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Concordia University–Portland

College of Education

Doctorate of Education Program

WE, THE UNDERSIGNED MEMBERS OF THE DISSERTATION COMMITTEE

CERTIFY THAT WE HAVE READ AND APPROVE THE DISSERTATION OF

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Effective Mathematics Instruction:

Developing Best Practices for Student Learning

Debra Wecker Flores

Concordia University–Portland

College of Education

Dissertation submitted to the Faculty of the College of Education

in partial fulfillment of the requirements for the degree of

Doctor of Education in

Teacher Leadership

Brianna Parsons, Ed.D., Faculty Chair Dissertation Committee

Lori Sanchez, Ed.D., Content Specialist

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Concordia University–Portland

2019

Abstract

The purpose of this qualitative, intrinsic case study was to examine the perspectives of teachers and students as they pertained to how they understood and described effective mathematics instruction. The research population consisted of six ninth-grade students attending the educational centers in a regional charter system in California. The research population also included six high school mathematics teachers from the same regional charter system who had taught ninth-grade mathematics for at least two school years. The research instruments used in this study included semistructured interviews, observations, and an examination of artifacts. Interview questions were open ended and designed to capture the experiences, opinions, ideas, and feelings of the participants. The purpose of the observations was to provide a description of the setting and everything that occurred within. Interviews were transcribed manually, and the data collected through interviews, observations, and artifacts was broken down through the process of coding. Data gathered through the interview and observation process and the examination of artifacts showed that both teacher and student participants understood that effective mathematics instruction depended on the level of teacher-student engagement, developing and adhering to expectations, relating mathematics to real-life, and creating a safe teaching and learning environment. The voices of those closest to the issues presented in a mathematics classroom are of great importance in determining how to best realize effective mathematics instruction. It is hoped that further research in the area of mathematics reform includes the voice of teachers and students.

Keywords: engagement, expectations, relevant lessons, safe teaching-learning environment, changing student attitude, growth mindset, self-efficacy

Dedication

I would like to dedicate this dissertation to:

My husband, *Tony Flores,* for your patience and support throughout this long journey; it was much needed and so greatly appreciated. Thank you for not letting me give up when other situations arose and took up so much of my time. I love you!

My daughter, *Adrian Flores Hanes,* your encouragement and understanding of the need for such a study was a great asset. Your knowledge of educational systems and experience in the classroom provided a valuable sounding board from which I was able to bounce off ideas. I am so proud that you are my daughter. I love you!

My nephew, *Corey Flores,* for the sense of competition you bring to everything we involve ourselves in. Our motto, "Always play to WIN!" As always, what's next? I love you!

My granddaughters, *Maya Grace* and *Viviana Faith,* may you too someday have the fortune to pursue your passion as your life's work. Grammy Loves You!!!

My brother, *Bill Wecker,* you were so interested in process, the research of others, and my research. I am so sorry you are not here to see the end result, but your presence was felt all the way to the end. I miss you!

Anakaren Munoz and *Garry Brooks,* my team teachers and the most valuable players! Thank you giving me the space when I needed it and always showing interest. Your support was greatly needed.

All of the students I have had the honor of working with during the past 35 years. You were my inspiration; what you brought to the classroom and what you were able to take away inspired this study. I would not have searched for answers to my questions without your presence in my life. Thank you!

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With the utmost respect and appreciation, I would like to thank Dr. Brianna Parsons. I am so happy I chose you for my Faculty Chair, I would never have been able to accomplish this study without you. You challenged me to dig deeper and think bigger; your dedication and expertise inspired me to consistently do my best work. Your questions kept me constantly looking for the answers, and your support led me to a finished product. You are so personable and our conversations about everyday life left me with the feeling that I had known you, personally, for a very long time. Thank you so much for agreeing to travel on this journey with me.

I would also like to thank Dr. Lori Sanchez and Dr. Mark Jimenez for agreeing to join the committee team. Your input challenged me to look beyond what was assumed. Your interest in the study was noted and your patience and guidance were greatly appreciated.

Finally, I would like to thank the organization that allowed this study to take place within the educational centers it established. Without your permission, this study would not have occurred, and the voices of teachers and students would have been unheard.

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Chapter 1: Introduction

Mathematics is a core discipline across all levels of education; Baloglu and Koçak (2006) noted that understanding of mathematical concepts is thought to be key to occupational and personal success. Nasser and Birenbaum (2005) indicated that achievement in mathematics determines placement, course selection, and admission to most educational systems. Yet a study published in 2017, on behalf of Change the Equation, found nearly three in 10 Americans reported they were not good at math. Furthermore, 21% of Americans felt frustrated and another 18% felt anxious when they had to do math. The majority of those surveyed believed that the lack of emphasis on developing good math skills would have a negative impact on the future of the economy (Change the Equation, 2017). Not only do many people feel their math skills are inadequate, but they recognize these skills as important to their daily lives.

Much of the research conducted in the last century has shown that little progress has been gained thus far in the overall improvement of student achievement in mathematics within the American educational system (Ball, Lubienski, & Mewborn, 2001; Stewart, 2012; Zopf, 2010). Some researchers believe the lack of progress in mathematics is a result of research focusing mainly on teacher preparation and curriculum. They argue that teacher practices, beliefs, and attitudes toward mathematics also play an important role in student achievement (Ellis & Berry, 2005; Hargreaves & Shirley, 2012; Morris & Hiebert, 2009; Superfine & Li, 2014). Gaining optimal student achievement in mathematics continues to be a topic of research, yet I found few studies that included the voice of those closest to the situation, those who are teaching and learning in America's schools.

Teachers' and students' experiences and opinions of how mathematics is taught and to what degree the concepts are learned should be taken into account to identify which methods work best in acquiring optimal achievement. This qualitative, intrinsic case study investigated the lived experience of ninth-grade students and their teachers as they pertain to the teaching and learning of mathematics. As researcher of this study, I was interested in the voice of students and teachers, and how they understood and described effective mathematics instruction.

Background, Context, History, and Conceptual Framework of the Problem

Mathematics is the study of numbers, quantities, and shapes and the relationship that exists between them (*Merriam-Webster Dictionary,* 2017), it also includes concepts many people tend to struggle with. "It is ironic that the subject seen as the most logical and intellectual is also the one that ignites so many passionate emotions" (Stuart, 2000, para. 4). Stuart (2000) indicated that student success and mathematical self-confidence are directly related to the methods used to present concepts and skills. Usher (2009) further suggested that not enough research has focused on young students' thoughts, concerns, and experience; research that enlists young students as the participants. Lazarides and Watt (2015) studied the relationship between the mathematics classroom environment, motivation, and career plans. They found that teachers' attitudes, beliefs, and expectations affected students' achievement and motivation. For most of the past century, students' personal thoughts and experiences were not considered with each new attempt to reform mathematics instruction, although student performance and level of success was the focus of all initiated reform.

Attitudes toward mathematics are key to determining the level of success in the subject. Amankonah (2013) believed mathematical knowledge and skills served as the "gatekeeper" to every student's future, and Pajares (2002) indicated that the knowledge and skills individuals possessed certainly play a critical role in what they choose to do in life. For students to achieve in mathematics, their attitudes toward the subject must be addressed.

Mathematics is a core subject and required to be taken at all levels of education. It is a discipline of relationships and logic, and yet it is one that creates frustration and anxiety in some members of the American population (Baloglu & Koçak, 2006; Change the Equation, 2017; Nasser & Birenbaum, 2005). Achievement in mathematics is used as a determining factor in course selection and placement in institutions of higher education and is seen as a factor in determining occupational and personal success (Nasser & Birenbaum, 2005). Yet researchers have found that little has been done to improve how and what mathematics is taught in American schools.

Some researchers believe the lack of progress in mathematics is a result of improvement focusing mainly on teacher preparation and curriculum. They argue that teacher practices, beliefs, and attitudes toward mathematics also play an important role in student achievement (Ellis & Berry, 2005; Hargreaves & Shirley, 2012; Morris & Hiebert, 2009; Superfine & Li, 2014). Baloglu and Koçak (2006) indicated that the most common emotional problem associated with mathematics is anxiety, while Suinn and Edwards (1982) suggested that "about half of the variance in mathematics achievement could be explained by factors other than intellectual ones" (as cited in Jain & Howson, 2009, p. 241). For students to achieve in mathematics, attitudes and beliefs of teachers and students must become part of the existing equation involving teacher preparation, knowledge, and curriculum.

For much of the past century, mathematics in American classrooms has been a topic of research and reform. From the early to the mid-20th century, mathematics curriculum shifted from collaborative, cooperative learning that was highly focused on personalized education, to providing students with only the math skills needed for the workforce, and then to mathematics that required a higher level of thinking and took into account its relationship between science and mathematics (Klein, 2003). How and what should be taught in mathematics and what students should learn seemed to shift with every new decade.

The latter part of the 20th century brought about two distinct educational concepts of how mathematics should be taught: procedural-formalist curriculum (PFP) and cognitive-cultural curriculum (CCP). The proponents of PFP believed in rote-learning; it was grounded in drill and practice with an expectation that students should memorize facts and procedures. In contrast, CCP required a new way of teaching, one that took students beyond rote knowledge and skills (Ellis & Berry, 2005). Educators supporting CCP invited students to think bigger, out-of-the-box, to become math problem solvers.

CCP grew through the need to teach all students, taking into account their cultural backgrounds and cognitive abilities. Proponents of CCP believe a relationship between mathematics and real-life situations must exist so that students are able to better understand and use the concepts being taught (Ellis & Berry, 2005). CCP created a foundation on which the content-area standards for No Child Left Behind and the Common Core Initiative would be built.

The last decade of the 20th century brought about Excellence in Education, a movement backed by politicians, which was based on rigorous content-area standards. The No Child Left Behind (NCLB) initiative was a result of the Excellence in Education movement (Woodward, 2004). The NCLB initiative eventually led to the Common Core Standards which took effect in the early part of the 21st century. The Common Core Mathematics Standards focus on encouraging students to develop a depth of understanding for mathematical concepts and the ability to apply them to real world issues and challenges (Common Core State Standards Initiative, 2017). Common Core standards are a compilation of high-quality math standards from states across the country.

Those involved in the education field and society in general seem to be aware that students must be prepared for the 21st century—a globalized society, one that is entrenched in technology and encourages innovation (Koch & Wilhoit, 2011). To be successful in the 21st century, students must become fluent in math, a demand that leaves educators trying to figure out exactly what methods and attitudes will provide such fluency that leads to an improvement in student achievement. The present shift in mathematics education seems to be one that attempts to combine various reforms of the past. It is as if educators are seeking the right balance in preparation, curriculum, innovative programs, and professional development.

The research of the early 21st century identified teacher preparation and curriculum as the factors contributing to student achievement in mathematics (Ball et al., 2001; Handal & Herrington, 2003; Hill, Rowan, & Ball, 2005). Research conducted as the 21st century progresses is focused on teacher and student attitudes and beliefs toward mathematics, as well as the environment in which it is taught (Amankonah, 2013; Bandura, 2012; Dweck, 2014; Lazarides & Watt, 2015). Researchers have indicated that student achievement was not just about teacher preparation or curriculum but included the attitude of teachers and students towards mathematics (Amankonah, 2013; Stramel, 2010). Researchers of the 21st century, thus far, have focused on factors such as motivation and praise and how their use might improve students' attitudes.

This study was designed to investigate how teachers and students described and understood effective mathematics instruction. It examined how Bandura's (2011) theories addressing social cognition (SCT), Dweck's (2014) growth mindset, and Zimmerman's (2000) self-regulated learning theories (SRL) contributed to increased student achievement in mathematics. Investigating teachers' and students' beliefs, attitudes, and expectations, along with the created classroom environment, produced commonalities in the views and actions of participants as they related to effective mathematics instruction. These commonalities showed it is not simply teacher preparation, teacher knowledge, and curriculum that is responsible for the level of mathematics achievement of students; teacher and student attitudes, beliefs, expectations, and classroom environment are equally responsible.

Statement of the Problem

Despite the history of reform efforts focused on providing American students with effective mathematics instruction, little progress in improvement has been realized (Ball et al., 2001; Koch & Wilhoit, 2011; Zopf, 2010). It is common for elementary and middle school teachers to possess limited mathematics content knowledge, which leads to high levels of anxiety, and low levels of self-efficacy (Good, 2009; Yavuz, Gunham, Ersoy, &Narli, 2013). Wilkins (2008) indicated that upper elementary teachers (Grades 3–5) had greater content knowledge and more positive attitudes toward mathematics than primary grade teachers (Grades K–2). Teacher preparation programs need to pay attention to pre-service elementary teachers' motivation to learn mathematics to help them develop a deep level of understanding, so they are better able to communicate concepts to the students and ensure achievement.

According to Baloglu and Koçak (2006), the most common emotional problem associated with mathematics is anxiety. They found "inadequate preparation, attitudes of the mathematics teachers and their teaching methods, inadequate mathematics textbooks, and the students' levels of thinking" (p. 1326) to be some of the common factors creating mathematics anxiety. I have taught math to students in junior/senior high school for the past 30 years and have found that a large percentage of students enter the classroom with fear and apprehension. They demonstrate anxiety and a general attitude of not liking math; in addition, many lack the basic foundational concepts and skills needed for higher-level mathematics courses. I have often wondered why so many students enter junior or senior high school with similar negative attitudes and low-level abilities. It is apparent that many students who struggle with math have a "matter-of-fact" attitude towards the subject—an "I am not good at math and never have been" type of mantra. My personal beliefs led to an interest in researching and identifying how students and teachers understood and described effective mathematics instruction.

Purpose of the Study

The purpose of this qualitative, intrinsic case study was to examine the perspectives of teachers and students as they pertained to understanding and describing effective mathematics instruction, and how their perspectives might aid in further studies of what factors might lead to effective mathematics instruction. Existing literature and research show that there continues to be a need for reform in mathematics education in the United States (Ball et al., 2001; Koch & Wilhoit, 2011; Zopf, 2010). Some researchers declared that reform must occur in the methods and length of time mathematics teachers are prepared (Ball et al., 2001; Handal & Herrington, 2003; Hiebert & Morris, 2009). In addition, they believed individuals should demonstrate an ability to be able to present mathematics concepts in a variety of ways so as to ensure understanding (Ball et al., 2001; Handal & Herrington, 2003; Tatto et al., 2012; Wilkins, 2008). Other researchers indicated that innovative programs and professional development are the key to reforming mathematics education; programs such as Science, Technology, Engineering and Mathematics (STEM), Math Counts, and teacher support groups that focus on setting goals and sharing ideas and resources (Hiebert & Morris, 2009; Land, 2011; Timmerman, 2004; Zopf, 2010). There are also researchers who believed that teachers need to possess a positive attitude toward the subjects they teach. Studies have shown that positive attitudes are more likely to bring about change in student attitude and achievement (Bandura, 1994, 2001, 2011; Dweck 2002, 2006, 2010, 2014; Pajares, 2002; Zimmerman, 2000). This study examined which factors, as described by students and teachers, lead to improved mathematics achievement, and how they understood effective mathematics instruction.

Research Questions

Under an assumption that the voice of those closest to the issue is of great importance in determining the level of students' mathematics achievement, the following research questions were addressed in this study:

- How do high school math teachers understand and describe the best instructional practices that lead to student success?
- How do ninth-grade students understand and describe academic success in mathematics?

The answers to these questions may lead to a realization that further research, which includes the voice of teachers and students, is needed in the area of mathematics reform.

Significance of the Study

The shift in paradigms over the past century assumed the need for flexibility in both the teaching and learning that was to occur in a mathematics classroom. The Conference Board of the Mathematical Sciences (CBMS) suggested:

> A large component of reforming mathematics education in the United States requires asking teachers to think differently about mathematics and to strengthen their own conceptual understanding of mathematics, leading many to reconstruct knowledge that had heretofore seemed disembodied and absolute. (as cited in Ellis & Berry, 2005, p. 13)

Philipp wrote, "The challenge is no longer how to get mathematics into students, but instead how to get students into mathematics" (as cited in Ellis & Berry, 2005, p. 12). To function successfully in the 21st century students will need to be challenged to think differently about the role mathematics plays in their daily lives.

Effective mathematics instruction continues to be an area of concern in American education. Researchers have suggested that successful instruction is more than memorizing facts and methods (Hiebert & Morris, 2009; Land, 2011; Timmerman, 2004; Zopf, 2010). It has become more about how students can relate mathematical concepts to their own lives (Common Core State Standards Initiative, 2017). In addition, teachers' and students' motivation, beliefs, and attitudes, along with the classroom environment, have become the focus of subsequent research (Dweck, 2014; Lazarides & Watt, 2015; Usher & Pajares, 2006; Zimmerman, 2000). As a result of this study, additional information is available that describes what teachers and students understand to be effective mathematics instruction.

Definition of Terms

Cognitive-cultural curriculum (CCP). Cognitive-cultural curriculum is the belief that mathematics is a set of logically organized, interconnected concepts that form through experience, thought, and interaction (Ellis & Berry, 2005).

Common Core State Standards Initiative. The Common Core Standards are a set of high-quality academic standards in mathematics and English language arts/literacy (ELA). These learning goals outline what a student should know and be able to do at the end of each grade. The standards were created to ensure that all students graduate from high school with the skills and knowledge necessary to succeed in college, career, and life, regardless of where they live. Forty-two states, the District of Columbia, four territories, and the Department of Defense Education

Activity (DoDEA) have voluntarily adopted and are moving forward with the Common Core (Common Core State Standards Initiative, 2017).

Content knowledge. Content knowledge refers to the facts, concepts, theories, and principles that are taught and learned in specific academic courses (Glossary of Education Reform, 2016).

Excellence in education. Excellence in education was a mathematics reform movement backed by politicians, which was based on rigorous content-area standards (Ellis & Berry, 2005).

Growth mindset. Growth mindset is the belief that individuals can develop and improve their abilities through practice and effort whereas a fixed mindset keeps an individual from progressing because of a belief that their mindset is predetermined, therefore cannot be changed (Dweck, 2006).

Hybrid teaching/learning system. Hybrid instruction, or hybrid courses, refer to classes where there is a carefully planned blend of both traditional classroom instruction and online learning activities (Fanter, 2010).

No Child Left Behind (NCLB; currently known as the Every Student Succeeds Act (ESSA) signed into law on December 10, 2015). NCLB was part of Title I of the Elementary and Secondary Education Act of 1965 (ESEA) which was put in place to ensure all children have a fair, equal, and significant opportunity to obtain a high-quality education and reach, at a minimum, proficiency on challenging state academic achievement standards and state academic assessments (U.S. Department of Education, 2004). The Every Student Succeeds Act reauthorized the Elementary and Secondary Education Act of 1965 (ESEA) and builds on the work state and local agencies have accomplished in past years. The ESSA puts excellence and equity for students and support for great educators at the forefront (U.S. Department of Education, 2016).

Procedural-formalist paradigm (PFP). Procedural-formalist paradigm defines mathematics as an objective set of logically organized facts, skills, and procedures that have been perfected over centuries (Ellis & Berry, 2005).

Progressive education. Progressive education focuses on collaborative and cooperative learning, social responsibility and democracy, personalized education and personal goals, and integration of community service and service-learning projects (Klein, 2003).

Rote-Learning. Rote-learning is the memorization of information based on repetition; typically used with letters, words, and numbers (Room 241 Team, 2017).

Self-efficacy. Self-efficacy is a person's belief about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Self-efficacy beliefs determine how people feel, think, motivate themselves, and behave. Such beliefs produce these diverse effects through four major processes. They include cognitive, motivational, affective, and selection processes (Bandura, 1994).

Social cognitive (learning) theory (SCT). Social cognitive theory is based on the idea that it is only when people believe they can produce desired outcomes that they apply themselves (Bandura, 1994).

Self-regulated learning theory (SRL). Self-regulatory learning theory describes self-regulatory processes as tools that must be taught and learned so that they can be used by students to improve performance, which will in turn lead to greater self-efficacy (Zimmerman & Schunk, 2001).

STEM (Science, Technology, Engineering, and Math). STEM is an educational program developed within some districts that provides the opportunity for students to study science, technology, engineering, and math. STEM is strongly supported by the U.S. Education Department in Race to the Top District programs. STEM teachers across the country are receiving resources, support, training, and development (U.S. Department of Education, 2015).

