certainly be found in the research findings, the value of accurate self-efficacy beliefs is most important in terms of classroom implications.

Classroom Implications

Middle school is a time of transition, both physically and mentally. It is a time when students are developing their own identities and placing less value on the opinions of their parents and more on their peers' opinions. Piaget argued that during middle school students begin to develop the ability to think abstractly but are not yet proficient, which implies that they have probably never thought about their own self-efficacy beliefs or what it means to have confidence in their own abilities (Miller, 2011). This is the very reason why it is so important to begin developing students' abilities to formulate accurate self-efficacy beliefs in middle school. Lloyd et al. (2005), Pajares (1996), Pajares and Graham (1999), and Chen and Zimmerman (2007) all conducted studies that confirm that higher-achieving, more mathematically motivated students have accurate self-efficacy beliefs. However, the ways in which accurate self-efficacy beliefs are cultivated vary widely.

Zydney et al. (2010) introduced the idea that the instant feedback from mathematical computer programs combined with student ability to select their challenge level allows students to quickly formulate accurate perceptions of their ability to successfully complete a given task. This seems to imply that computers and technology have a place in the mathematics classroom and that they may even provide students with a means to explore their mathematical identities in terms of their areas of strength and weakness. The problem, however, is that this presents an impersonal way to learn, which contradicts other research suggesting that the ideal mathematical learning environment is social.

Furthermore, Ramdass and Zimmerman (2008) found that the explicit teaching of self-correction and self-regulation strategies helped students to develop accurate self-efficacy beliefs. This seems as though it is a simple and straightforward strategy, yet it empowers students to be in partial control of their own learning. While Middleton et al. (2004) supported the argument that self-monitoring strategies and goals were beneficial for students' accuracy of self-efficacy beliefs, they found that students who held high self-efficacy beliefs responded to change in a more adaptive way than students with low self-efficacy beliefs. Therefore, the researchers asserted that simply feeling efficacious in mathematics could not be associated with motivation or even a desire to learn.

The research on this topic implies that accurate self-efficacy beliefs are important for performance and that mastery experience is important for self-efficacy beliefs. Therefore a strong means of motivating middle school math students is to give them opportunities to reflect upon their self-efficacy beliefs as well as opportunities to have mastery experiences as well as see themselves as mathematically competent.

Boaler and Staples (2008) found that social learning communities, in which students were expected to help and support each other, fostered feelings of mathematical self-efficacy and motivation. They were not alone in this finding, but their study emphasized the fact that teachers need to move beyond performance goals and allow students opportunities to see themselves as valuable to a mathematics community, which captures the essence of what it means to develop a social learning community.

Furthermore, problem-based or discovery instruction allows students to access information from multiple entry points and construct their own understanding. This process, as mentioned by Lubienski (2000), Cerezo (2004), Ried and Roberts (2006) and Higgins (1997), does much more for students' sense of mastery experience than direct instruction or any kind of procedural lesson. When coupled with math tasks that are important to students and take in to account students' ability levels and need for challenge, as mentioned by Schweinle et al. (2006), students develop accurate senses of self-efficacy as well as positive attitudes toward mathematics and increased mathematical motivation.

In light of the above implications, it is safe to say that it is a combination of reflection, explicit teaching of self-regulation strategies, student construction of mathematical knowledge carefully cultivated by appropriate math tasks, and a social learning community; this combination of circumstances allows students to develop accurate mathematical self-efficacy beliefs, positive attitudes, and motivation. Without one of these components, students begin to develop negative regard for mathematics as a whole. Therefore, if the goal is to help students overcome mathematical anxiety and avoidance so that more students will pursue higher mathematical education, middle school math teachers need to create opportunities for students to reflect upon their self-efficacy beliefs, have mastery experiences, and see themselves as valuable in the mathematics classroom.

Suggestions for Further Research

The literature that was reviewed in this paper was limited in several ways. For some sections of the research, several studies were found, while for others only two studies provided evidence for the subsection's theme. Due to this, there are several aspects surrounding this paper's topic that would be idea for further study. Of particular interest would be further research surrounding different demographic variables and how those factors interact with different classroom variables.

One demographic factor that is in immediate need of further research is how self-efficacy beliefs are influenced by socioeconomic status. Socioeconomic status, though suggested by some to be loosely linked to race, is an area in which little research has been conducted to investigate how self-efficacy beliefs affect academic performance, motivation, and academic confidence for students in K-12 across the SES spectrum. While the demographic variables addressed by the research articles in chapter two were important, a more holistic picture would be gathered if socioeconomic status had been included.