STEAM (Science, Technology, Engineering, the Arts, and Mathematics). STEAM is an educational approach designed to prepare educators and students for the 21st century. Science, Technology, Engineering, the Arts, and Mathematics is used to guide student inquiry, dialogue, and critical thinking. The objectives of STEAM advocates taking thoughtful risks, participating in experiential learning, seeing a problem through to the solution, being creative, and embracing collaboration (Education Closet, 2016).

Assumptions, Delimitations, and Limitations

Assumptions, delimitations, and limitations are important to any study because they allow for the adjustment of any shortcomings that might exists in the choices made by the researcher (Simon, 2011). The researcher considered certain assumptions, delimitations, and limitations in the design of this study. Assumptions were things found to be true of the organization, the researcher had knowledge of the culture and nature of the regional charter system. The researcher created the boundaries or delimitations by setting the criteria for issuing invitations to the participants. Limitations existed simply because of the design of charting system; I had no choice but to conduct the research within these limitations.

Assumptions. This study was conducted with the assumption that commonalities in the responses and experiences of the participants would emerge through an interview and observation process. Semistructured interviews were used to elicit responses from the participants; they were asked to share their understanding and description of effective mathematics instruction. It was assumed that participants would be honest in their responses to the interview questions and that they would answer questions to the best of their ability. It was also assumed that special lessons or revised teaching methods would not be initiated simply for the benefit of the scheduled observations. Interviews were followed up with member checking, which allowed the researcher to clarify interview responses and give the participants an opportunity to explain or revise their responses.

Delimitations. I set criteria as to whom would be invited to participate in this study. Only ninth-grade students who had at least one year of direct instruction in a junior high math class, within the regional charter system, were invited to participate. Teachers within the system must have had two years of experience teaching ninth-grade students in a direct instruction classroom. I made the decision not to observe or interview any teacher that I had mentored, or with whom I had team-taught, and I did not interview any students that I had taught. All delimitations were put in place so as to avoid conflict of interest.

Limitations. This study was designed to investigate how a small number of students and teachers within a particular organization understood and described effective mathematical instruction. The organization is a charter system that provides instruction in a hybrid model; students learn through independent study, online courses, or direct instruction; only those teachers and students involved in teaching and learning through direct instruction were considered for participants. This created a limitation in the invitation process as direct instruction classes were limited to 20 students and not all centers offered direct instruction. The organization was chosen because I teach within the region. It was important to demonstrate discipline so as to listen rather than speak; to be open-minded and take in all information without interjecting personal opinions and experience.

Summary

Throughout the past century, numerous paradigm shifts were initiated in an attempt to reform the way in which mathematics is taught in the American classroom. How mathematics is taught and what students should learn is also a continuing topic for education researchers. Researchers have focused their studies on such topics as teacher preparation, curriculum, innovated programs, and support systems, and yet many conclude that little has changed in the way of reform (Ball et al., 2001; Koch & Wilhoit, 2011; Usher & Pajares, 2006; Zopf, 2010). Some researchers believe attitude, motivation, and self-efficacy beliefs are determining factors in how well students and teachers function and achieve in a mathematics classroom (Amankonah, 2013; Bandura, 1994; Dweck, 2006; Zimmerman & Schunk, 2001). Subsequent research may show that it is not one factor or another, but a combination of many that may produce the reform needed and lead to effective mathematics instruction in American classrooms.

The purpose of this qualitative, intrinsic case study was to examine the perspectives of teachers and students as they pertained to understanding and describing effective mathematics instruction, and how their perspectives might aid in further research studies on the subject. I believe the voices of those closest to the issues presented in a mathematics classroom are of great importance in determining how to best realize effective mathematics instruction in the American classroom. It was hoped that this research study, which included the voice of teachers and students, may lead to a realization that further research that does the same is needed in the area of mathematics reform.

Chapter 2: Literature Review

The various mathematics movements of the past century have led to a shared view of unbalanced practices and outcomes in mathematical knowledge and learning as it pertains to American schools and its students (Ellis & Berry, 2005). Each new movement in mathematics focused first on curriculum, then on teacher preparation, but only occasionally were teacher practices included (Ellis & Berry, 2005; Hargreaves & Shirley, 2012; Morris & Hiebert, 2009; Superfine & Li, 2014). Some researchers subscribed to the opinion that mathematics reform initiated thus far has had little impact toward improvement (Ball et al., 2001; Stewart, 2012; Zopf, 2010). The question remains whether the focus should be placed solely on subject matter or pedagogical approach, or if researchers should be looking at the effects of a combination of practices, along with teacher attitudes and beliefs towards mathematics.

According to Huinker and Madison (1997), improving pre-service teachers' efficacy will improve instruction and student achievement. Handal and Herrington (2003) argued that elementary and secondary mathematics teachers were expected to teach in a traditional manner even though they may have held different views and used different techniques in presenting concepts. Teachers with high self-efficacy beliefs employ lessons that are challenging and engaging; they are better equipped to reach all students (Amankonah, 2013). These teachers tend to be more comfortable providing creative mathematical lessons, leaving the traditional methods behind.

Educational environments foster and reinforce the development of instructional methods utilized by teachers (Handal & Herrington, 2003). Studies have shown that poor test scores, assignment scores, and teachers' beliefs affect students' attitudes, performance, and self-efficacy (Amankonah, 2013; Stramel, 2010; Yavuz et al., 2013). It is the teacher's beliefs that dictate how they prepare and present lessons; therefore, pedagogical knowledge cannot be the only factor in determining the effectiveness of a teacher.

Usher (2009) suggested that not enough research has considered young students' thoughts, concerns, and experience; research that enlists young students as the participants. Teachers' and students' opinions involving the teaching and learning of mathematics should be taken into account to identify which methods work best at acquiring optimal achievement. The researcher investigated the lived experience of ninth-grade students and their teachers as they pertained to the teaching and learning of mathematics. The researcher sought to identify how teachers and students described and understood effective mathematics instruction.

The Significance / Problem Statement

The educational reforms directed at mathematics have not significantly improved mathematics instruction in American schools during the past century. Beginning with the 1980s, mathematics education took on a paradigm shift that offered two opposing curricular designs: the procedural formalist curriculum (PFP) or the cognitive-cultural curriculum (CCP; Ellis & Berry, 2005). Procedural formalist curriculum was grounded in drill and practice; students memorized facts, concepts, and methods. Students were taught a particular way to solve mathematics problems and were led to believe there was only one correct way to solve a problem. The premise of PFP was based on the idea that "Learning and assessment are structured around the notion that there is a unique, mathematically correct way to solve a problem" (Ellis & Berry, 2005, p. 11). The use of PFP did not account for differences in learning styles, which left the level of student achievement unbalanced (Ellis & Berry, 2005). Educators were fully aware that not all students would catch on using the PFP method but were satisfied with an assumption that those who did, would be capable of understanding and achieving the concepts and methods of higher-level math courses" (Ellis & Berry, 2005). Procedural formalist curriculum worked well for those students who could memorize facts and procedures, although it challenged the creative thinker.

Cognitive-cultural curriculum was initiated in the mid-1980s with the hope of making mathematics understandable and relevant to all students; a remedy to the shortcomings of PFP. Ellis and Berry (2005) stated CCP is based on the following belief:

> For students to really understand mathematics they need opportunities to both (a) share common experiences with and around mathematics that allow them to meaningfully communicate about and form connections between important mathematical concepts and ideas, and (b) engage in critical thinking about the ways in which mathematics may be used to understand relevant aspects of their everyday lives. (p. 12)

CCP was built on the belief that mathematical concepts are life skills that are acquired through everyday human experiences; they are logically organized and interrelated concepts that have become culturally relevant (Ellis & Berry, 2005). CCP required a new way of teaching, one that took students beyond rote knowledge and skills.

CCP required teachers to find ways to present relevant mathematical concepts and relate them to everyday life situations. Gutiérrez stated, "Teacher practice aligns with the everyday dilemmas that teachers face, the power that they wield, the influence of local contexts, and the relationships between humans" (as cited in Ellis & Berry, 2005, p. 14). The initiation of CCP allowed for more challenging and engaging lessons, ones that would better prepare students for higher level math courses and real-world situations.

Researchers have suggested effective mathematics instruction continues to be an area of concern in American education. Some identify teacher preparation as the most important underlying factor to effective instruction (Ball et al., 2001; Handal & Herrington, 2003; Hill et al., 2005; Tatto et al., 2012; Wilkins, 2008); others believe it is the availability of support systems for teachers and students (Chiu, Hsu, & Wang, 2006; Usher & Pajares, 2006). Some researchers believe the initiation of innovative programs and professional learning communities will improve mathematics instruction (Hiebert & Morris, 2009; Land, 2011; Timmerman, 2004; Zopf, 2010). Still others argue that it is attitude, self-efficacy beliefs (Bandura, 1994, 2001, 2011; Pajares, 2002), ability to self-regulate (Zimmerman, 2000), and the ability to grow the mindset (Dweck 2002, 2006, 2010, 2014) that will lead to effective mathematics instruction. The problem is that despite the history of reform efforts focused on providing American students with effective mathematics instruction, little progress in improvement has been realized.

Organization

To determine best practices for effective mathematics teaching and learning, this literature review examined various techniques and programs as they pertained to mathematics instruction. The review began with a synopsis of the history of attempts at reform and improvement of mathematics education in the United States. The history of mathematics reform was followed by the conceptual and theoretical frameworks. This study utilized social cognitive theory, self-regulated learning theory, and research related to growth mindset to examine how ninth-grade students understood and described effective mathematics instruction. Each theory and research study offered insight on how to best improve students' experience and achievement in mathematics.

A review of the literature discussed the findings of studies that focused on how students learn best, the impact of innovative programs, teacher/student beliefs and self-efficacy, and continued reform and improvement. The review of research methods showed that qualitative studies were used most often. Qualitative methods allow the researcher to observe, describe, and interpret activities, events, or individuals in their own space. Interaction between the researcher and participants is balanced and the researcher is not set apart from or above the participants (Kuna, 2006). Quantitative research reviewed within the literature was used to compare or measure student test scores and progress using numerical data. Some of these studies were longitudinal and followed students as they progressed through the grades; there was limited human interaction in these studies. Other research studies were conducted using mixed methods, meta-analysis, or case studies.

Synthesis of the research methods provided support for pursuing a research project to answer the following research questions:

- How do high school mathematics teachers understand and describe the best instructional practices that lead to student success?
- How do ninth-grade students understand and describe academic success in mathematics?

Usher (2009) indicated that not enough research has focused on the teaching and learning of mathematics, nor considered students' thoughts, concerns, and emotions. Gravemeijer (2004) stated:

> Reforming mathematics education requires instruction that helps students in developing their current ways of reasoning into more sophisticated ways of mathematical reasoning. This implies that there has to be ample room for teachers to adjust their instruction to the students' thinking. But, the point of departure is that if justice is to be done to the input of the students and their ideas built on, a well-founded plan is needed. (p. 105)

Statements such as these indicated a need for studies that include the ideas, opinions, and practices of teachers and students as they coexist in one teaching and learning environment.

Conceptual Framework

A conceptual framework considers all current theories, findings, and circumstances of a research question; it increases the validity of a study (Berman & Smyth, 2015). It acts as a road map, a blueprint of sorts; it ties literature, research, and ideas together, and allows for the creation of a fluid dissertation (Berman & Smyth, 2015). Common threads related to the teaching and learning of mathematics were noticed throughout previous research. There was ample literature on the topic of mathematics and there were several authors who were often encountered. Research included studies covering such topics as pedagogy and teacher preparation (Ball et al., 2001; Handal & Herrington, 2003; Hill et al., 2005; Tatto et al., 2012; Wilkins, 2008), professional development and innovative programs (Hiebert & Morris, 2009; Land, 2011; Timmerman, 2004; Zopf, 2010), improving test scores (district wide, nationally, and internationally; Achieve, 2008; Ball, Hill, & Bass, 2005; Darling-Hammond, 2010; Huinker & Madison, 1997; Loveless, 2004; Wilkins, 2008), and student attitudes and beliefs toward math (Amankonah, 2013; Stramel, 2010; Zimmerman, 2000).

A conceptual framework is the logical progression through relevant ideas that lead to the development of the research questions for the study. In addition, the conceptual framework points to the most suitable research design, how and what data should be collected, and how the data should be analyzed. The goal of crafting a thorough conceptual framework is to ensure the research questions are adequately addressed (Ravitch & Riggan, 2016). The following was an attempt to identify and grow the conceptual framework as it emerged not only from my own interest but from the literature and from theory. The hope was to begin to develop a roadmap that would lead to a clear and thorough dissertation, which would prove to be a valid and useful research study.

Personal Narrative

I have taught math to students in junior/senior high school for the past 35 years and have found that a large percentage of students enter the classroom with fear and apprehension; they demonstrate anxiety and a general attitude of not liking math. In addition, many lack the basic foundational concepts and skills needed for higher-level mathematics courses. I have often wondered why so many students enter junior or senior high with the similar negative attitudes and low-level abilities. It is apparent that many students who struggle with math have a "matter-of-fact" attitude toward the subject, an "I am not good at math and never have been" type of mantra and relationship with the subject. Because of this, the students who are successful in math often dominate the classroom and discussion, allowing those who struggle to remain voiceless and unseen, further adding to their inconsistencies in knowledge and self-efficacy in the subject.

According to Huebner and Corbett (2008), "To effectively teach math, all teachers must develop and maintain skills that enable them to help students understand the complex concepts that underpin mathematical formulas and computation" (pp. 2–3). Mathematics is progressive; students enter each grade with prior mathematical knowledge, various talents, capabilities and disabilities, personalities, desires, and goals. When students are allowed to make mistakes, correct mistakes, work problems out in a way that makes sense to them, when they are offered encouragement by teachers and peers, participate in hands-on activities, and made to feel that they are an important asset to the teaching and learning community, even struggling students can grow in ability and confidence. I fully believe it is the teacher's duty to pay attention to their students, get to know the human being first; and to lead them to the realization of some level of success and confidence in their abilities.

Theoretical Frameworks

A theoretical framework links concepts and shows how they are related. Merriam (2009) stated, "The framework of a study will draw upon the concepts, terms, definitions, models, and theories of a particular literature base and disciplinary orientation" (p. 67). This study utilized social cognitive theory (SCT), self-regulated learning theory (SRL), and research related to growth mindset to examine how teachers of ninth-grade math students understood and described best instructional practices and how ninth-grade students understood and described academic success in mathematics. These theories were selected because each offered insight on how to best improve student experience, attitude, and ability to achieve in mathematics.

Social cognitive (learning) theory. Bandura (1994, 2001), presented social cognitive theory (SCT), which indicates that human development involves many different types and patterns of change, creating diversity in social practices:

> People are self-organizing, proactive, self-reflecting, and self-regulating, not just reactive organisms shaped and shepherded by environmental events or inner forces. Human self-development, adaptation, and change are embedded in social systems. Therefore, personal agency operates within a broad network of socio-structural influences. (p. 266)

Bandura organized his theory in a model that shows how behavior, the environment, and the individual are bound together, each element sharing equal importance in developing the whole being.

Bandura (1986) introduced triadic reciprocal determinism, which describes how behavior, the environment, and the individual are intertwined. According to Bandura (1986), both the social world and personal characteristics influence an individual's behavior. Bandura's SCT focuses on the ability of a person to be actively engaged in their own destiny; they can make decisions and take actions that will determine their own development, thus achieving a desired result (Pajares, 2002). Bandura (1986) stated, "What people think, believe, and feel affects how they behave" (p. 25). Social cognitive theorists believe it is social systems and environment that influence an individual's desire to achieve, their emotional state, personal standards, and self-efficacy beliefs.

Self-efficacy beliefs are formed by an individual's interpretation of how well he or she completed a task or how the performance was rated by others (Bandura, 1994). Researchers have established that self-efficacy beliefs, attitude, behavior changes, and motivation are highly correlated. This leads to the idea that performance does not merely depend on how capable or knowledgeable an individual is but also on how capable and knowledgeable one believes one is. Graham and Weiner (1996) indicated self-efficacy was a greater predictor of behavioral outcomes and individual identity than any other motivational factor employed, especially in education. Grootenboer, Smith, and Lowrie (2006) suggested identity plays a large role in the development of self-efficacy belief:

> We see identity as a unifying concept that can bring together multiple and interrelated elements that all stakeholders (including teachers and students) bring to a learning environment. These elements include beliefs, attitudes, emotions, cognitive capacity, and life histories. (p. 612)

Crittenden (2005) described what SCT looks like in a classroom. He suggested that teachers set the mode, define how the classroom is to function, set the guidelines and expectations, and establish the environment. Students enter the environment with a wide variety of attitudes, behaviors, experiences, and abilities. When the teacher has created an optimal environment, "the classroom stimuli first observed by the student is the basis upon which the reciprocal determinism and learned behavior will evolve" (Crittenden, 2005, p. 962). Crittenden suggested an optimal environment would involve (a) establishing high expectations and enthusiasm that encourages student preparation and participation, (b) an awareness of each student's learning styles and capabilities, and (c) a well-prepared classroom management plan that fosters rewards and consequences aimed at shaping expected behaviors.

Self-regulated learning theory. Barry Zimmerman (Everson, n.d., para.1) is a pioneer of the self-regulated learning theory (SRL); he has studied its impact in the classroom for more than 20 years. The philosophy behind SRL is "when students become engaged, they take greater responsibility for their learning, and their academic performance improves" (Everson, n.d., para. 3). Self-regulatory processes are tools that can be used by students to improve performance, which will in turn lead to greater self-efficacy (Zimmerman & Schunk, 2001), but not many students are prepared to use these processes, so they must be taught and learned. Teachers should guide students to plan, practice, evaluate, and adjust. They should encourage students to persist, to try new and different methods, to set goals, and to measure progress toward reaching the goals. Zimmerman (2000) claims that practice, planning, and evaluation are dependent on one another and if taught correctly, can assist a student in self-regulatory learning.

SRL promotes student planning, practicing, and evaluating (Zimmerman, 2000). In the planning process, students are directed to define the problem, review any past experience or performance with the problem, and conduct a task analysis which identifies desired outcomes. Students are then expected to practice the plan, paying attention to goals they have set and observing their performance as they move forward. Finally, students are asked to self-evaluate, determining if the plan met the goals or if it needed to be revised. Zimmerman's (2000) SRL processes allow students to generate their own feedback and self-assess.

Zimmerman's (2000) model is similar to steps taught by mathematics teachers when guiding students in problem solving. When students are taught to solve problems, they are led to read the problem and decide what they know and what they are being asked to find out. They must then develop a plan to solve the problem. Students then work toward solving the problem, trying different strategies and revising when needed. Finally, they check their answer. If it does not work, they reevaluate the exploration and planning process and try again (Big Ideas Math, n.d.; Department of Mathematics and Computer Science, 1993; Montague, Warger, & Morgan, 2000; Russell, 2016).

Zimmerman (2000) found self-efficacy beliefs were predictive of two measures of students' effort: rate of performance and expenditure of energy. He indicated that self-efficacy measures focused on performance capabilities rather than on personal qualities, such as one's physical or psychological characteristics. Usher and Pajares (2006) reinforced Zimmerman's SRL theory when he found that individuals form self-efficacy beliefs by interpreting information from mastery experience, secondhand experience, societal influences, and physiological states.

Whether in everyday life situations or mathematics class, students face problems that require them to evaluate their skills and estimate their ability to complete a variety of tasks. When students are able to practice, plan, and evaluate, they are more likely to understand what needs to be done. Zimmerman (2000) suggested that students are more likely to succeed when they are taught how to control and be accountable for their own learning. SRL gives students choices in such things as methods to be used, assistance that may be needed, and time frame to complete the task.

Growth mindset. Dweck (2002) indicated that individuals' perception of their abilities plays a key role in their achievement and motivation. A fixed mindset leads individuals to believe their intelligence is genetic and nothing can be done about it, while a growth mindset allows individuals to work toward developing their intelligence over time. Dweck (2010) indicated this occurs through planning, practice, and evaluating one's performance. Dweck (2015) noted, "We found that students' mindsets—how they perceive their abilities—played a key role in their motivation and achievement" (para. 2). According to Dweck (2015), students who believe they can achieve more are motivated to become smarter, so they create goals and put forth the effort to improve. This leads to an attitude of working harder and longer, which ultimately leads to higher achievement.

Stramel (2010) found that middle school students who had low mathematics self-efficacy beliefs felt unsuccessful or distressed. Stramel attributed those beliefs to the low marks students received on daily assignments and assessments, as well as the distress of not understanding the mathematical concepts. Furthermore, Stramel stated "The influence of the teacher, grades, and hands-on activities impact middle school students' attitudes toward mathematics and mathematics self-efficacy beliefs" (p. 138). Stramel (2010) concluded that what students think and feel about their abilities in mathematics is developed over time and involves various factors such as encouragement, challenges, practice, methods, and assessment of ability. Students who are recognized for a job well done tend to improve in effort and performance.

Bandura's social cognitive theory (1986), Zimmerman's (2000) self-regulated learning theory, and Dweck's (2002) philosophy of fixed and growth mindsets have identified consistent attributes that lead to the development of positive self-efficacy. True to each theory or philosophy is the need for an individual to set goals, work towards those goals, seek assistance, put forth effort and time to the task at hand, evaluate the end-product, and revise when needed. Each of these attributes allows students to be in control of their own learning, which in turn will increase their level of self-esteem and achievement.

Review of Research Literature

How students learn mathematics and what types of mathematics they learn is a subject of continual debate in the United States. In 1923, the National Council of Teachers of Mathematics (NCTM) was founded with the main purpose of combatting the progressivist educational takeover of mathematics (Klein, 2003). Charles M. Austin, the first president of the NCTM stated, "The organization would keep the values and interests of mathematics before the educational world" (as cited in Klein, 2003, p. 5). Furthermore, "Curriculum studies and reforms and adjustments should come from the teachers of mathematics rather than from the educational reformers" (Austin, as cited in Klein, 2003, p. 5). Despite the NCTM's quest, progressive education, which is focused on students becoming good learners, as well as positive, productive citizens of society, has from time to time, beginning with Dewey in the early 1900s, found its way into the American educational system (Klein, 2003).

History of educational reform in mathematics. Since the inception of the NCTM, numerous shifts in how mathematics was taught and what degree of knowledge and skills students should receive has occurred. The 1930s brought about progressivism; school curriculum determined by the needs and interest of the students, not by academic subject matter (Klein, 2003). Progressive education focused on collaborative and cooperative learning, social responsibility and democracy, personalized education and personal goals, and integration of community service and service-learning projects. "Schooling isn't seen as being about just academics, nor intellectual growth limited to verbal and mathematical proficiencies" (Kohn, 2008, para. 12). Progressive educators believed students were unique, so the teaching and learning environment focuses on this uniqueness. Progressive educators worked alongside students to design lessons and define the expected outcomes of the lessons.

Progressive education consisted of hands-on learning, collaborative projects, and apprenticeships (Kohn, 2008). Employers of that time observed that those entering the work force did not possess the necessary basic arithmetic skills to be successful at their job or in life and so in the 1940s demanded a new system of mathematical education (Klein, 2003). This new model was called the Life Adjustment Movement; it was devoted to a curriculum that provided appropriate high school courses that focused on such things as consumer buying, insurance, taxation, and home budgeting; algebra, geometry, and trigonometry fell to the sidelines, the belief being they were not necessary for the work force or life in general (Klein, 2003).

With the end of World War II, the study of advanced mathematics was found to be an important component of national security and people wanted a more rigorous mathematics curriculum. By the mid-1950s the New Math era was born, hoping to bring back the higher-level math courses and the College Entrance Examination Board (CEEB) established Advanced Placement (AP) testing (Ellis & Berry, 2005). The 1950s also brought about the formation of the National Science Foundation (NSF) and the country began promoting a Science/Math curriculum. The timing was ironic, as Russia launched Sputnik in 1957 and so began the Space Race. The United States government decided to use NSF funding to create the School Mathematics Study Group (SMSG), reasoning that reform had not occurred fast enough (Ellis & Berry, 2005). New Math textbooks were produced and distributed nationwide by the SMSG; the textbooks "reflected the content and viewpoint of modern mathematics much more completely and accurately than they reflected the pedagogical innovations" (Hayden, 1983, as cited by Ellis

& Berry, 2005, p. 10). Critics of the SMSG New Math claimed the content of the textbooks was too intellectual and the language used was unfamiliar to most educated adults. The textbooks did not necessarily provide the pedagogical innovations of the time, causing them to be widely rejected and forcing a longing to return to a more familiar time of basic skills (Ellis & Berry, 2005).

"Back-to Basics" was the mathematical movement of the 1970s and 1980s. Ellis and Berry (2005) described back-to-basics as "decontextualized and compartmentalized skills-orientated mathematics" (p. 10). The practices of back-to-basics slightly improved the standardized test scores, but it did not necessarily provide students with the higher levels of cognition and understanding needed for algebra, geometry, trigonometry, or calculus (Ellis & Berry, 2005). Procedural formalist curriculum (PFP) and Cognitive-cultural curriculum (CCP) were a product of the 1980s. The 1990s brought about "Excellence in Education" which was based on rigorous content-area standards. The Excellence in Education movement was backed by politicians who believed it would lead the United States to be first in the world in math and science (Woodward, 2004). Not only did content-area standards become important, so did the need to teach all students. The No Child Left Behind movement of the early 21st century was a direct result of Excellence in Education (Woodward, 2004).

During the early 21st century, most states in America chose to participate in Common Core State Standards. The Common Core standards are a compilation of high-quality math standards from states across the country. The mathematics standards provide students in grades K–5 with a solid foundation in whole numbers, addition, subtraction, multiplication, division, fractions, and decimals. The standards for middle school students aim to build on that solid foundation and stress not only routine skills but also conceptual understanding. The middle school standards are intended to better prepare students for the rigorous math courses of high school. The high school standards are designed to prepare students for college and provide career readiness. Students are expected to practice applying mathematical ways of thinking to real world issues and challenges (Common Core State Standards Initiative, 2017). The developers of the standards believe that helping students form a depth of understanding and ability to apply mathematics will only enhance their ability to succeed as college students and employees (Sloan, 2010).

Progress and change continue to occur in the form of innovated programs such as Career Technical Education (CTE), Science, Technology, Engineering, and Math (STEM), and more recently Science, Technology, Engineering, the Arts, and Mathematics (STEAM). Although their full range of goals vary slightly, STEM, CTE, and STEAM share an overall common purpose of preparing America's students to be college and career ready in the 21st century (Koch & Wilhoit, 2011; U.S. Department of Education, 2015). Both programs focus on the application of mathematics in real-world settings, which falls in line with the Common Core Initiative. Some innovative programs center on alternative teacher professional development (TPD) models and the value of professional communities. These programs offer novice teachers opportunities to share resources and communicate best practices. One such TPD, known as Connect-Me, "Mentors novice teachers and empowers them through supports and resources that encourage standards-based teaching" (Dalgarno & Colgan, 2007, p. 1051). Although attempts in improvement continue to occur, many movements seem to mirror those that preceded them. Klein (2003) stated:

> It would be a mistake to think of the major conflicts in education as disagreements over the most effective ways to teach. Broadly speaking, the education wars of the past

century are best understood as a protracted struggle between content and pedagogy. At first glance, such a dichotomy seems unthinkable. There should no more be conflict between content and pedagogy than between one's right foot and left foot. They should work in tandem toward the same end and avoid tripping each other. Content is the answer to the question of what to teach, while pedagogy answers the question of how to teach. (p. 2)

The present shift in mathematics education seems to be one that attempts to combine various reforms of the past. It is as if educators are seeking the right balance in preparation, curriculum, innovative programs, and professional development. There is an awareness in the education field and society in general that students must be prepared for the 21st century—a globalized society, one that is entrenched in technology and encourages innovation (Koch & Wilhoit, 2011). To be successful in the 21st century, students must become fluent in math; educators are left trying to figure out exactly what methods will provide this fluency so that student achievement is improved.

Teacher preparation. The past two decades have produced ample literature concerning the preparation of pre-service mathematics teachers; and the culmination of much inquiry has determined the level of content knowledge possessed by the teacher is directly related to student achievement (Hill et al., 2005; Wilkins, 2008). To present effective lessons, teachers must first understand the mathematical concepts to be presented. Ma (1999) found, "No revolution in American habits is required to create mathematics specialists or to give them opportunity for study and collegial interaction" (p. 886). Furthermore, Ma (1999) indicated that a teacher must have a profound understanding of fundamental mathematics (PUFM), which involves not only an understanding of mathematical concepts, but also an understanding of how best to communicate the concepts to students.

Barker (2007), in agreement with Ma (1999), acknowledged the importance of not only teacher knowledge in mathematics but also the importance of possessing attributes that allow them to enlist their knowledge to effectively use curriculum, design lessons, and present concepts. Teaching mathematics requires much more than just knowing the basics. Ball et al. (2005) stated, "In our data, we see repeatedly the need for teachers to have a specialized fluency with mathematical language, with what counts as a mathematical explanation, and with how to use symbols with care" (p. 21). It is important for teachers to recognize the learning styles and capabilities of their students. This allows for variation in teaching methods, which leads to better student understanding and self-efficacy beliefs.

Reform for teacher preparation. It has long been known that reform is needed in the mathematics classroom, but little has changed as the initiated reforms have made little impact towards improvement (Ball et al., 2001). Handal and Herrington (2003) attributed this phenomenon to teachers who still perceive mathematics in traditional rather than broadminded terms. Teaching mathematics is multi-dimensional; it includes knowledge of various mathematical topics (Hill, Schilling, & Ball, 2004), as the teacher should be knowledgeable enough to present concepts in multiple ways. Reform is difficult and students have continued to struggle with lessons as presented by their teachers (Ball et al., 2001). When teachers learn math using particular sequences and methods, it becomes the preferred way to teach mathematical concepts. This creates a dilemma for students, because if they are having difficulty understanding a sequence or method demonstrated by the teacher and ask for help, the teacher simply re-presents the problem using the same procedures, just taking more time to present it.

Teachers need to be able to present problems in a multitude of forms so as to reach all students (Ball et al., 2001).

More recent studies have focused on the role of institutions in preparing teachers to teach math; conclusions implied the need for valid reform in the area of preparation (Hargreaves & Shirley, 2012; Hiebert & Morris, 2009; Hill et al., 2004; Jansen, Bartell, & Berk, 2009; Superfine & Li 2014). Timmerman (2004) introduced three interventions to be used in the reform process: problem-solving journals, structured interviews, and peer teaching were influential in facilitating change in the prospective teachers' beliefs and abilities. Hiebert and Morris (2009) believed innovated factors needed to be employed to improve teachers' knowledge base. Some of the innovated factors listed were teachers developing shared goals, enlisting change in small increments, and using tangible products. Zopf (2010) suggested the use of pilot programs to analyze tasks needed to teach mathematical knowledge, as well as how to best present problems, while others believed the use of professional learning communities and professional development will lead to needed reform (Land, 2011). According to Ball et al. (2001), many times students are not allowed to develop an appreciation for mathematics because of the amount of time that is spent on drill and practice or unwavering teaching methods.

Teacher attitude and self-efficacy beliefs. According to Huinker and Madison (1997), improving pre-service teachers' efficacy will improve instruction and student achievement. Research findings have indicated that self-efficacy for teaching facilitates the relationship between mathematics teaching anxiety, experience, and mathematics subject area partiality for pre-service teachers (Olson, 2014). Through their research, Huinker and Madison (1997) found that the more positive the impact on teacher efficacy in the preparation process, the more likely it is that they will engage in effective teacher behavior. Study findings have suggested that teacher self-efficacy beliefs, relating to their ability to teach math, affect students' attitudes and their ability to succeed with the subject. Furthermore, studies have shown that it is the responsibility of teachers to identify factors that influence their beliefs, then capitalize on the positive factors and minimize the negative factors in the classroom environment. Studies also show that principals and school administrators who view the teaching of mathematics as a positive endeavor increase teacher confidence for teaching the subject (Amankonah, 2013).

Pre-service teachers' attitudes toward mathematics are an important predictor of self-efficacy beliefs about teaching and learning math, and yet it is common for elementary teachers to possess limited mathematics content knowledge, which leads to high levels of anxiety, and low levels of teacher efficacy (Good, 2009; Yavuz et al., 2013). Wilkins (2008) indicated upper elementary teachers (Grades 3–5) had greater content knowledge and more positive attitudes toward mathematics than primary grade teachers (Grades K–2).

Teacher preparation programs may need to pay attention to pre-service elementary teachers' motivation to learn mathematics to help them develop a deep level of understanding, so they are better able to communicate concepts to the students and ensure achievement. Creating a deep level of understanding will only increase the self-efficacy beliefs toward mathematics, and studies have shown there is a high correlation between content courses and the self-efficacy beliefs of pre-service teachers towards math (Phelps, 2009).

Handal and Herrington (2003) argued that pedagogical knowledge is not a total predictor of instructional behavior because beliefs dictate how lessons are taught, and, due to their conservative nature, education environments foster and reinforce the development of traditional instructional beliefs. While Huinker and Madison (1997) found the addition of methods courses in the teacher preparation program provided a significant change in teacher efficacy, the courses allowed the pre-service teachers to explore mathematics as both the teacher and the learner. "From these enriched experiences, the pre-service teachers emerged with stronger commitments and better understanding of effective teaching and with determination that all children can successfully learn science and mathematics" (Huinker & Madison, 1997, p. 125). Each of these researchers has validated the work of the others. They have shown that it takes much more than content knowledge to effectively teach math in a way that all students learn and achieve.

Student attitudes and self-efficacy beliefs. Amankonah (2013) suggested that mathematics knowledge and skills serve as the "gatekeeper" to students' choice of college majors, their success obtaining college degrees, and their entry into the workforce. Studies (Stramel, 2010; Usher 2009) have shown that poor test scores and assignment scores, along with teachers' attitudes, affect students' attitudes and self-efficacy. Students' experiences impact both mathematics self-efficacy beliefs and attitudes toward mathematics. When students continually receive negative feedback, they tend to give up and assume that they lack the skills to succeed (Stramel, 2010). Usher (2009) indicated students form self-efficacy in mathematics through experience, persuasion, and feedback. Usher (2009) also found teaching techniques, course placement, and students' self-regulated learning contributed to the formation of self-efficacy beliefs.

Rice, Barth, Guadagno, Smith, and McCallum (2013) found that both self-esteem and self-efficacy were increased when students were afforded greater support for math and science from parents, teachers, and friends. They also found that social cognitive models focused on academic and career outcomes highlight attributes such as attitude, interest, and self-efficacy as key factors affecting students' pursuit of STEM (science, technology, engineering, and math) or STEAM (science, technology, engineering, the arts, and math). Finally, they concluded that students with social supports are more apt to do better in math and science, developing interest that creates greater achievement.

Social cognitive theory is based on the idea that it is only when people believe they can produce desired outcomes that they apply themselves (Bandura, 1994). Bandura suggested that both self-efficacy and self-esteem are developed through experience, persuasion, feedback, and personal interpretation of an action or task. To acquire positive self-efficacy toward teaching and learning mathematics both teachers and students must have at their disposal a support system that encourages goal setting, collaborative learning, and positive reinforcement (Amankonah, 2013; Land, 2011; Rice et al., 2013; Timmerman, 2004; Zopf, 2010). Although reform remains slow, studies have shown progress in pre-service teacher preparation, innovative programs, and support systems, all designed to increase the self-efficacy beliefs of teachers and students in mathematics. Creating an attitude of success is the key; Yavuz et al. (2013) found attitude to be the predictor of self-efficacy beliefs.

Review of Methodological Issues

Research is a scientific, methodical way of finding answers to questions. In educational studies research typically is carried out using qualitative, quantitative, or a mixture of both (mixed method). Diem (2014) indicated that the type of research used should be based on the purpose of the study, so that the method chosen produces reliable, valid results. Research methods are useful to effectively evaluate a program or its participants in an objective way (Diem, 2014). Armstrong (2012) stated “The underlying motive for research is intellectual ambition: the desire to know and understand the world, to appreciate the best that has been said and thought on the topics that grip our imaginations” (para. 2). The research findings of this literature review have provided insight into the progress of reform as they pertained to mathematics education in the United States. It has been consistently found that any attempt at reform has had little impact on the improvement of teaching and learning (Baker, 2006; Ball, 1990, Ball, 2005; Ball et al., 2001; Hill et al., 2004; Ma, 1999; Wilkins, 2008).

Quantitative studies. Quantitative methods within this literature review were used to compare student test scores and achievement levels. These studies focused only on numbers; human interaction was not necessary. Rescorla and Rosenthal (2004) conducted a quantitative meta-analysis that examined the change in ability and achievement level of a group of third graders as they progressed and tested in fifth, eighth, and 10th grades. Ball et al. (2005), Darling-Hammond (2010), Loveless (2004), and Malley (2017) conducted quantitative studies that compared the Program for International Student Assessment (PISA) scores of American students to those on a global stage. Ball et al. (2005) indicated, “With the release of every new international mathematics assessment, concern about U.S. students’ mathematics achievement has grown” (p. 14). Each researcher highlighted the fact that American students still were not yet able to be internationally competitive in mathematics.

Qualitative studies. Much of the research pertaining to teacher knowledge and preparation, educational reform, attitudes, and self-efficacy beliefs (focused on teachers and students in mathematics) were conducted using qualitative research techniques. The studies took on interviews, questionnaires, surveys, and observations to determine the views or abilities of teachers. Participants were typically teachers and administrators; students and parents were rarely used as participants. Few studies focused on the voices of students.

Qualitative meta-analyses were conducted to portray the historical quest for mathematics reform in American Schools (Ellis & Berry, 2005; Klein, 2003; Stigler& Hiebert, 2009; Woodward, 2004). Ball et al. (2001), Hiebert and Morris (2009), and Jansen et al. (2009)

provided meta-analyses in which they extensively reviewed and reported on past literature pertaining to teacher preparation. They agreed there is a need for growth in teachers' mathematics knowledge base and found that growth will only occur if the process of preparing teachers to teach mathematics improves.

Longitudinal studies examining the relationship between the learning environment and adolescent development in mathematics classrooms were conducted by Frenzel, Pekrun, and Goetz (2007) and Ryan and Patrick (2001). Researchers found that positive changes in motivation and achievement occurred when teachers exhibited and promoted an environment that fostered interaction and mutual respect. Wilkins and Ma (2003) and Klem and Connell (2004) measured change in student attitudes toward the beliefs in mathematics when transitioning from one level of schooling to the next. They examined adolescents' supportive relationships with parents, teachers, and peers and how it affected motivation at school. Klem and Connell (2004) included school- and class-related interest, academic goal orientations, and social goal pursuit of teacher support and engagement in their study, and all data collected was from the perspective of teachers and students. Wilkins and Ma (2003) found that while students' ideas of the nature of mathematics did not change as they progressed from middle school to high school, students did show a substantial negative change in their attitudes toward and beliefs about the social importance of mathematics.

Using quantitative and qualitative research together (mixed methods). Mixed methods research combines at least one component of a qualitative study with at least one component from a quantitative study (Bergman, 2008). Using quantitative and qualitative research approaches in a study strengthens the validity of the results (Madrigal & McClain, 2012). By design, Creswell, Plano, Gutmann, and Hanson (2003), described a mixed method study as “a procedure for collecting, analyzing, and reporting research such as that found in the time-honored designs of quantitative experiments and surveys and in the qualitative approaches of ethnographies, grounded theory studies, and case studies” (p. 163). Mixed method research is an attempt to validate the use of multiple approaches in answering research questions, rather than restricting or constraining researchers' choices; it is an extensive and creative form of research Onwuegbuzie, 2004).

There were several mixed-methods studies within the literature review. Amankonah (2013), Hill et al. (2004), Hill et al. (2005), Phelps (2009), and Timmerman (2004) were among those who studied teacher preparation and content knowledge. Amankonah (2013) and Timmerman (2004) studied how preparation affected teachers’ self-efficacy beliefs. Although consensus on method of reform was not detected, all agreed that teacher preparation in the subject of mathematics was in need of improvement.