Furthermore, most of the studies included in chapter two were limited in their generalizability due either to the limited number of participants or to their lack of ethnographic diversity. In a society that is becoming increasingly diverse in ethnic population, it hardly makes sense to conduct studies that include homogeneous ethnic representation. Such studies would benefit from being conducted in several different settings with a participant pool representing a variety of ethnic and socioeconomic-status backgrounds.

Additionally, several of the quantitative studies employed the one-shot case study design. Unfortunately, this kind of research design is inherently flawed because it does not account for history, maturation, instrumentation, regression, selection, testing, or mortality. A design that would have afforded the researchers better internal validity would have been the pretest/posttest control group which accounts for mortality, maturation, and selection, and allows researchers more control over the selection, instrumentation, testing, and regression than any other design. Of course, for ethical reasons, often the control group subsequently needs to be given the same treatment as the experimental group, which adds time to the study. However, a control-group design leaves the researchers with a more holistic view of the implications of their research.

In summary, valuable future research will explore how socioeconomic status affects middle school students, studies will be conducted with more ethnically diverse participants, and the researchers will use designs which give them a more holistic picture of what is occurring. It would benefit all educators, not simply middle school mathematics educators, to understand how more students can experience engagement and development of self-efficacy in the classroom.

Conclusion

Chapter one of this literature review laid out the reasons for examining how middle school students' mathematical self-efficacies were influenced and how they related to mathematical motivation. Moreover, the chapter reviewed the history of the psychology of self in the United States and the relatively recent importance it has played in the development of educational practices. Chapter one also outlined the controversies surrounding contributing factors to self-efficacy beliefs and linked the lack of self-efficacy beliefs to math anxiety and avoidance. Lastly, chapter one described the limitations of this literature review and the personal interest the author has in the topic.

Chapter two reviewed the research surrounding mathematical self-efficacy beliefs of middle school students. The research of that chapter was organized into two major themes of human capital/demographic variables and pedagogical practices/classroom environments. Under the umbrella of these two themes several subthemes emerged. Within demographic variables, gender, race, and giftedness emerged as relevant factors influencing self-efficacy. Furthermore, under the theme of pedagogical practices/classroom environments the subthemes of problem/discovery-based instruction, social environment, technology, student perceptions, strategies for student empowerment, and balancing challenge with ability surfaced as relevant classroom variables influencing students' mathematical self-efficacy beliefs. These themes and subthemes were used to address the guiding question of this literature review, which was what effects does self-efficacy have on mathematical motivation in middle school students and what are the factors affecting self-efficacy in middle school students.

The research presented in the Human Capital/Demographic Variables section of chapter two demonstrated that while girls and boys are equally capable of being successful in mathematics, girls tend to be underconfident in their abilities while boys are overconfident. Additionally, schools tend to cater to the learning preferences of White students, and this works to put students of color at a disadvantage and causes these students to develop low mathematical self-efficacy beliefs. Furthermore, while gifted students do have higher self-efficacy beliefs than regular education students, they also tend to have more accurate beliefs. The Pedagogical Practices/Classroom Environment section of chapter two supported the last assertion and added that social learning environments, in which students are taught self-regulation strategies, teachers employ opportunities for students to construct their own knowledge using meaningful, balanced, and important tasks, and students see themselves as valuable to the mathematics community, are crucial elements to forming positive attitudes, self-efficacy beliefs, and motivation in a mathematics classroom. Chapter three summarized the findings from chapter two, developed classroom implications based on the research, and suggested areas for future research.

The importance of the research presented in this paper cannot be overstated. As mentioned in chapter one, there is a widespread epidemic of mathematical anxiety and fear of getting the wrong answer (Hembree, 1990). This anxiety and fear have a detrimental effect on students' mathematical self-efficacy beliefs, on standardized test scores, and ultimately on the economic growth of the United States. When students do not feel mathematically efficacious, they begin to develop anxiety and math avoidance strategies; students then perform poorly on standardized tests and the United States is left with a small pool of students who are still interested and qualified for mathematical jobs. Therefore it is imperative that middle school math teachers allow students opportunities for reflection and construction of their own mathematical knowledge in social learning environments that allow all students opportunities to see themselves as mathematically competent and valuable.

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