Huinker and Madison (1997) and Rescorla and Rosenthal (2004) conducted mixed-methods studies involving student achievement and test scores. Rescorla and Rosenthal (2004) followed a group of third graders as they progressed through 10th grade**.** They analyzed yearly test scores looking for improvement and observed and interviewed participants. They had hoped to show that there was growth in ability as students moved from elementary grades to high school. Their prediction was unfounded. Huinker and Madison (1997) hoped to show that teacher beliefs played a role in the way they teach. Teachers were assigned to cohorts, given pre- and post-test, interviewed, and observed. Huinker and Madison (1997) found that teachers with greater self-efficacy beliefs were more effective with mathematics instruction.

Regardless of methodology, research provides answers to questions, and, if used correctly, is an effective tool to evaluate programs or participants in an objective way (Diem, 2014). The type of research used should be based on the purpose of the study, so that the method chosen produces reliable, valid results (Diem, 2014). By gaining an understanding of the strengths and weaknesses of quantitative and qualitative studies, researchers place themselves in a position to mix or combine strategies so that they can collect multiple data using different strategies (Johnson & Onwuegbuzie, 2004).

Synthesis and Critique of Research Findings

A review of the literature showed that teacher preparation programs had a major disconnect between what is taught in math courses and the kind of math elementary teachers needed know to be able to teach it. Studies suggested that to improve teacher knowledge, the time pre-service teachers spent in preparation needed to be increased, that more math courses should be required, and professional development needed to be initiated.

Researchers noted that the lack of teacher knowledge was not being adequately addressed. Some of them suggested increasing the number of math courses for pre-service teachers would not necessarily improve their ability to teach it. They believed it was about knowing how students learn and being able to present math concepts in a variety of ways so as to reach all students.

Many researchers focused their studies on the attitude and beliefs and the influence they had on teaching math. They concluded that it wasn't just about teacher preparation; it was more about an attitude towards math, not only the teacher's attitude, but also of the students. They suggested that improving the attitudes of teachers and students was essential to the level of achievement in mathematics.

Studies addressing reform in teacher preparation and knowledge. Studies that focused on teacher preparation showed that in most colleges and universities, there is a major disconnect between what is taught in mathematics courses and the kind of math elementary school teachers need know and be able to teach. According to the National Mathematics Advisory Panel (2008), students begin to struggle in middle school when they are confronted with algebraic concepts. The advisory panel suggested elementary teachers be mathematically knowledgeable and understand the various ways in which students learn. Teachers should be aware of which “particular instructional practices can have a positive impact” (National Mathematics Advisory Panel, 2008, p. xiv), and use these practices to ensure student success.

The Common Core State Standards Initiative (2017) has identified six strands of mathematics that students in grades sixth through eighth must be taught: Number Systems, Ratio and Proportions, Expressions and Equations, Statistics and Probability, Geometry, and Functions. Greenberg, Walsh, and McKee (2015) indicated 23 states do not support a single elementary teacher preparation program that provides solid math preparation for teachers seeking an elementary teaching certificate. Other studies also found that professional learning opportunities provided across the country did not address the shortfall in teacher content knowledge (Askey, 1999; Ball et al., 2001; Hargreaves & Shirley, 2012; Hiebert & Morris, 2009; Hill et al., 2004; Jansen et al., 2009; Ma, 1999; Simon, 1993; Superfine & Li, 2014).

Ball (2003) suggested there is much more to improving the ability to teach math than requiring more mathematics course work for pre-service teachers; “Increasing the quantity of teachers’ mathematics coursework will only improve the quality of mathematics teaching if teachers learn mathematics in ways that make a difference for the skill with which they are able to do their work” (p. 1). The National Mathematics Advisory Panel (2008) indicated that when preparing students for ninth-grade algebra, the goal of K–8 mathematics must include providing ample opportunities for students to demonstrate proficiency with mathematical operations, accurate demonstration of procedures, and knowledge of number relationships that will assist students in their problem-solving efforts.

Hiebert and Morris (2009) indicated shared goals, tangible products, small tests of small changes, and multiple sources of innovation assisted in building the necessary knowledge to teach mathematics. Hargreaves and Shirley (2012) suggested observing and evaluating what the best school systems in the world are doing, to identify what American schools at the national, state, and local level might do differently and better. Ball et al. (2005) reiterated the need to look at what other countries were doing when they found that the release of every new international mathematics assessment had caused concern about U.S. students' mathematics achievement and its lack of growth.

Studies addressing academic and self-regulatory efficacy beliefs. The most prominent contemporary researchers who have addressed academic and self-regulatory efficacy beliefs are Bandura (1986, 1994, 2001, 2011), Chiu et al. (2006), Dweck (2001, 2006, 2010, 2014), Grootenboer et al. (2006), Stajkovic and Luthans (2003), Usher (2009), Usher and Pajares (2006), and Zimmerman (2000). Bandura (2000) indicated that human development encompasses many different types and patterns of change that create diversity in social practices. Triadic reciprocal determinism, introduced by Bandura (2011), described how behavior, the environment, and the individual are intertwined. Bandura's (1986) SCT implies that behaviors formed by individuals are a result of how one thinks, feels, and believes.

Stajkovic and Luthans (2003) believed that self-regulation and reflection were closely related to an individual's self-efficacy, as well as a precursor to confidence in abilities, which becomes a determinant of motivation. They discussed how Bandura (1997) intertwined individual self-efficacy to collective efficacy, which is acquired from working within a group or being a team member. The study conducted by Stajkovic and Luthans (2003) allowed them to formulate these findings:

> Not only can social cognitive theory provide comprehensive understanding of work motivation, but self-efficacy and collective efficacy, with their clearly demonstrated strong relationships with work-related task performance, seem to have considerable implications for improving human performance in organizations. (p. 139)

Zimmerman (2000) stated, “Two decades of research have clearly established the validity of self-efficacy as a predictor of students’ motivation and learning” (p. 89). He found self-efficacy to be an important factor in predicting various forms of student motivation, such as activity choices, effort, persistence, and emotional reactions. In addition, when self-regulating was involved, self-efficacy, improvements of students’ methods of learning, and predicted achievement outcomes where highly correlated.

Perels, Gürtler, and Schmitz (2005) conducted a study in which they measured the effects of self-regulatory training on eighth-grade students’ problem-solving competence. They found that when students were given training in both self-regulatory strategies and mathematical problem solving, there was an increase in motivation, self-regulation, and problem-solving techniques. Labuhn, Zimmerman, and Hasselhorn (2010) studied the effects of self-evaluative standards and feedback on accuracy and performance in mathematics. They found that while self-evaluative standards had no effect on accuracy or performance, feedback increased both. Furthermore, they found that feedback, when given as social comparison, seemed to be more supportive than individual feedback. A 1996 study conducted by Zimmerman, Bonner, and Kovach involved training fourth grade teachers and students to implement the cyclical model of self-regulatory learning during mathematics instruction. The cyclical model included forethought, performance, and self-reflection (Zimmerman, 2008). Teachers were tasked with developing homework assignments, quizzes, and a final exam in arithmetic skills. Students were asked to keep a daily journal in which they kept track of goals, how long and when they studied, what kind of things distracted them, and how many breaks they took while doing homework. Students were given daily feedback on homework and quiz scores and their goals were reviewed and progress toward them was assessed. It was found that students' willingness to put forth the effort, their interest in the subject and task, their desire to reach the learning goals, and their perception of self-efficacy increased (Zimmerman, 2008).

Dweck (2006) identified a growth mindset as the belief that individuals can develop and improve upon their abilities through practice and effort whereas a fixed mindset keeps an individual from progressing because of a belief that their mindset is predetermined, therefore cannot be changed. Grootenboer et al. (2006) showed how identity plays a large role in developing self-efficacy belief, indicating that identity can be thought of as how individuals perceive themselves and their abilities, and how they are recognized and looked upon by others. Chiu et al. (2006) determined the importance of social interaction ties, reciprocity, and identification.

Dweck (2014), through analysis of her study of seventh grade students, found that mindsets predicted math achievement. She concluded that their beliefs of personal intelligence played a key role in their mathematics success or failure. Students with a growth mindset were more apt to develop learning goals and carry them out. They demonstrated consistent effort and were more concerned with the learning process than the grade received. Boaler (2013), in her study of ability and mathematics, found that growth mindset should be "the center of all school improvement initiatives" (p. 150). Boaler's (2013) analysis went on to state that fixed mindsets add to the inequalities in the education system; "They particularly harm minority students and girls; they also contribute to overall low achievement and participation" (p. 150). Encouraging growth mindset will lead to more positive school environment, where labels and negative messages cease to exist.

Summary

Numerous researchers have conducted studies related to teachers' attitudes and self-efficacy beliefs with regard to mathematics instruction (Amankonah, 2013; Barker, 2007; Handal & Herrington, 2003; Hiebert and Morris, 2009; Huinker & Madison, 1997; Phelps, 2009; Timmerman, 2004; Yavuz et al., 2013). Those studying student attitudes and self-efficacy beliefs were equally numerous (Dweck, 2014; Musu-Gillette, Wigfield, Harring, & Eccles, 2015; Núñez et al., 2015; Rice et al., 2013; Stramel, 2010; Usher, 2009). All researchers, regardless of methodology, location, or choice of participants agreed that attitude is a predictor of self-efficacy beliefs and that effective opportunities to learn are needed to promote prospective mathematics teachers as well as students.

According to Bandura (1994), "A strong sense of efficacy enhances human accomplishment and personal well-being in many ways. People with high assurance in their capabilities approach difficult tasks as challenges to be mastered rather than as threats to be avoided" (p. 71). Dweck (2014) stated:

> There is a growing body of evidence that students' mindsets play a key role in their math and science achievement. Students who believe that intelligence or math and science ability is simply a fixed trait (a fixed mindset) are at a significant disadvantage compared to students who believe that their abilities can be developed (a growth mindset). (p. 2)

Amankonah (2013) and Stramel (2010) concluded that it was not just about teacher preparation; it was more about an attitude toward mathematics—not only the teacher's attitude but also the students. The literature contained in this review has illustrated a multitude of methods that could be used to improve teacher preparation, individuals' attitudes, self-efficacy, motivation, and achievement. Perhaps the road ahead is to figure out how to combine the most effective methods to ensure all students grow in their ability and attitude towards mathematics.

Chapter 3: Methodology

The purpose of this study was to investigate the lived experience of ninth-grade students and their teachers as they pertain to the teaching and learning of mathematics. The study sought to identify how teachers and students described and understood effective mathematics instruction; this study was interested in the voice of students and teachers. The methodology used in this study was qualitative and took the form of an intrinsic case study. This chapter describes the sampling method of the study, the research questions, and how responses were collected and analyzed. Further, this chapter includes assumptions, limitations, and attributes that made this study unique and purposeful. The participants included high school math teachers and ninth-grade students who attended or taught in several educational centers in a regional charter system in California.

Research Questions

The research questions that laid the foundation for this study were:

- How do high school math teachers understand and describe the best instructional practices that lead to student success?
- How do ninth-grade students understand and describe academic success in mathematics?

Purpose and Research Design

The purpose of this qualitative case study was to examine the perspectives of teachers and students as to how they understood and described effective mathematics instruction, and how their perspectives might aid in further studies. Due to a personal interest that has continued to develop over a 35-year period of teaching mathematics to junior and senior high school students, the research design took on the form of an intrinsic case study. Through the analysis of data, connections between teacher and student participants' abilities, knowledge, attitudes, and beliefs were identified. The use of a qualitative, intrinsic case study allowed the voices of participants to be heard and documented.

This case study was designed to investigate the "how" and "why" participants understood practices that lead to effective mathematics instruction. It allowed for a naturalist approach, where interactions with participants were one-on-one and took place in a school setting they were familiar with. A case study allowed for a personalized, naturalistic, experience-based form of qualitative research (Stake, 2010). Participants were free to converse truthfully, citing experiences, ideas, opinions, and what they understood to be successes and failures in mathematics instruction.

The use of a case study allowed the participants' opinions and experiences to be examined. Their interactions were observed and documented; their voices and actions were the basis for data collection. Tellis (1997) stated, "Case studies give a voice to the powerless and voiceless" (p. 3). This case study used interviews, observations, and the examination of artifacts as methods to collect data.

Research Population and Sampling Method

The research population consisted of six ninth-grade students attending educational centers in a regional charter system in California. The research population also included six high school mathematics teachers from the same regional charter system who had taught ninth-grade mathematics for at least two school years. The ninth-grade students must have completed at least one year of junior high math within the regional charter system.

This study used purposive sampling. Purposeful sampling is used to gain insight into a phenomenon, rather than to generalize a population (Onwuegbuzie & Leech, 2007). Participants were not randomly selected; instead, two purposeful sampling strategies were used: homogeneous and criterion. Homogeneous allowed for the sampling of groups who had similar attributes, while criterion involved choosing groups that met certain characteristics set forth by the researcher (Onwuegbuzie & Leech, 2007). The participants must have met certain criteria. Teachers must have taught entry level high school math, within a direct instruction setting for at least two years. Students must have been enrolled in ninth grade, taking the entry level high school math course in a direct instruction setting. In addition, students must have received at least one year of junior high math in a direct instruction setting within the charter region.

The education program involved in this study is hybrid. Students have the option of independent study, online learning, or a combination of direct instruction (math, science, and English) and independent study or online learning. Not all students or teachers were involved in direct instruction. There was a total of nine mathematics teachers in the region at the time of the study, but only eight of them taught students in a direct instruction setting. Centers that provided direct instruction to junior high students was limited to three sites at the time interviews took place. The researcher teaches at one of the centers, so any students who had been taught in junior high by her were not included in the study. The educational design of the charter system limited the number of participants. Participants were recruited through the following process:

Teacher participants. There were nine mathematics teachers available within the regional charter system, eight met the criteria. They were introduced to the study and an invitation to participate was given. Six teachers accepted the invitation within one week's time. I hand delivered consent forms to each teacher participant, at which time they were read and signed. Teacher participants were given a choice of face-to-face interviews or being interviewed with the use of information and communications technology (ICT). I asked teacher participants if they would mind if I visited their classroom to experience and document the climate; several agreed to a visit. Interview and observation schedules were determined, and teacher participants were invited to bring to the interview and share any recognition, such as awards, medals, ribbons, or trophies, they may have received in regard to mathematics.

Student participants. Through a database listing all students in attendance within the charter system, the researcher was able to identify nine ninth-grade students who had completed at least one year of direct instruction junior high math within the charter system. I scheduled a time to meet with each of the nine students, in their home center, so introductions could take place. I described the purpose of the study and asked each of the students if they were interested in participating. All nine students expressed interest and were given a parent permission form. Six ninth-grade students returned the signed parent permission form. When signed parent permission forms were returned an interview time was scheduled. Students were invited to bring to their scheduled interview any special recognition, such as award certificates, grade reports, or progress reports, and were told they would be asked to describe how the recognition affected their attitude and ability towards mathematics. Before interviews took place, I went over the consent form with each student, and it was signed. All interviews were face-to face and took place in an administrator's office where only the researcher and student were present.

Purposive sampling allowed for the non-random selection of teachers and students who were engaged in mathematics instruction and learning in a classroom setting within the identified charter school system. Using homogeneous and criterion strategies allowed for the collection and comparison of ideas, opinions, and beliefs of the participants. All participants had either taught or were being taught in the same regional charter system.

Instrumentation

The research instruments used in this study included interviews, observations, and an examination of artifacts. Interview questions were open-ended and designed to capture the experiences, opinions, ideas, and feelings of the participants. Observations were conducted to validate the perspectives of teacher and student participants as they pertained to understanding and describing effective mathematics instruction. Observations were not evaluatory, rather, their purpose was to provide a description of the setting and everything that occurred within. Maxwell (2008) described interviews and observations as methods that allow for the collection of rich data. The examination of artifacts provided further validation in the form of triangulation.

Interviews. Interviewing for a qualitative study allows for flexibility and gives the participants an opportunity to tell and describe their own stories. It allows the researcher to obtain a rich, descriptive picture of the personal experiences of the participants using their own words. "Qualitative interviewing is a flexible and powerful tool to capture the voices and the ways people make meaning of their experiences" (Rabionet, 2011, p. 563). This study employed semistructured interviews.

Semistructured interviews use open-ended questions. Some of the questions may be highly structured, whereas others offer flexibility in the way they can be answered (Merriam & Tisdell, 2015). Semistructured interviews allow the researcher to probe the participants to obtain specific information as it relates to the study. A guide is used in semistructured interviews that includes topics and questions that must be covered, although the interviewer can change the order in which the questions are asked. Information is collected in a conversational manner; it is detailed and rich with information (Harrell & Bradley, 2009). The choice to use semistructured interviews fit within this study because they were less rigid, allowed for probing, and provided an opportunity to dig deep into the thoughts and experiences of the participants.

Probing was used to follow up on questions already answered, to dig deeper and obtain clarifying meaning. Probing questions allowed for adjustments to the original questions, so that the researcher could get a clear, in-depth description of what the participant was trying to portray. Probing questions typically began with the words "who, when, where, or what" (Merriam & Tisdell, 2015, p. 122). Probing questions were important to the interviewing process because they allowed for reinforcement and clarification of the participants' responses.

An interview protocol was developed as a guide to the teacher and student interview process (see Appendix A and B). Interviews began with a description and purpose of the research and an explanation of why the participants had been chosen. Laying the ground rules followed, and included the time frame of the interview, the researcher's warranty to protect personal information, and an explanation of what types of data would be collected and how it would be reported. Questions were grouped by topic so the researcher could monitor the direction of the conversation. Arranging the questions by topic minimized the tendency of interviewees to veer off topic. In addition, the arrangement provided a guide for the researcher to know what questions still needed to be answered and where probing was needed (Harrell & Bradley, 2009). When the interview process had ended, the researcher thanked the interviewee for his or her participation, asked if there were any questions or concerns, and stated that results would be shared when the study was concluded.

Observations. Observations provided a deep description of the setting in which the study took place. Maxwell (2008) asserted that observations provide a concrete account of what occurs through descriptive notetaking or videos. Furthermore, Patton (2003) stated that using observations along with interviews allows for the gathering of different kinds of data or triangulation. Observations that took place in this study provided insight into the interactions of the groups. They allowed the researcher to experience the classroom environment and validate the spoken words of the participants. The researcher observed the classroom environments as a participant.

The observer as participant method is employed when the researcher is known to the group. The researcher can interact with the participants if the situation should warrant. Using this method gives the researcher access to large amounts of information, although the information available is controlled by the group being observed (Merriam & Tisdell, 2015). Observing as a participant gave the researcher first-hand experience with the group. It allowed the researcher to physically see, hear, smell, and feel what was really happening in the classroom environment.

Merriam and Tisdell (2015) suggested a checklist of things to be observed. The list included: the physical setting, the participants, activities and interactions, conversations, subtle factors, and the researcher's own behavior. An observation protocol was created and used as a guide (see Appendix C), to remind me of everything I needed to see and hear. Baker (2006) suggested the researcher use all five senses to achieve the desired results when collecting data from observations. To ensure credibility and validity it was important to create a plan and be diligent in collecting and sorting the field notes compiled during the observations.

Artifacts. Participants of this study were invited to share artifacts as they related to their experiences with mathematics instruction. According to Merriam and Tisdell (2015), artifacts, being physical objects related to the study, provided data in its natural form. The use of artifacts in this study offered validation as to how participants' attitudes and opinions were developed in relation to mathematics. Teachers were invited to share any awards they had received as a student or teacher of mathematics, such as trophies, medals, ribbons, including any special recognition they had received from students. Students were invited to share such things as award certificates, grade reports, progress reports, testing scores, or any other special recognition they had received in relation to mathematics. All participants were told that they would be asked to describe how the recognition affected their attitude and ability towards mathematics.

Data Collection

Patton (2003) described the data collected in purposeful sampling as informative-rich and illuminative. This study employed semistructured interviews, observations in the form of observer as participant, and the examination of artifacts. Interviews were recorded and transcribed verbatim by the researcher, and time was allocated for the transcription to be reviewed and approved by interviewees. The collection of data from interviews included notetaking, audio recordings, and transcriptions of recorded material. Observation field notes consisted of descriptive details of the classroom environment and all activities that occurred at that particular time. Observations included the *what* of the classroom; *what* was the teacher doing, *what* were the students doing, and *how* they interacted and functioned as a whole unit. Participants were invited to share artifacts in the form of grade reports, certificates, awards, progress reports, or any other physical evidence that highlighted their mathematics experience. Participants were asked to describe how they felt when they received the recognition.

To ensure confidentiality of participants, all recordings and transcriptions were stored on the researcher's personal computer and memory stick. Notes were filed in the researcher's personal research folder. Member checking was enlisted so that participants had the opportunity to validate their contributions to the study. A description of how data was collected is listed below:

Teacher data (interview):

1. All consenting teacher participants were interviewed via information and communications technology (ICT).
2. All interviews were recorded with the use of a digital recorder.
3. Interviews were manually transcribed by the researcher.
4. Participants were given the opportunity to review transcriptions and revise if needed.
5. If artifacts were provided by a teacher participant, they were asked to provide a description of the artifact and its impact on their past or present attitude towards mathematics. Their responses were recorded and added to their transcribed interview responses.
6. All recordings and transcriptions were stored on the researcher's personal computer and memory stick.

Teacher data (observation):

1. Classroom visits were scheduled with those teachers who consented to them.
2. The researcher documented classroom activities as they related to the observation protocol (see Appendix C).
3. Teachers were thanked for allowing the researcher to visit their classroom and given a copy of the notes complied during the visit.
4. Teachers were given the opportunity to clarify anything the researcher commented on as a result of the observation.

5. Notes were attached to the teacher's transcribed interview responses and filed in researcher's personal research folder.

Student data:

1. Individual face-to-face interviews were scheduled with the six ninth-grade students who returned parent permission forms.
2. Interviews took place in an administrator's office within the center where the student was enrolled.
3. Consent form was reviewed, signed, and the purpose of study reiterated.
4. Interviews were recorded on researcher's digital recorder.
5. If artifacts were provided by a student participant, the student was asked to provide a description of the artifact and its impact on his or her past or present attitude toward mathematics.
6. Interviews were played back at the end of the session so student would have the opportunity to revise responses or add comments.
7. Interviews were manually transcribed by the researcher.
8. Transcribed interviews were delivered to each student participant for review.
9. All recordings and transcriptions were stored on the researcher's personal computer and memory stick.

Attributes

In this study, participants were students and teachers associated with a charter school system in California. The charter school system's original purpose was credit recovery. The mission was to locate young people who had dropped out of high school and provide them with the necessary curriculum to meet the requirements of obtaining a high school diploma. At the time of this study, there were educational centers operating throughout all the Southern California region, serving more than 5,000 students in grades seven through 12.

Currently the system provides a hybrid learning model. Students can complete their studies independently with an independent study teacher, attend direct instruction classes, or meet academic requirements through an online program. Within the region of inquiry, math and English classes became a requirement for all ninth and 10th graders in 2013. The junior high math classes were established in 2014; the following year a language arts class was added. Due to demand, the junior high program began to provide direct instruction in language arts, math, history, science, and physical education in subsequent years. It was noted by the charter that students in seventh through 10th grade were not sufficiently motivated to complete core subjects independently, therefore, direct instruction classes were formed.

Data Analysis Procedure

Data analysis involves giving meaning to the findings of a study. To discover meaning, the researcher looked for patterns and common themes within the data (Merriam & Tisdell, 2015). Data collected in this qualitative study was emergent (Maxwell, 2008; Merriam & Tisdell, 2015; Patton, 2003); as I progressed through the analysis process, new patterns and themes appeared. Data collected in this case study was not independent; it was sorted and guided to a point of intersection. "The researcher must ensure the data are converged in an attempt to understand the overall case" (Baxter & Jack, 2008, p. 555). Maxwell (2008) identified three strategy groups for qualitative analysis: categorizing strategies (coding or tagging), connecting strategies (narrative analysis and individual case studies), and memos and displays. This study employed coding of the semistructured interview responses of both teachers and students, as well as memos and note-taking of observations and the examination of artifacts to guide the discovery of convergence and theme development. In addition to coding, memos, and note taking, a sentence outline was developed to further identify similarities and differences within the data.

Categorizing strategies: coding. This study employed coding. Recorded interviews were uploaded to the researcher's personal computer and transcribed manually. Notes were made in the margins of each transcribed interview and similarities that were noted within teacher and student responses were color-coded. The actual interview questions and responses were placed in an Excel workbook. The workbook was titled All Interview Responses; the first sheet was titled Teacher Responses and contained all teacher participant responses. The second sheet was titled Student Responses. Actual interview questions and participant responses were placed under a column on the far left labeled Raw Data. Each interview question and their probes were color-coded. Raw data was read again and the similarities, which were color-coded within the notes, were placed in the second column. The second column of the sheet was labeled Initial Code. The initial codes were then examined further and statements with like meaning were combined. The initial codes were then segregated into categories. The four categories were labeled teacher/student engagement, teacher/student expectations, creating a safe environment, and making the lesson relevant. A code was given to each category and subcodes were listed under each. Each category was further broken into teacher and student comments, and where applicable, positive and negative attributes were identified. A third column on each sheet of the Excel workbook was created and labeled Final Code, in which the four categories were listed. The four categories represented what Saldaña (2013) described as the Second Cycle coding. The researcher's final codes were a result of taking a large amount of data and arranging it into smaller categories. Themes were formulated from the categories that emerged in Second Cycle coding.

Connecting strategies: narrative analysis and individual case studies. This case study also used observations as a method to collect data. Observations were used as validation to the voice and actions of student and teacher participants. The researcher visited three classrooms. Dates and times were agreed upon when teachers signed the consent form. The researcher used an observation protocol as a guide (see Appendix C). Comments and notes were added under each category on the protocol as the class time progressed. Immediately following the observation, the notes taken were copied and given to the teacher participant so that they could add comments if they so choose. The researcher then read through the notes and color-coded any activities, in speech or action that coincided with the color-coded teacher and student interview responses. Activities not mentioned by teachers and students in interview responses were also noted. According to Maxwell (2008), observations provide a rich description of data. The use of observations allowed the researcher to provide a narrative of what was taking place in real time and to link the descriptive data to the interview responses.

Analytic tools: memos and artifacts. Participants of this study were invited to share artifacts as they related to their experiences with mathematics instruction. The researcher extended this invitation when interviews were being scheduled. Three teachers and three students accepted the invitation and provided artifacts. The researcher asked each participant to describe the artifact and the impact it had on their performance, attitude, or opinions toward mathematics. Their descriptions were recorded along with their interview responses. Notes were made within their transcribed descriptions and color-coded to coincide with similar activities and responses already identified. The use of artifacts offered validation as to how participants' attitudes and opinions were developed in relation to mathematics.

Sentence outline. A sentence outline was constructed using the themes developed during the coding process. The themes became the heading statements of the outline, the subthemes were situated as subpoints, and participants' responses as subsequent subpoints. The use of a sentence outline gave the researcher the opportunity to once again review all responses, paraphrase like comments, and place responses under proper themes.

The researcher chose to employ multiple forms of data collection to validate connections between teachers and student participants' perception of effective mathematics instruction. The connections emerged and themes were developed as the various forms of data were analyzed. The use of coding for the semistructured interviews, the creation of notes and memos for the observations, and participants' description of artifacts provided the basis for data collection and assisted in providing validity to the study.

Delimitations of the Research Design

The students invited to participate in this study must have been in ninth grade, enrolled in direct instruction of the entry level high school mathematics course within the regional charter system. In addition, students must have had at least one year of direct instruction in a junior high math class within the regional charter system. Teachers, to receive an invitation, must have had two years of experience teaching mathematics to ninth-grade students in a direct instruction setting. The researcher was employed within the organization and was aware of the nature and mannerisms of the teachers and students. This made it necessary for the researcher to keep bias in check. It was important to discipline one's self to listen rather than speak, to be open-minded and take in all information without interjecting personal opinions and experience.

Limitations of the Research Design

Limitations to qualitative research may arise due to the size of the population being studied; the familiarity of the researcher with the organization or individuals; time constraints; self-reporting; the researcher's personal discipline to avoid interjecting their own thoughts, ideology, and opinions when interviewing or observing; and the inability to replicate the study (Merriam & Tisdell, 2015). This study investigated how a small number of students and teachers, within a particular organization, understood and described effective mathematics instruction. The organization was a charter system that provided instruction in a hybrid model; students learn through independent study, online courses, or direct instruction. Only those teachers and students involved in teaching and learning through direct instruction were considered for participation. This created a limitation in the invitation process as direct instruction classes were limited to 20 students and not all centers offered direct instruction.

Because this study was site specific, replication may be difficult, although similar hybrid teaching and learning systems may exist; therefore, familiarity with the issues may be of interest to other researchers. Because qualitative research involves interactions between humans and their environments, researcher-participant relationships may create situations where conflict of interest arises (Orb, Eisenhauer, & Wynaden, 2001). To avoid these issues, this study did not seek participants that were taught by the researcher or teachers the researcher had mentored.

Validation

Whether a study is qualitative or quantitative, careful attention must be paid to validity and reliability of the study. Merriam and Tisdell (2015) indicated a research study must be conducted in a rigorous manner and it must put forth perceptions and conclusions that other researchers find to be true. The researcher created and used an interview protocol for both teacher and student participants (see Appendix A and B). An observation protocol was created and used as a guide for classroom visits (see Appendix C). All recordings were immediately uploaded to the researcher's personal computer and memory stick. All notes and memos were filed in the researcher's data folder and kept under lock and key. Interviews were transcribed verbatim by the researcher. The raw data were used to search for meaning in the participants' responses. The researcher's own assumptions were kept in check; student and teacher responses were quoted in their totality.

To ensure validation, a variety of methods for collecting data were used in this study. The use of semistructured interviews, observations, and the examination of artifacts provided triangulation. Triangulation reduced biases that might have been present if only one specific method of data collection was used (Maxwell, 2008). Member checking was also employed as a form of validating teacher and student responses. It was important to give participants the opportunity to confirm their responses and actions, and to revise as needed.

Credibility. Strategies to increase credibility in a qualitative study include a discussion of alternative interpretations of the findings, a discussion of outliers that do not fit with the observed patterns or themes, and the use of triangulation (Patton, 2003). Triangulation involves the use of various methods, sources, theories, and investigators, all aimed at increasing the validity and credibility of a qualitative study (Farmer, Robinson, Elliott, & Eyles, 2006). Merriam and Tisdell (2015) indicated that triangulation allows the researcher to validate something a participant said during an interview with what actually is observed. Maxwell (2008) stated, "Triangulation reduces the risk of chance associations and of systematic biases due to a specific method and allows a better assessment of the generality of the explanations that one develops" (p. 245). This study employed triangulation as a method of collecting and analyzing data. Notes, memos, and transcriptions of semistructured interviews, observations, the examination of artifacts, and participants' reviews were analyzed and validated for trustworthiness.

Transferability. This study originated from a personal interest. I realized many years ago that something was hampering students' achievement in mathematics and that the phenomenon began at an early age and never really seemed to dissipate. The goal of this study was to discover how teachers and students understood effective mathematics instruction, and how they described the phenomenon. The transferability of the findings will lie with the readers. Merriam and Tisdell (2015) stated, "Every situation is theoretically an example of something else" (p. 255). If the readers of this study are able to generalize the situations and discover enough similarities, then the study will become useful to their own inquiries.

Dependability. Dependability is based on transferability. Because a qualitative study is based on the researcher's desire to find out about a single case or nonrandom purposeful sample, generalization that might transfer from one study to another may not be present. Maxwell (2008) indicated, "The generalizability of qualitative studies is usually based on the development of a theory that can be extended to other cases" (p. 246). This study used a purposeful sample. Participants taught or were being taught in the same regional charter system. The researcher set criteria that would determine which students and teachers would be invited to participate, which created a homogeneous sampling.

Expected Findings

This case study was conducted to investigate how teachers and students described and understood effective mathematics instruction. It was anticipated that the research would illustrate commonalities in the views and actions of participants, and show that it may be a combination of teacher preparation, teacher knowledge, and theories addressing social cognition (Bandura, 2012), mindset (Dweck, 2014), and self-efficacy (Zimmerman, 2000) that would lead to real mathematical reform in the American classroom.

Ethical Issues

Ethical issues are present in any type of research study, so ethical principles are a necessity. Orb et al. (2001) stated, "Ethics pertains to doing good and avoiding harm" (p. 93), and harm can be prevented by following ethical principles. Creswell and Poth (2017) suggested ethical considerations should be present in all phases of the research process, from the earliest stages of developing the study to the presentation of conclusions in the published work. To present a valid and worthwhile study, I adhered to the ethical principles put forth by The American Psychological Association (APA; 2017).

Institutional approval was required to conduct this study. This was the first stage in avoiding conflict of interest. The information submitted in the proposal was accurate and gave a thorough account of what the research study entailed (APA, 2017). This research study was conducted through the use of interviews, observations, and the examination of artifacts. APA's (2017) Informed Consent to Research and Informed Consent for Recording Voices and Images, found in the *Ethical Principles of Psychologists and Code of Conduct,* were adhered to. These standards stated that participants had a right to be informed of the purpose of the study, what procedures were followed, and how long the study would take. Participants officially granted consent to record their answers to interview questions and to the classroom visits. Participants were informed of and understood confidentiality limits and they knew they had a right to decline or terminate their participation.

All data was stored on the researcher's personal computer, personal portable drives, and in a notebook constructed solely for the purpose of storing data. All recordings were uploaded to the researcher's password protected personal computer and saved on the portable drives and then deleted from the recording devise. No other person had access to the researcher's personal computer or portable drives. Portable drives were kept in locked box and notebooks were kept in locked briefcase. Participants' identity was protected with the use of pseudonyms and each observation period was assigned a number.

Conflict of interest statement. The researcher designed and produced this study as a student novice researcher. The participants were invited to be part of this study. They were not offered payment, in any form, or coerced to participate. Any teacher the researcher had team taught with or mentored was not considered. In addition, the researcher did not invite any student they had taught. The researcher held no influence over the participants. The researcher was not associated with any organization and did not receive payment to conduct or produce the findings of this study.

Debriefing. The researcher reported collected data in its raw form, and included all responses, even those that appeared to be outliers. Participants were given the opportunity to review their contributions to the study and clarify any information they found to be incorrect or misleading. Participants were informed that they had a right to review the results and conclusions of the study and that an opportunity to do so would be provided (APA, 2017). All recorded data was deleted immediately after the member checking process was complete.

Researcher's position. In the reporting of research results it is the duty of the researcher to accept all responses without interjecting personal experience or opinion, making sure that the findings arise from the data and not their own predispositions. The researcher reported all findings (positive and negative) and did not fabricate data to sway the conclusions to fit their personal beliefs and experiences (APA, 2017). Plagiarism is the responsibility of the researcher to stay true to their work and not pass on another's as their own (APA, 2017). A researcher may take credit only for the work they have done. They may not put their name on anything to which they have not substantially contributed (APA, 2017). The work of this study is my own, written in my own words, with the aid of experts who are cited or quoted throughout.

The purpose of this research study was to describe, understand, and interpret how teachers and students described and understood effective mathematical instruction. Data obtained from this research study will be shared when a request from a proper entity is made, as is called for in APA's (2017) *Ethical Principles of Psychologists and Code of Conduct* under the standard titled Sharing Research Data for Verification. The data being shared will be in their original, unaltered state, with the confidentiality of participants guarded. Sharing research data allows for the verification of claims by subsequent researchers (APA, 2017).

Summary

This research study was a qualitative intrinsic case study. Triangulation in the form of semistructured interviews, observations, and artifacts provided the basis for data collection and assisted in providing validity to the study. Participants were high school math teachers and ninth-grade students who taught and were being taught through direct instruction in a classroom setting. Participants were not randomly selected; instead, two purposeful sampling strategies were used: homogeneous and criterion. Teachers and students who met the criteria were invited to participate; those who accepted were informed of all pertinent ethical principles outlined in APA's (2017) *Ethical Principles of Psychologists and Code of Conduct.* Answers to how teachers and students described and understood effective mathematics instruction were sought.

Data collected through interviews, observations, and artifacts were broken down through the process of coding. It was anticipated that data would illustrate commonalities in the views and actions of participants, and show that it may be a combination of teacher preparation, teacher knowledge, and theories addressing social cognition (Bandura, 2011), mindset (Dweck, 2014), and self-efficacy (Zimmerman, 2000) that are described and understood by teachers and students that make up the elements of effective mathematical instruction.

Chapter 4: Data Analysis and Results

The purpose of this study was to investigate the lived experience of ninth-grade students and their teachers as they pertain to the teaching and learning of mathematics. The study sought to identify how teachers and students describe and understand effective mathematics instruction. Previous studies show that not enough research has focused on young students' thoughts, concerns, and experience; research that actually enlists young students as the participants (Usher, 2009). Lazarides and Watt (2015) found that teachers' attitudes, beliefs, and expectations affected students' achievement and motivation. The researcher was interested in the voice of students and teachers, and how they understood and described effective mathematics instruction.

This study utilized social cognitive theory (SCT), self-regulated learning theory (SRL), and current and prior research related to growth mindset and self-efficacy to examine how teachers of ninth-grade math students understood and described their best instructional practices. These theories were also used in the examination of how ninth-grade students understood and described academic success in mathematics. In a description of SCT, Crittenden (2005) stated that a teacher is responsible to set the mood of a classroom, define how the classroom is to function, construct the guidelines and expectations, and establish the environment. Zimmerman and Schunk (2001) described self-regulatory processes, identified in SRL, as tools that, if used by students, enhance performance and lead to improved self-efficacy. Dweck (2014), a leading researcher in motivation and growth mindset, noted that students who think they can achieve more, are motivated to become smarter by creating goals and putting forth greater effort. These theories and beliefs drove the design of the interview and observation protocols of this study.

The methodology used in this study was qualitative and took the form of an intrinsic case study. According to Stake (2010), intrinsic case studies are used when a researcher has an intense desire to better understand a particular phenomenon. The use of a case study allowed the participants' opinions and experiences to be examined; their voices were the basis for the data collection. Tellis (1997) stated, "Case studies give a voice to the powerless and voiceless" (p. 3). Literature has demonstrated a need for such case studies, as so few have included the voice and actions of students and teachers and the interactions that occur during mathematics instruction (Lazarides & Watt, 2015; Usher, 2009).

The research questions that laid the foundation for this study were:

- How do high school math teachers understand and describe the best instructional practices that lead to student success?
- How do ninth-grade students understand and describe academic success in mathematics?

This study involved conducting semistructured interviews, member checking, observations, and the examination of artifacts. The interviews were tape recorded and transcribed by the researcher, and transcriptions were returned to participants for review and validation. Observations were conducted and classroom climate documented. The process of transcription, creation of memos, arrangement of questions and responses in an Excel workbook, and the formation of a sentence outline allowed for the emergence of themes and subthemes. This chapter includes the descriptions of the sample, the research methodology, the summary of the findings, and the presentation of the data and results.

Description of Sample

The research sample consisted of six ninth-grade students in attendance at one of several educational centers in a regional charter system based in California. The ninth-grade students must have completed at least one year of junior high direct instruction math in the regional charter system. The research sample also included six high school mathematics teachers from the same regional charter system, who had taught ninth-grade mathematics for at least two years. The program was designed as a hybrid educational system, so not all students or teachers are involved with direct instruction. The educational design of the charter system limited the number of participants. There was a total of nine mathematics teachers in the region at the time of the study; eight of them taught students in a direct instruction setting. Centers that provided direct instruction to junior high students was limited to three sites at the time interviews took place.

The limited number of teachers, direct instruction classes, and centers serving junior high students led to the development of a study that used purposive sampling. Purposeful sampling is used to gain insight into a phenomenon, rather than to generalize a population (Onwuegbuzie & Leech, 2007). Participants were not randomly selected; instead, homogeneous and criterion sampling were employed. Homogeneous sampling allowed for groups with similar attributes, while criterion sampling involved inviting only those students and teachers who met the requirements set forth by the researcher.

Mathematics teachers within the charter system who met the criteria were given an invitation to participate in this study; six teachers accepted the invitation. Through a data base listing all students in attendance within the charter system, the researcher was able to identify nine ninth-grade students who had completed at least one year of direct instruction, junior high math within the charter system. The researcher scheduled a time to meet with each student so that an invitation to participate in the study could be extended. Those students who expressed interest were given a parent permission form, and six ninth-grade students returned the signed parent permission form. Teacher and student participants were required to be active members of the educational setting at the time of the study. Table 1 provides demographic information for the teacher participants. To ensure participants' confidentiality, teachers were numbered 1 through 6.

Table 1

Demographic Data of Teacher Participants

Participant	Degree	Credential	Years of Experience
Teacher 1	Bachelor Master	Single Subject Mathematics	10+
Teacher 2	Bachelor	Single Subject Mathematics	4 to 10
Teacher 3	Bachelor	Single Subject Mathematics	10+
Teacher 4	Bachelor	Single Subject Mathematics	4 to 10
Teacher 5	Bachelor Master	Single Subject Mathematics	4 to 10
Teacher 6	Bachelor	Single Subject Mathematics	10+

As Table 1 shows, all but one teacher participant earned at least a bachelor's degree in mathematics. All teacher participants hold a single subject teaching certificate in mathematics. In California, this certificate identifies teachers as highly qualified to teach mathematics. Although there is a wide range of mathematics courses taught, all taught Integrated Math 1, which is the entry level math course for high school students in California. Integrated Math 1 replaced Algebra 1 with the inception of the Common Core Standards. Teaching experience in high school math ranged from four to 25 years. All teacher participants continue to teach in the charter system used for this study.

As part of the teacher interview, each participant was asked, "Why did you choose to become a mathematics teacher?" This was done to investigate choice of profession versus necessity. All but one teacher voiced a passionate desire to not only assist students in becoming more successful in mathematics, but also to help them become more comfortable with the subject in the classroom and in real life. Teachers 1 and 3 chose to teach math because they wanted to change students' attitudes towards the subject and ease the intimidation factor. They wanted to assist students in gaining confidence in the understanding of concepts and show students how the concepts applied to their daily lives. Teachers 4 and 6 voiced a life-long passion for mathematics and wanted to share that passion with their students. Teacher 6 expressed the desire to "show others the beauty in mathematics." Teacher 2 chose to teach math so that students would be encouraged to think for themselves and not have to rely on memorizing formulas. Teacher 5, the outlier, chose the profession because of the demand for qualified mathematics teachers, although, as time passed, Teacher 5 did come to the realization "that minority students were not represented proportionally in education." This realization led Teacher 5 to dedicate more time and effort in teaching these students. The responses provided by teacher participants gave the researcher valuable background information that aided in the analysis of data. This study also enlisted six ninth-grade students, who were enrolled in the charter system at the time of the study. Table 2 provides demographic information of the students. To ensure confidentiality, students were labeled using capital letters A through F.

Table 2

Demographics of Student Participants

Participant	Math Course Enrolled In	Years in Attendance at Charter
Student A	Integrated Math 1	2.5
Student B	Integrated Math 1	3
Student C	Integrated Math 1	3
Student D	Integrated Math 1	2
Student E	Integrated Math 1	3
Student F	Integrated Math 1	2

The table shows that all the student participants were enrolled in the entry level high school math course, which is the typical placement for a ninth-grade student. Years in attendance includes the current year. Students who have been in attendance for three years began their educational experience at the charter at the beginning of seventh grade. Student A enrolled at the center at the beginning of the second semester of the seventh-grade year. Students who have attended for two years enrolled in a center of the charter system at the beginning of their eighth-grade year and all were taught math in a direct instruction setting.

Research Methodology and Design

The methodology used in this study was qualitative and took the form of an intrinsic case study, which is used when a researcher has an intense desire to better understand a particular phenomenon (Stake, 2010). I have taught math to students in junior/senior high school for the past 35 years and have found that a large percentage of students enter the classroom with fear and apprehension. This study used semistructured, open-ended interview questions so that the voices of teachers and students could shed light on the research questions being addressed in this study and provide some direction in how to develop best practices for student learning in mathematics.

The use of a case study allowed for a naturalist approach, where interactions with participants were one-on-one and took place in the various school settings with which they were familiar. Case studies provide a personalized, naturalistic, experience-based form of qualitative research (Stake, 2010). Participants were free to converse truthfully, citing experience, ideas, and opinions as they related to a mathematics class. Yin (1994) indicated that a researcher should use a case study to investigate the "how" and "why" questions. The interview questions of this study were developed so that teacher and student participants were able to elaborate on their descriptions, ideas, and opinions as to practices that lead to success or lack of it in a mathematics classroom. The interview questions for teachers can be found in Appendix A.

Interviews. Teacher interviews were conducted first, as receiving consent was much less time consuming than receiving parent permission and consent from student participants. Teacher participants were given a choice of face-to-face interviews or being interviewed with the use of information and communications technology (ICT). All teachers chose to be interviewed via ICT, which allowed for visual, back-and-forth communication. The interviews were recorded on the researcher's personal digital recorder. The recordings were transcribed by the researcher and delivered to the participants, at which time follow-up interviews occurred. The subsequent interviews gave the researcher the opportunity to probe the teacher participants as to their expectations of the classroom and their students. It became clear, while transcribing student interviews, that there was a need for this information. One teacher provided a syllabus, another provided a written document of classroom expectations. The remaining four teacher participants indicated their expectations were stated orally at the beginning of the year or semester.

Notes were made within each transcribed interview and similarities throughout the participants' responses were color-coded. The actual interview questions and responses were placed in an Excel workbook. The workbook was titled *All Interview Responses;* the first sheet was titled *Teacher Responses and* contained all teacher participant responses. Actual interview questions and participant responses were placed under a column on the far left labeled *Raw Data*. Each interview question and their probes were color-coded. Raw data were read again and the similarities, which were color-coded within the notes, were placed in the second column. The second column of the sheet was labeled *Initial Code*. There were 191 initial codes under teacher responses at the completion of this process.

The initial codes were examined further and statements with like meaning were combined. Four categories emerged from the statements with like meaning. These categories were labeled teacher/student engagement, teacher/student expectations, creating a safe environment, and making lesson relevant. A code was given to each category and subcodes were listed under each. Each category was further broken into teacher and student comments, and where applicable, positive and negative attributes were identified (see Appendix D). The categories were then segregated into classifications, *Leads to Mathematical Success* and *Leads to Less Mathematical Success.* The process resulted in 51 teacher preliminary codes for *Leads to Mathematical Success* and 24 teacher preliminary codes for *Leads to Less Mathematical Success* (see Appendices E and F).

Student interviews were scheduled through a process of contacting parents and setting up dates and times that were convenient for both the parent and student, as parents were the main source of transportation for the ninth-grade students. Student interview questions are listed in Appendix B. Because students within the charter system do not attend classes on Friday, all interviews were scheduled to take place on a Friday. Several Fridays were spent visiting the various centers so that student participants could personally be interviewed. All student participants were scheduled to their own face-to-face interview with the researcher. Student participants were invited to bring any special recognition they may have received in relation to mathematics to the scheduled interview.

Interviews took place in the principal's office and only the researcher and the student participant were present. Each interview was tape recorded and played back so that the student participant could hear their responses. After listening to the recorded interview, student participants were asked if they wished to make additional comments. Two student participants chose to add to their comments. Interviews were uploaded to the researcher's personal computer on the same day as the interview. All interviews were transcribed by the researcher. Transcriptions were placed in sealed envelopes and delivered personally or mailed to each student participant. So that each participant's responses could be validated, member checking occurred through the process of requesting student participants to read through the transcriptions and if changes were to be made, contact the researcher so a meeting could be scheduled. Again, two student participants indicated the need to clarify a few responses. Time was scheduled for these student participants and changes or additional information was added to their responses.

The same process was used to analyze student participants' data as was used to analyze teacher participant data. Notes were made within each transcribed interview and similarities throughout the participants' responses were color-coded. The actual interview questions and responses were placed in the Excel workbook titled *All Interview Responses,* on the second sheet titled *Student Responses.* Interview questions and participant responses were placed under a column on the far left labeled *Raw Data*. Each interview question and their probes were color coded. Raw data were read again and the similarities, which were color-coded within the notes, were placed in the second column labeled *Initial Code*. There were 202 initial codes under student responses at the completion of this process. As stated above, the initial codes were examined further and statements with like meaning were combined. This process created four categories: teacher/student engagement, teacher/student expectations, creating a safe environment, and making a lesson relevant (see Appendix D). The initial codes were segregated into two classifications, *Leads to Mathematical Success* and *Leads to Less Mathematical Success.* The process resulted in 50 student preliminary codes for *Leads to Mathematical Success* (see Appendix E) and 20 student preliminary codes for *Leads to Less Mathematical Success* (see Appendix F). In addition, there were 35 comments related to past and present mathematical ability as perceived by student participants. The comments that pertained to present mathematical ability were integrated with the themes and subthemes. Comments made about past experience are discussed in the next section.

The third column on each sheet of the Excel workbook, *All Interview Responses*, was labeled *Final Code*. The final code represented the four categories that emerged during the First Cycle of coding, teacher/student engagement, teacher/student expectations, creating a safe environment, and making lessons relevant. The categories represented the Second Cycle of coding as described by Saldaña (2013). The researcher's final codes were derived through the process of taking a large amount of data and arranging it into smaller categories.

A sentence outline was then constructed using the themes as the main points, the subthemes as the subpoints, and responses as subsequent subpoints. The use of a sentence outline gave the researcher the opportunity to once again review all responses, paraphrase like comments, and place responses under proper themes. Each subtheme was further broken up to separate student responses from teacher responses. Some of the subsequent subpoints were paraphrased, while others were the actual words of the participant. Actual words of the participants were placed in quotations. The purpose behind this technique was to preserve the emotion portrayed by the participants when responding to certain questions.

Observations. This case study used observations as a method to collect data. Observations were not evaluatory but used as validation to the voice and actions of student and teacher participants. The use of observations allowed the researcher to provide a description of what was taking place in real time and to link the descriptive data to the interview responses. According to Maxwell (2008), observations provide a rich description of data. Several classrooms were visited, and the environmental climates were documented.

Observations were conducted to validate the voices of participants as they were expressed in the interview responses. Two of the observations occurred at one center; the third took place at a different center within the region. The researcher was interested in experiencing the atmosphere of the classroom as defined by participants. The researcher was seeking to describe the level of teacher/student engagement, teacher/student expectations, and if lessons were related to real life. The purpose of the observations was not to evaluate the teacher, but to experience the total classroom environment.

Observation 1. The first classroom visited was bright and colorful. Student work was displayed on the walls. Students sat at tables of three and there were graphing calculators and various writing utensils (pens, pencils, colored pencils, markers) on each table. The teacher was engaged with the students throughout the lesson. A student arrived late, but the teacher greeted them and inquired about the day's traffic. Another student was not feeling well, and the teacher told them, "If you need to get up and go, please do, you don't have to ask." The classroom door remained open and other teachers and students in the main center would wave as they walked by. There was chatter in the bigger room of the center, but none of this seemed to deter the progress of the lesson—instruction and interaction moved forward.

The lesson involved linear functions. The teacher used the depreciation rate of new vehicles to demonstrate the concept. The teacher misspelled something on the board and one of the students pointed out the mistake. The teacher joked and thanked the student for paying such close attention, then continued with the instruction. The teacher consistently prodded students to dig deep to remember what they had learned in junior high as it pertained to the current lesson. Students were comfortable and confident in asking questions and offering answers. If they were not understanding, the teacher retraced the steps and went over it again. There was a sense that everyone wanted to be there, and that everyone wanted to be an active participant in the classroom and the lesson.

Observation 2. In the second classroom visited, the students were sitting at tables in pairs. Each student had a math folder and was taking notes. The room was dark because the teacher was using an online tutoring program to go through the procedures of the lesson. There were posters on the wall that showed how math and science interrelate and depicting real-life scenarios where the use of math is needed. Students were learning about systems of equations. The teacher would pause the online program to ask questions and assess the progression of the students' learning. Students in this classroom were not as confident as those in the first classroom visited. The teacher had to call on students; not all of them were willing to provide what they knew or had learned during the instruction time. During this particular lesson, there was very little student-to-student interaction. The teacher controlled the direction and pace of the lesson.

Observation 3. The third classroom space was much smaller than the first two. Students were sitting on both sides of the tables; there were four to six students sitting at each table. The classroom was shared with other teachers, all teaching different subjects, so the walls were decorated with posters and student work relating to various subjects. Students were determining the constant rate of change of a set of data. Students moved from table to table, getting help from others whenever they felt the need. The teacher restated the objective of the lesson several times, other than that, the teacher left the students to perform the task at hand. When students had completed the task, each was invited to the front of the room to present what they had done. The students joked with each other and challenged the work of others. Each presenter was offered suggestions made by their peers, which allowed the presenter to make any necessary revisions to the work. Students handed their work to the teacher at the conclusion of their presentation. The teacher used an online graphing calculator to input the student data and, using a Smart Board, demonstrated how the calculator could be used to produce a linear function of the data, where the equation and slope (constant rate of change) were posted. The students then practiced using graphing calculators provided by the teacher. These students were comfortable in their space, and confident in their ability. It was okay to be wrong, because someone was going to help them correct their mistakes.

The observations conducted provided valuable insight into what actually was occurring in the classroom environments. Teachers' desire to assist students in achieving success was evident. The atmosphere in each classroom was welcoming and there was a sense that all students were comfortable with the teacher, fellow students, and general environment.

Artifacts. Examining artifacts assisted in validating this study by providing triangulation. Merriam and Tisdell (2015) indicated that triangulation allows the researcher to validate something that a participant said during an interview with what actually is observed or examined. Participants of this study were invited to share artifacts as they related to their experiences with mathematics instruction. Three teacher participants and three student participants shared special recognition they had received over the years. Artifacts, being physical objects related to the study, provided data in its natural form (Merriam & Tisdell, 2015). The use of artifacts offered validation as to how participants' attitudes and opinions were developed in relation to mathematics. Participants' explanations of the artifacts demonstrated how past and present attitudes and opinions related to mathematics were formed. Table 3 lists the artifacts and the teachers and students who chose to share them.

Table 3

Artifacts Shared by Teacher and Student Participants

Participant	Artifact
Student A	Progress Report
Student C	Award Certificates
Student D	Award Certificates
Teacher 3	Monthly Math Awards Thank you notes and cards from students
Teacher 5	Corporate Award
Teacher 6	Corporate Award

Student C and Student D shared artifacts in the form of Honor Roll Certificates, Effort in Mathematics Award, and math growth scores on a standardized test. Student A shared a progress report showing an A+ on a math test. This student participant indicated consistent failure in math until enrollment in the charter system. The student recalled great pride in receiving the A+ and indicated their confidence and effort in mathematics has greatly improved since receiving the progress report. Student D shared the Effort in Mathematics award and special recognition for math growth scores on a standardized test, which is taken several times during the year to gauge student growth. Student D had the highest growth score in mathematics of all students in the same grade for that year. The Effort in Mathematics award was given to Student D as a result of growing several grade levels in mathematical ability in one years' time. Student C shared an Honor Roll Certificate and explained that being on Honor Roll meant that they have to do their best at all times, or they will lose the special recognition.

Teacher 3, Teacher 5, and Teacher 6 shared special recognitions they had received as a result of their mathematics ability or teaching practices. Teacher 3 shared monthly math certificates received while in grade school and high school. Teacher 3 indicated a passion for mathematics and recalled the passion developing at a very young age. As a result, Teacher 3 was consistently recognized, elementary school through college, for excelling in mathematics. Teacher 3 said the desire to teach math originated with this passion and recognition. In addition, Teacher 3 shared notes and cards of appreciation from the students. Teacher 3 felt the cards and notes were as special as any recognition received.

Teacher 5 and Teacher 6 both received a yearly award presented by the governing body of the charter. The award is given to individuals who demonstrate the ability to go above and beyond the normal duties of a teacher; they were recognized for dedication to their students, their peers, and the overall program. Teacher 5 was able to share examples of everything they had done that qualified them for receiving the award. In contrast, Teacher 6 had trouble remembering the name of the award and indicated that they were not sure why they had received it. Teacher 6 implied that they were just doing their job and did not believe they had done anything extra or special in their duties.

The special recognition received by teacher participants affirmed their dedication to their students. The awards, cards, and notes validated teachers' passion for mathematics and their desire to share it with others. Student participants voiced how acknowledgment of their efforts aided in improvement of confidence, ability, and a desire to achieve in mathematics. The use of artifacts provided triangulation, which allowed for the validation of what was observed through the interview process and observations.

Triangulation. The design of this study allowed for triangulation. Triangulation involves the use of various methods, all aimed at increasing the validity and credibility of a qualitative study (Farmer et al., 2006). The use of semistructured interviews, observations, and artifacts provided the basis for data collection and assisted in providing validity to the study.

The choice of methodology and the design allowed the data to be displayed so that similarities and differences in the participants' responses would become evident. The similarities and differences were then categorized, which allowed for the emergence of themes and subthemes. Strauss (1987) stated, "The goal of coding is not to produce counts of things but to "fracture" the data and rearrange it into categories that facilitate comparison between things in the same category and between categories" (p. 29). To validate the voice of each participant, I categorized all responses, even those that appeared to be outliers. To further validate, observations were conducted, and artifacts examined.

Summary of Findings

Similarities in comments and practices became evident while I transcribed, read, and color-coded teacher and student participants' responses to the interview questions. It was insightful to see that many of the student responses coincided with those of the teachers. The responses of the participants, observations, and examination of artifacts indicated the following five attributes were important when identifying best practices as they relate to effective mathematics instruction: teacher/student engagement, teacher/student expectations, creating an environment of trust, making lessons relevant to real life, and mathematical ability.

Four themes and subsequent subthemes were created using the five attributes identified from the data. The themes and subthemes emerged from the sum result of analyzing data related to observations, the examination of artifacts, and the interview responses of the participants. While mathematical ability is discussed later, it was not considered a theme or subtheme. Table 4 lists the themes and subthemes that were developed as a result of the data analysis process.

Table 4

Themes and Subthemes

Theme	Subtheme
1. Engagement is essential to the level of effectiveness of mathematics instruction.	1. Positive engagement leads to success. 2. Lack of engagement stifles mathematical success.
2. Established expectations create a path to success in a mathematics classroom.	1. Certain expectations must be present for teacher and students to believe success will occur.
3. Making lessons relevant to real-life creates a more interesting and successful mathematics classroom.	1. Teachers and students feel more successful when the math they are learning in the classroom is useful in their daily lives.
4. Creating an environment of trust, where no one is afraid to participate, is essential to successful mathematics classroom.	1. Teachers and students want a classroom in which there is mutual respect and students were not afraid to take a chance.

In addition to the responses that formed the themes and subthemes, student participants contributed 35 comments related to their past and present mathematical ability and experience. While the present experiences were pertinent to the study, past experience has only aided in the formation of student participants' opinions of what should occur in elementary classes regarding the teaching and learning of mathematics. For this reason, present mathematical ability was integrated into the themes and subthemes. Past experiences and opinions will be discussed in the next section. A detailed description of the observations and participants' explanation of the personal value and meaning of the artifacts will also be discussed in the next section.

Presentation of the Data and Results

This intrinsic case study investigated how high school math teachers understood and described the best instructional practices that led to student success, and how ninth-grade students understood and described academic success in mathematics. Semistructured interviews, observations, and the examination of artifacts supplied data for this study; the voices of the participants were the basis for the data collection. Through the process of data analysis, similarities in opinions and experiences of the teacher and student participants emerged and allowed for the creation of four themes and subsequent subthemes. The use of semistructured interviews, observations, and the examination of artifacts provided validation of responses and actions through the process of triangulation. The data collected and how it relates to effective mathematics instruction is presented below.

Theme 1: Engagement is essential to the level of effectiveness of mathematics instruction. Regarding the effectiveness of mathematics instruction, many of the same practices that determine success were identified by the students and teacher participants. Both groups spoke of engagement, collaborative group work, addressing questions and answers, excitement, and active participation in solving problems as positive influences on the level of effectiveness of instruction in a mathematics class. Teacher 1 described engagement that leads to success in mathematics instruction as:

> I felt most successful when I had a class of students where the majority were interested in learning the material I was teaching. Their questions and comments made the class more interesting and brought life and a sense of discovery to the class. Their positive energy built up my own and made our exchange in mathematical ideas exciting and fun.

Teacher participants implied that success occurs when students are creative, curious, and use logic to solve problems. Student B confirmed the teacher participants' opinion on the use of curiosity, creativity, and logic with this response:

> I like math. It is crazy what I can do. I get engaged and if I have to work and flex my brain to actually be able to do the harder concepts, it gets me going. I realize that I've overcome the hardships of the math problem.

Teacher subtheme 1: Positive engagement leads to success. Teacher participants indicated that success occurs when students are engaged, happy, doing their work, and asking questions, and when students are working together and helping each other solve problems. Teacher participants further indicated that success occurs when the teacher is walking around, answering questions, and explaining the objective of the lesson to students. Some teacher participants said they felt most successful when students were trying to identify what the question was, asking questions of the teacher and their peers, and not focusing on memorizing formulas. Teacher 4 indicated success occurs when students "reach their respective potentials and have some fun in doing so." Teacher 1 described success as "thinking creatively and logically. Students will be more academically successful if they learn to reason how to approach and solve a problem instead of simply plugging numbers into a formula." Teacher 3 indicated students perform better when there is an impression of success, "understanding the mathematical concepts, engaged with the material, feeling accomplished or smart when learning math, and improving in their math skills and knowledge." Teacher 5, being the outlier to several responses, said, "Acquisition of the Common Core State Standards (CCSS) for respective courses, as well as proficiency in the Common Core (CC) Standards for Mathematical Practices." Teacher 5 was the only interviewee who consistently spoke of mastery or proficiency of the Common Core Standards as a measure of academic or mathematical success.

Student subtheme 1: Positive engagement leads to success. Student participants indicated that they felt most successful when everyone was excited and participating, when they were working together, checking each other's work, and debating processes and answers. Student participants indicated that success happens when the teacher is willing to stop instruction to answer questions and give examples, when the teacher is walking around helping students, and when the teacher really helps the students who need extra help. Student B believed engagement leads to success, "The most successful environment is when there is engagement. I think that's the key factor in the success of students in mathematics. When the teacher is working with students and the students are working together in a group." Student A felt success occurs when everyone is working together and moving along at the same pace:

> I understand mathematical success like, everyone's really on the same page, going at the same pace and everyone's understanding and learning and they get it. We all work in groups and everybody is collaborating and the teacher helps with whatever we need. When we can't understand a problem, the teacher helps us. We move around to different tables and we meet new people and we are collaborating and we can help each other.

Student E spoke of how an interest in excelling leads to success:

> Success is when I see teachers who are really good math teachers and I see kids who are interested in excelling. I feel like it changes the kid's perspective, because you see that

> when you do try, you can accomplish it even if it's really, really hard. If there is a strong desire for math and if someone has a strong desire to learn it and takes the time to really perfect it, then you are successful.

Teachers subtheme 2: Lack of engagement stifles mathematical success. Teacher participants felt least successful when they were rushed and not allowing students to ask questions. They felt least successful when students were mindlessly taking notes, not talking to each other, or demonstrating a genuine lack of interest. Some teacher participants implied a lack of success occurs when students are not understanding, do not have the necessary prior knowledge, or are simply waiting for the teacher to do the work for them. Teacher 1 described a time of least success as:

> I found myself starting a newer, higher-level topic on the get-go, where I assumed that students will know what I shared with them. That just doesn't work. It was to the point where I either notice a blank stare, or a student will bluntly say, I don't know what you're saying. I would have to retract my steps and find a past knowledge to connect with the new topic and start the session over.

Teacher 3 expressed frustration when "I didn't explain something via the shortest route and when the students could not see any concrete examples in the real world." In addition, Teacher 2 described a time of least success as that which occurs:

> Whenever a student asks me if a formula will be on a test, I feel like I am failing the student. I try to not teach in a way that requires students to memorize formulas, so when I get that question, I feel like I am not getting my point across.

Students subtheme 2: Lack of engagement stifles mathematical success. Student participants felt least successful when they were expected to learn on their own and the teachers did not help. Student participants also felt least successful when the teacher moved through material quickly and would not stop to answer questions or explain a concept. In addition, student participants felt least successful when they were not allowed to work in groups or ask each other questions or for help. Student E was concerned about the teacher assessing students' prior knowledge. Student E provided this statement, "The teacher should know what the students can do and not do so they can really help them." Student A described a time of feeling least successful as:

> In my old school I didn't feel very successful because I was alone, and the teachers didn't really help and I was failing a lot. They just went really fast and I couldn't keep up. Everything was so stressful and everyone else was passing. I would ask if I could come in and retake a test to up my score, but the teacher would say no. He would tell me I needed to study more and try harder. I would tell him that I couldn't learn that way and he would tell me that I just needed to figure something out.

Student B felt least successful when they could not check their work against their peers:

> I feel least successful when we are not working in groups. I don't have anybody to ask questions of or work with. I want to know if their answers are the same as mine or if their answers are not the same. If they're different, what did one of us do wrong? What's the difference between our answers?

Student E responded, "No one is helping or showing how to do anything. People have to do everything by themselves. I am not sure the teacher knows how to do the problems. If they did, why won't they help?"

Teacher and student participants were in agreement when stating some of the factors that hampered the effectiveness of mathematics instruction in the classroom. Factors included not working in groups or talking to each other, teacher moving too fast or being rushed, and the teacher assuming students' prior knowledge. In addition, student participants felt success was stifled when the teacher did not offer assistance, did not provide examples, and did not allow students a second chance or opportunity to correct mistakes.

Theme 2: Established expectations create a path to success in a mathematics classroom. As stated earlier in this chapter, teacher/student expectations were heavily commented on by teacher and student participants. Teacher participants spoke of what they expected of their students, and what they expected of themselves. As a result of student participants' comments on the topic, the researcher scheduled additional meetings with the teacher participants to inquire about their classroom expectations and how they were communicated to the students. Two teacher participants provided documents that are sent home at the beginning of each school year and given to new students upon their enrollment in their classes. One was in the form of a syllabus, the other a Word document. The remaining four teacher participants implied their expectations are communicated orally to students at the beginning of the year or semester.

The syllabus provided by one of the teacher participants listed what would be taught in class, the materials to be brought to class each day, and the cell phone and other electronic devices policy. It also listed what was expected of students and what students could expect from the teacher. Finally, it offered the grading rubric for the class. The other document provided by another teacher participant also listed student as well as teacher expectations. It spelled out R-E-S-P-E-C-T throughout the document. It discussed positive feedback and constructive criticism, and when and how assignments, quizzes, and tests would be taken and turned in and listed the tardy/absence policy.

Teachers subtheme 1: Certain expectations must be present for teacher and students to believe success will occur. Teacher participants implied that it was a combination of good classroom management skills, students paying attention and doing the work, and a strong teacher-student relationship that led to a successful mathematics classroom. Teacher 4 elaborated on the importance of developing teacher-student relationships:

> My students like being in my classroom because they know who I am as a person and they know that I am genuinely interested in their lives as well. Students respect me and want to do well in my class, so they put forth the effort to learn and do their work to live up to my expectations of them.

Teacher 5 was more concerned about the general behavior of the students, “All students are working together using technology, notes, and one another as resources. Students are on task doing different things.”

Teacher participants also commented on how having a lack of expectations—of themselves and of their students—contributed to a less successful class. Teacher participants found they were least successful when they were unorganized and had not put enough time or effort into preparing a lesson. Teacher participants commented on teaching a lesson that involved concepts they did not particularly like and how it hindered the effectiveness of the lesson. Teacher 6 and Teacher 1 created a visual of what a mathematics classroom without expectations looked like by supplying comments such as, “When I am not holding everyone accountable to expectations in the classroom, I noticed that the students are more off task, talking about matters other than math” and “I find that I feel least successful with students who have lost interest in learning, who are, in fact, only interested in their cellphones and in social media.”

Students subtheme 1: Certain expectations must be present for teacher and students to believe success will occur. Student participants also provided comments on expectations and the role they play in the level of success that could be gained in a mathematics class. Student participants expected teachers to assist students in achieving their goals in the subject of math and in life in general. Student participants expected teachers to keep them engaged and to know when a student was struggling and offer help. Student participants expected the teacher to have control of the classroom; keeping noise to a minimum and making sure students stayed on task. Student C needed a peaceful, quiet space, “I am most successful when everybody is quiet, when there's not a lot of commotion.” Student participants expected their teachers to get to know them, not only their mathematical ability, but also as a person. Student E expected, “A relationship with the teacher, as in we know each other, as in your name, as they know who you are. You know a little bit about each other and if they’re a good math teacher or not.” While Student D wanted the teacher to be aware of students’ knowledge and ability, “The teacher should know what the students can do and not do so they can really help them.”

Student participants believed that to be successful in a math class, they too, had to place expectations on themselves. They stated that they needed to come to school, pay attention, and do the work. They also believed that success was when they were trying hard and getting their work done. Student E spoke of fairness in time and effort, “I feel like it would be in my best interest to do better because I have to take into consideration that teachers are taking time off for me and that I should give my time to them.” Student B, who spoke much about the importance of knowing math so that it could be used throughout one’s life said, “You need to be able to do math properly later in life.” Student B added, “Achieve, get your diploma and then a degree.”

Through their responses, student participants implied that they were as responsible as the teachers for the level of success achieved in a math class.

Student participants were also willing to share experiences and opinions of what a classroom without expectations looked and felt like. Student C expressed how easy it was to get distracted in a class when there was a lack of expectations:

> When there's people talking or sometimes people will listen to music while the teacher is talking, and then you can hear the music from their earbuds, or there's this one girl who watches like anime or something on the computer. I look and I see her watching it and then I kind of like watch it while he's teaching, so then that kind of distracts me, kind of pushes me out of my focus zone.

Other student participants added that they get distracted and cannot learn when teachers allow students to talk and do whatever they want. Student E stated, "No one was helping or showing how to do anything. There was noise and no one was paying attention. People had to do everything by themselves." Student D shed a different light on expectations of what teachers should not do:

> When the teacher's angry with stuff that happens outside of that class and was angry at the other class before ours. I feel like their mood does change, which is a natural response, but I just feel like if I was a teacher, I would completely turn off what went on in any other class because it just makes the kids feel uncomfortable.

Student and teacher participants agreed that success occurs when everyone is actively living up to the expectations put forth and suffers when expectations are not present or adhered to. Student participants expected their teachers to know the subject and control the learning environment, and teacher participants expected their students to come to class prepared to learn.

Student participants also implied that they expected to be prepared for junior and senior high school math upon leaving elementary school.

Theme 3: Making lessons relevant to real life creates a more interesting and successful mathematics classroom. Teacher and student participants indicated a need to demonstrate how mathematics being taught in class was relevant to the real world. Teacher participants expressed a need to move away from the requirement of memorizing formulas and get students involved in solving math problems that related to real life. Student participants said they needed examples they could relate to and agreed that being able to understand the concepts and use them later in life was more important than memorizing formulas.

Teachers subtheme 1: Teachers and students feel more successful when the math they are learning in the classroom is useful in their daily lives. Teacher participants acknowledged that many of their students had a poor attitude toward math and students believed they would never use in real-life what was being taught. Teacher participants indicated there was a need to change students' attitudes so that success could occur. To assist in changing student attitudes, teacher participants indicated they prompt students to be creative and use anything and everything they know to solve problems. In addition, many stated they facilitate class discussions and real-life examples of the use of mathematics as it occurs in their daily lives. Teacher 2 addressed the issue of memorizing formulas:

> Math, many times, gets a reputation as being a subject where you have to memorize in order to be successful. I believe that is the opposite of what math should be. I want to show kids that formulas are tools that must be used logically to solve real world problems.

Teacher 4 spoke of excitement when "a student says, oh, that's why this is important. I love the feeling I get when students use mathematical concepts to solve non-mathematical problems." Teacher 4 went on to say: "I feel the most successful when students have an "aha" moment and finally understand a concept that was previously hard for them. I also love when students think certain things about math or how they relate to real life is cool or interesting."

Teacher 3 believed mathematical ability improved when "students were able to work comfortably with numbers and with measurements as they apply to real life situations. Having a strong sense of numbers and being able to communicate that number sense with others." All teachers responded, with agreement that mathematical success depended on students' abilities to solve problems using prior knowledge, creativity, and curiosity.

Students subtheme 1: Teachers and students feel more successful when the math they are learning in the classroom is useful in their daily lives. Student participants indicated success in mathematics meant understanding the concepts and being able to use them later in life. They were not interested in memorizing formulas and equations, but rather being provided with examples of how concepts being taught could be applied to real-life situations. Student E voiced this opinion, "It's not a matter of memorizing, it's a matter of understanding and being able to use it later on." Student B, who felt teachers should use examples familiar to students, offered this statement, "When my teacher is having a class conversation and using examples that kids can relate to." Student D believed:

> Using stuff to help kids remember, like the TV for an example. He'll say something that happened on TV and involve it with math and it catches our attention because we're interested in what's on the TV and when you compare it to math, it just makes it a more engaging lesson.

Student B was concerned about how math could be used throughout life:

> If you have a true understanding of it, and you needed to get help one or two times on it, that helps you get a true understanding of the subject, so you'll be able to remember it later in life. Math is a very important thing for later on in life.

Teacher and student participants indicated the importance of relating mathematics in the classroom to mathematics used in real life. Student participants realize they have several more years of high school mathematics and many want to go to college, where enrollment in mathematics courses will be required. Student participants want to gain a level of understanding that can be carried through their lives. Teacher participants felt that students were more apt to succeed if lessons were related to their lives.

Theme 4: Creating an environment of trust, where no one is afraid to participate, is essential to a successful mathematics classroom. Teacher and student participants listed mutual respect, developing relationships, and a lack of fear as characteristics of a positive classroom environment. Teacher participants indicated that students were able to shed their fears as they put forth effort into solving problems, and demonstrated curiosity, creativity, and the ability to use logic in the process. In contrast, student participants indicated that the lack of effort, curiosity, and creativity on the part of a student does not always mean the student is not knowledgeable in regard to math. Student participants felt it was the teacher's responsibility to know what their students knew and what they could do. Student participants indicated that creating a positive classroom environment, where no one was afraid to participate, depended on how well the teacher knew their students, and how much effort they were willing to put into helping their students improve and achieve more.

Teachers subtheme 1: Teachers and students want a classroom in which there is mutual respect and students were not afraid to take a chance. Teacher participants indicated that creating a positive environment, where students feel safe and confident, increases the level of effectiveness of the mathematics taught and learned in a classroom. Teacher participants said a successful mathematics classroom is one where students are not afraid to be creative or use logic to solve problems, when students do not feel intimidated, and are willing to do their part to learn math and to understand processes and concepts. Teacher participants implied that mutual respect and developing a relationship with students assists in creating a positive classroom environment. In addition, teacher participants believed that encouraging students to put forth effort, to think differently, to ask as well as answer questions, encouraged a positive classroom environment. Teacher 4 stated that:

> I love teaching math and my students can tell that I have a passion for math and teaching. I like to create a positive class culture where students feel safe to be themselves and learn. I put forth the time and effort to make sure my students are successful. I push my students to change their attitudes about math and try to boost their confidence so that they feel comfortable when doing math. I have turned math haters into math lovers.

Students subtheme 1: Teachers and students want a classroom in which there is mutual respect and students were not afraid to take a chance. Student participants described a positive environment as one where they felt welcomed and respected, and when a relationship with the teacher was developed. Student B, remembering past experience, said, "I don't want to be stressed out. I want everyone to work together and be helpful." Student D expressed a need for the teacher to know the students:

> I want a comfortability with the teacher. Knowing, in general, how the kid feels about math. The teacher supports the kids. They don't make them feel like they don't know anything. They make them feel like they could learn more and they help them to learn more.

Student E reiterated some of the same points as Student A and Student D, although Student E added their opinion on what an environment that does not support success looks and feels like:

> I feel like to get kids' attention you really need to show that you appreciate them. I feel like I wouldn't respect the teacher that didn't respect me and didn't talk to me or didn't even make eye contact, or if they didn't try to help me. Some kids are embarrassed, so until the teacher really tries to get to know them, they might seem like they don't know how to do anything. They might be really good at math, but for anybody to know that, all depends on the teacher and how they relate to the kids. I think when a kid doesn't know how to do something and doesn't do their work, the teacher thinks they are a bad kid, but really, they just don't know how to do something. The teacher needs to know their students and what they can do, because some people are too afraid to ask for help.

Student participants believe they need to feel welcomed and respected in the classroom. Student participants also want their teachers to know them as a person, as well as having knowledge of their mathematical ability. Teacher participants indicated they have an understanding of the attitude most students have developed towards mathematics. Teacher participants feel the best way to change this attitude is to provide an atmosphere where teaching and learning can occur without fear; where students are encouraged to use prior knowledge, grit, curiosity, creativity, and logic to solve problems.

As stated earlier in this chapter, student participants spoke about their mathematical ability, past as well as present. Student participants' perception of their present mathematical ability was included in the themes and subthemes. The researcher felt it was important to include students' perceptions of past ability; it was these comments that lead the researcher to gain a better understanding of how student participants' attitudes and opinions toward mathematics had formed.

Mathematical ability. Teacher participants rarely addressed students' mathematical ability, although they did admit that assuming students' prior knowledge of a concept being taught created a less successful mathematics lesson. Student D went back as far as kindergarten to share past experience with mathematics:

> I did best in kindergarten, definitely, because my mom worked hands-on with me before I went to kindergarten. I actually knew how to count to a hundred before I even went into kindergarten. So, it was just really easy for me and my teacher made me feel really special. She made me feel like I knew a lot and made me feel higher than everybody else.

Student E felt most successful in second grade, "I learned how to do multiplication. Multiplication was easy for me and no one else got it until like fourth grade. I wanted to learn how to do it, so I just learned it. I wanted to pursue it." The other students indicated a feeling of success with mathematics did not occur until junior high or entering ninth grade. Student A described experiences that have led to an improved attitude towards math:

> My attitude towards math has changed over time. Here the teachers really help all the kids who need extra help. I was one of those who always needed extra help. When I

came here, I felt more welcomed. I didn't feel so stressed and it just really helped that the teachers were here to help.

Several student participants wanted to share elementary school experiences that had helped to form their opinions and expectations of what needs to occur in a classroom for effective mathematics instruction to be realized. Student B felt the need to express this opinion, which resulted from past experiences:

> Teachers don't give you a strong enough foundation in math at all, in elementary school. They spend all their time on literature, history, and PE. They barely ever focus on math and it is important for college and science. You get a weak foundation in math before you go to junior high and high school. Since your foundation is weak, it makes it harder to be able to learn concepts in math later on. You need to start learning objectives for seventh grade so you have base of knowledge before you move on.

Student E contributed a general statement as well as one about an experience with an elementary teacher. The general statement was, "Some elementary teachers don't get it; they basically don't dedicate anything or much time to math." Describing a previous experience, Student E said, "My teacher didn't teach well. She didn't really teach us. She didn't teach or help me. It didn't seem like she knew how to do it."

All six student participants felt they were proficient in adding, subtracting, multiplying, and dividing when entering junior high. One student said they were also comfortable with fractions, another said they understood exponents and the order of operations. While a third said geometry was pretty easy. Concepts student participants found most challenging in junior high were absolute value, any type of word problem, and graphing points on a line, especially when greater than or less than (inequalities) were involved. Some struggled with graphing functions on a coordinate plane.

Assessing their mathematical ability as a ninth grader, student participants felt as if they were progressing and functioning at the appropriate level for their grade. Student E said, "I like math more now and I think it makes sense. It's all one way, you just need to see a picture and then you remember how to do it." Student F said, "It's still hard, but I am trying and getting better." Student D added, "I don't know all things, but it usually comes easier now, if it is explained properly." Student C described their present mathematical ability as, "My academic ability is pretty good. I am understanding concepts in math."

Student participants, in their descriptions of past and present mathematical ability, were able to express when they felt most successful and the factors that led to that feeling. All students, despite struggling with some concepts, felt they progressed greatly in junior high. As ninth-grade students in this charter system, they felt they were progressing in their mathematical skills. Student participants attributed this growth to engagement with teachers and their peers, having expectations met by both teachers and students, and feeling safe to ask questions and contribute answers. Student participants also indicated appreciation for teachers' efforts in making concepts understandable and relating them to real-life situations.

Summary

This study sought to identify how teachers and students describe and understand effective mathematics instruction. The research questions addressed were:

- How do high school math teachers understand and describe the best instructional practices that lead to student success?

- How do ninth-grade students understand and describe academic success in mathematics?

Semistructured interview questions, member checking, examination of artifacts, and observations were used to investigate the lived experience of ninth-grade students and their teachers as they pertain to the teaching and learning of mathematics. This study was interested in the voice of students and teachers, and how they understood and described effective mathematics instruction.

Data gathered through the interview and observation process and the examination of artifacts showed that both teacher and student participants understood that success in mathematics depended on the level of teacher-student engagement, the development and adherence to expectations, relating mathematics to real life, and creating a safe teaching and learning environment, where no one was afraid to participate. Data suggested that teachers should develop a relationship with their students and know what they can and cannot do. Data further suggested that students expect their teachers to assist them in achieving, to provide help when needed and to present examples that are relatable and apply to their daily lives. Data suggested teachers want students to use logic and be curious and creative in their efforts to achieve success in math. Data compiled though teacher interviews showed that teachers realize that many students have developed a bad attitude towards math, and it is this attitude that must be changed for real success to occur. Finally, data showed that both teachers and students want to be respected and feel safe within their space.

Employing semistructured interviews, observations, and the examination of artifacts provided validation in the form of triangulation. Interviewing both teachers and students gave a clearer view of what needs to take place in the classroom so that success can be realized by all.

The data indicated factors that led to the understanding of effective mathematical instruction and academic success in mathematics were similar for both teachers and students.

Chapter 5: Discussion and Conclusion

This study was qualitative and took the form of an intrinsic case study; the researcher was interested in the voice of the participants and sought to identify how teachers and students described and understood effective mathematics instruction. The participants included high school math teachers and ninth-grade students who attended or taught in several educational centers in one region that exists within a larger charter system in California. Studies have shown that not enough research has focused on young students' thoughts, concerns, and experience; research that actually enlists young students as the participants (Usher, 2009). The purpose of this chapter is to report the findings of the researcher and how they relate to existing literature on effective mathematics instruction. In addition, the research questions are addressed in relation to the data collected and the analysis process. This chapter offers a summary of results, a discussion of the results, a discussion of how the results relate to the literature, limitations to the study, implication of the results for practice, recommendations for further research, and a conclusion.

Summary of the Results

Many students have developed a negative attitude towards mathematics (Boaler, 2013). The factors contributing to this attitude are the belief that to achieve in mathematics, an individual must be gifted in the subject, be able to memorize concepts and formulas, and come up with answers quickly (Sun, 2014). The researcher was interested in the voice of students and teachers, and how they understood and described effective mathematics instruction and the ability to succeed in the subject.

The researcher used semistructured interviews, observations, and the examination of artifacts to collect data and find answers to the following research questions:

- How do high school math teachers understand and describe the best instructional practices that lead to student success?
- How do ninth-grade students understand and describe academic success in mathematics?

The spoken word of teacher and student participants led to the formation of four themes that they felt were essential in providing effective teaching and learning in mathematics. The themes were formulated from similar responses found in the analysis of the research data. The four themes developed were: (a) engagement is essential to the level of effectiveness of mathematics instruction, (b) established expectations create a path to success in a mathematics classroom, (c) making lessons relevant to real-life creates a more interesting and successful mathematics classroom, and (d) an environment of trust is essential to a successful mathematics classroom.

The following theories and beliefs drove the design of the interview and observation protocols of this study. Social cognitive theory (SCT), self-regulated learning theory (SRL), and current and prior research related to growth mindset.

Social cognitive theory (SCT). Social cognitive theorists believe it is social systems and the environment that influence an individual's desire to achieve, their emotional state, personal standards, and self-efficacy beliefs. Social cognitive theory focuses on the ability of a person to be actively engaged in their own destiny; they can make decisions and take actions that will determine their own development, thus achieving a desired result (Pajares, 2002). Bandura (1986) indicated that both the social world and personal characteristics influence an individual's behavior.

In a description of SCT, Crittenden (2005) stated that a teacher is responsible to set the mood of a classroom, define how the classroom is to function, construct the guidelines and expectations, and establish the environment. A series of comments made by teacher and student participants demonstrated the presence of the underlying principles of SCT:

> I love teaching math and my students can tell that I have a passion for math and teaching. I like to create a positive class culture where students feel safe to be themselves and learn. I set high expectations for students and most of them succeed at reaching those expectations. I put forth the time and effort to make sure my students are successful.

Teacher 4 indicated, "Students respect me and want to do well in my class so they put forth the effort to learn and do their work to live up to my expectations of them."

Student participants indicted they too were responsible for setting the mood of a classroom. When describing expectations, Student E responded with:

> Considering all the teachers that helped me, I've gotten better over the years. I feel like it would be in my best interest to do better because I have to take into consideration that teachers are taking time off for me and that I should give my time to them.

A comment offered by Student D also identified principles of SCT, "The teacher supports the kids. They don't make them feel like they don't know anything. They make them feel like they could learn more and they help them to learn more." The researcher witnessed the existence of SCT principles during classroom visits. Classrooms were welcoming, everyone was on task, there was mutual respect and concern for one another, and not only did the teacher praise the students, but students praised each other.

Researchers have established that self-efficacy beliefs, attitude, behavior changes, and motivation are highly correlated. Graham and Weiner (1996) indicated self-efficacy was a greater predictor of behavioral outcomes and individual identity than any other motivational factor employed, especially in education. This leads to the idea that performance does not merely depend on how capable or knowledgeable an individual is, but also on how capable and knowledgeable one believes they are.

Self-regulated learning theory (SRL). Zimmerman and Schunk (2001) described self-regulatory processes as tools that, if used by students, enhanced performance and lead to improved self-efficacy. The philosophy behind SRL is: “when students become engaged, they take greater responsibility for their learning, and their academic performance improves” (Everson, n.d., para. 3). Self-regulated learning theory (SRL) promotes student planning, practicing, and evaluating (Zimmerman, 2000). Analyzed data collected in this study showed that teachers guide students to plan, practice, evaluate, and adjust. Furthermore, the data showed that teachers encourage students to persist, to try new and different methods, to set goals, and to measure progress toward reaching those goals. Classroom visits affirmed that the principles of SRL were in place. Students were engaged with the teacher as well as their peers. They worked together comparing methods and evaluating solutions, debated processes, made adjustments, and persisted until the correct solution was found.

Teacher participants described a successful mathematics classroom as one in which students are talking to each other and trying to find a way to approach a problem. Teachers indicated success occurs when students are curious, use grit, and are persistent in their efforts to understand a problem; when they are working together using technology, notes, and one another as resources. Furthermore, teacher participants indicated effective mathematics instruction occurs when students are on task, evaluating their work and comparing it to others. Zimmerman (2000) claimed practice, planning, and evaluation are dependent on one another and if taught correctly, can assist a student in self-regulatory learning. When students are able to practice, plan, and evaluate, they are more likely to understand what needs to be done. Self-regulated learning theory (SRL) gives students choices in such things as methods to be used, assistance that may be needed, and a time frame to complete the task

Growth mindset. Dweck (2014), a leading researcher in motivation and growth mindset, noted that students who think they can achieve more are motivated to become smarter by creating goals and putting forth greater effort. A fixed mindset leads an individual to believe their intelligence is genetic and nothing can be done about it, whereas a growth mindset allows an individual to work toward developing their intelligence over time. Teacher participants acknowledged that students came to class with a bad attitude towards mathematics, believing that they could never achieve, as illustrated in this comment made by Teacher 1, "Many students have a bad attitude towards math and say they are bad at math. They believe that they will never use math in their futures, and their parents tend to agree with them." Blad (2015) indicated the key to changing attitudes and creating a growth mindset is to provide open problems that challenge students to think differently, to explore various strategies in the solving process. Blad (2015) further states, coming up with an answer quickly is not as important as being able to explain the concepts. Student A's statement provided an example of a fixed mindset evolving into a growth mindset:

> I'm able to roll with it and I'm like okay yeah math is fun. Math is good. But then when I don't understand something and it's like kind of frustrating, I'm like I don't like math. I guess I have a neutral feeling. I feel like bubbly when I get things right, the nervous feeling in my stomach is lifted away. I feel more like intrigued to learn what is being taught because now I know I can do it.

Teacher participants indicated they encourage students to put forth effort and perseverance when solving problems, to ask questions of others, and know that it is okay to make a mistake. This statement provided further evidence that the philosophy of growth mindset was being practiced by the teachers involved in this study.

Bandura's social cognitive theory (1986), Zimmerman's (2000) self-regulated learning theory, and Dweck's (2002) philosophy of fixed and growth mindsets identified consistent attributes which lead to the development of positive self-efficacy. Similarities in the views and actions of the teacher and student participants showed it was not simply teacher preparation, teacher knowledge, and curriculum that defined the level of student achievement in mathematics. The analysis process showed teachers' beliefs, attitudes, and expectations along with their created classroom environment impacted students' motivation and achievement. The analysis also showed that students were motivated to achieve when they were given time to work with others and correct their mistakes, praised for their efforts, and recognized for what they had accomplished.

Discussion of Results

The researcher's examination of interview responses of the participants, notes obtained during classroom visits, and shared artifacts led to the identification of four areas of commonalities addressed by teacher and student participants in their description of effective mathematics instruction. The four themes produced as a result of the analysis process were: (a) engagement is essential to the level of effectiveness of mathematics instruction, (b) established expectations create a path to success in a mathematics classroom, (c) making lessons relevant to real-life creates a more interesting and successful mathematics classroom, and (d) an environment of trust is essential to a successful mathematics classroom.

Engagement is essential to the level of effectiveness of mathematics instruction. In regard to teacher/student engagement, many of the same practices that determined success were identified by both student and teacher participants. Both groups spoke of collaborative group work, addressing questions and answers, excitement, and active participation in solving problems as positive influences on the level of effectiveness of instruction in a mathematics class. Student B described a feeling of success as:

> A most successful environment is when there is engagement. I think that's the key factor in the success of students in mathematics. When the teacher is working with students and the students are working together in a group.

Teacher and student participants also offered thoughts on what causes a lack of teacher/student engagement. Factors included not working in groups or talking to each other, teacher moving too fast or being rushed, and the teacher assuming students' prior knowledge. Teacher 2 offered this description of a less successful mathematics class:

> When I am feeling least successful is when I am rushed and not allowing the students a chance to question what they are doing. Basically, if the class consists of the students taking notes mindlessly, I feel like I am not being successful.

In addition, student participants felt least successful when the teacher did not offer assistance, did not provide examples, and did not allow students a second chance or opportunity to correct mistakes.

Established expectations create a path to success in a mathematics classroom. Student and teacher participants agreed that success occurs when everyone is actively living up to the expectations put forth and suffers when expectations are not present or adhered to. Student participants expected their teachers to know the subject and control the learning environment. Student D, when speaking of personal expectations said, "I need to go to class, pay attention, and do the work." Teacher participants expected their students to come to class prepared to learn. Student participants implied that they expected to be prepared for junior and senior high school math upon leaving elementary school and acknowledged that it was their duty to come to class, pay attention, and do the work. Teacher participants agreed that it was a combination of good classroom management skills, students paying attention and doing the work, and a strong teacher-student relationship that led to a successful mathematics classroom.

Lessons relevant to real life create a more interesting and successful mathematics classroom. Teacher and student participants indicated an importance of relating mathematics in the classroom to mathematics used in real life. Some student participants indicated a desire to gain a level of understanding of mathematics that could be carried through their lives. Student B commented, "The more successful you are in education the better that will be for you in the longer span of your life" and "Math is a very important thing for later on in life because you need economics, because you have to do your taxes and bills and everything. You need to be able to do math properly later in life." Teacher participants expressed a need to move away from the requirement of memorizing formulas and get students involved in solving math problems that related to real life. Student participants said they needed examples they could relate to and agreed that being able to understand the concepts and use them later in life was more important than memorizing formulas. Teacher 4 offered this comment on moving away from memorizing formulas, "Class discussions really help students understanding the lessons (old and new). Math practices have to go beyond individual investigation and written examples." Teacher participants felt that students were more apt to succeed if lessons were related to their lives.

Teacher participants acknowledged that many of their students had a bad attitude toward math and that students believed they would never use in real life what was being taught. Teacher participants indicated there was a need to change students' attitudes so that success could occur.

Teacher participants indicated some of the techniques they used to change student attitudes were prompting students to be creative and use anything and everything they knew to solve problems. Teachers said they facilitate class discussions and real-life examples of the use of mathematics as it occurs in the real world. Several comments made by teachers on the topic were, “I understand mathematical success as students becoming curious about how to use a concept for everyday use” and “The ability to work comfortably with numbers and with measurements as they apply to real life situations. In addition, teachers felt the best way to change students’ attitude toward mathematics was to create an atmosphere where teaching and learning could occur without fear; where students are encouraged to use prior knowledge, grit, curiosity, creativity, and logic to solve problems.

An environment of trust is essential to a successful mathematics classroom. Teacher and student participants listed mutual respect, developing relationships, and a lack of fear as characteristics of a positive classroom environment. Teacher participants also indicated that students were able to shed their fears as they put forth effort into solving problems, and demonstrated curiosity, creativity, and the ability to use logic in the process. This comment was offered by Teacher 1, “I feel most successful when all of my students are understanding what I’m teaching and are enjoying being in my classroom.” Student participants indicated that creating a positive classroom environment depended on how well the teacher knew their students, and how willing they were to help students improve and achieve. Evidence of this was found in several student comments, “When I came here, I felt more welcomed. I didn’t feel so stressed and it was just really helpful that the teachers were there to help” and “Having comfortability with your teacher. Knowing, in general, how the kid feels about math. The teacher supports the kids. They don’t make them feel like they don’t know anything.” Teacher and student participants felt there was a need to create an environment that harbored mutual respect and where everyone was allowed to make mistakes.

The observation process further validated the spoken words of student and teacher participants and were factors of the theme development process. The researcher was able to witness the attributes, mentioned by the participants, actually occurring in the classroom and to document the climate created by all who were present within the space. The examination of artifacts gave the researcher a sense of the importance recognition has on the desire to continue to put forth the effort to achieve in mathematics.

Discussion of the Results in Relation to the Literature

A search for studies that involved the voices of ninth-grade students and their teachers was conducted by the researcher during the literature review process; the search resulted in a deficiency of useful studies. Usher (2009) suggested that not enough research has focused on young students' thoughts, concerns, and experience. The lack of useful studies prompted the researcher to design a study that would examine which factors, as described by students and teachers, lead to improved mathematics achievement, and how they understood and described effective mathematics instruction.

The underlying problem addressed in this study was that despite reform efforts focused on providing American students with effective mathematics instruction, little progress in improvement has been realized throughout the years (Ball et al., 2001; Koch & Wilhoit, 2011; Zopf, 2010). Existing literature and research show that there continues to be a need for reform in mathematics education in the United States. Some researchers declared reform must occur in the methods and length of time mathematics teachers are prepared (Ball et al., 2001; Handal & Herrington, 2003; Hiebert & Morris, 2009). In addition, they believed individuals should demonstrate an ability to be able to present mathematics concepts in a variety of ways to ensure understanding (Ball et al., 2001; Handal & Herrrington, 2003; Tatto et al., 2012; Wilkins & Ma, 2003). There were also researchers who believed teachers needed to possess a positive attitude toward the subjects they teach (Bandura, 1994, 2001, 2011; Dweck 2002, 2006, 2010, 2014; Pajares, 2002; Zimmerman, 2000).

The current trend in mathematics has become more about how students can relate mathematical concepts to their own lives (Common Core State Standards Initiative, 2017). Common Core State Standards (CCSS) were developed for grades K–12 in 2010. The goal was to create a set of standards in English Language Arts and Mathematics that would be adopted by every state in the nation, thus creating consistency in what students were taught and able to do. Forty-two states agreed to adopt the standards and implemented them in 2014. The standards were more rigorous then the previous ones and were designed to prepare students for the 21st century (Meador, 2019). All assessments are computer based with writing components and are designed to test higher level thinking skills. Common Core State Standards define what students should learn and be able to do at end of each grade level. The development of CCSS appeared to be a result of existing literature that addressed mathematics reform.

Researchers have suggested that successful instruction is more than memorizing facts and methods (Hiebert & Morris, 2009; Land, 2011; Timmerman, 2004; Zopf, 2010). Furthermore, Ellis and Berry (2005) wrote, “The challenge is no longer how to get mathematics into students, but instead how to get students into mathematics” (p. 12). Making lessons relevant to real life emerged as a theme through the analysis of the interview responses of teacher and student participants, both of whom indicated an importance of relating mathematics in the classroom to mathematics used in real life. Teacher participants also expressed a need to move away from the requirement of memorizing formulas and get students involved in solving real-life math problems. Further, student participants said they needed examples they could relate to and agreed that being able to understand the concepts and use them later in life was more important than memorizing formulas. Teacher participants felt that students were more apt to succeed, and use acquired skills if lessons related to their lives. The responses of the teacher and student participants implied they agreed with the current direction mathematics education has taken.

Stuart (2000) indicated that student success and mathematical self-confidence are directly related to the methods used to present concepts and skills. Math is about asking questions, communicating, and making connections (Boaler, 2015; Ruef, 2017; Sun, 2014). Teacher and student participants listed collaborative group work, addressing questions and answers, and active participation in solving problems as positive influences on the level of effectiveness of instruction in mathematics. Ruef (2017) indicated teachers should encourage students to work together and share their ideas when solving problems. Zimmerman and Schunk (2001) indicated that teacher-student engagement leads to greater self-efficacy. Self-efficacy beliefs are formed by an individual's interpretation of how well they completed a task or how their performance was rated by others (Bandura, 1994). Teachers should encourage students to persist, to try new and different methods, to set goals, and to measure progress toward reaching those goals (Zimmerman & Schunk, 2001). The participants of this study, through their responses, indicated working in groups, sharing answers, debating methods, and persisting in finding the correct solutions were valuable attributes of effective mathematics instruction. Students indicated these practices gave them a greater sense of accomplishment, while teacher participants said these factors assisted in improving student attitudes.

Attitudes toward mathematics are key to determining the level of success in the subject. Usher (2009) indicated students form self-efficacy in mathematics through experience, persuasion, and feedback. To acquire positive self-efficacy toward teaching and learning mathematics, teachers and students must have at their disposal a support system that encourages goal setting, collaborative learning, and positive reinforcement (Amankonah, 2013; Land, 2011; Rice et al., 2013; Timmerman, 2004; Zopf, 2010). Studies have shown that poor test scores and assignment scores, along with teachers' attitudes, affect students' attitudes and self-efficacy (Stramel, 2010; Usher 2009). Student participants spoke of a need for second chances, an opportunity to work with others and correct mistakes.

According to Blad (2015), students expect to fail in mathematics if they are unable to offer correct answers, quickly. She further implied that teachers should encourage students to rework a problem or approach it from a different angle. In doing so, students learn from their mistakes and begin to understand the underlying concepts (Blad, 2015). Teacher participants believed that encouraging students to put forth effort, to think differently, to ask as well as answer questions encouraged a positive classroom environment and improved student attitudes. Assuring students that calculating incorrect answers does not define failure, but rather offers the opportunity to look at problems differently and try again, provides students with a sense of personal achievement.

Personal achievement provides students with confidence and a desire to continue on a path to success. Dweck (2002) indicated that an individual's perception of their abilities plays a key role in their achievement and motivation. According to Dweck (2015), students who believe they can achieve more, are motivated to become smarter, so they create goals and put forth the effort to improve. This leads to an attitude of working harder and longer, which ultimately leads to higher achievement. Teacher participants indicated they prompt students to be curious and creative, and to use logic and their prior knowledge to solve problems. Student participants who shared and described artifacts relating to mathematics spoke of how the recognition increased the effort they put into the subject and how the recognition increased their confidence in the ability to succeed.

Through the observation process, the researcher experienced environments where students were welcomed and respected. They were not afraid to make mistakes and were given opportunities to reformulate their ideas and try again. The teachers knew which students were more vulnerable and needed prompting. According to Blad (2015), it is important to encourage students and praise their efforts. When students are allowed to make mistakes, correct mistakes, work problems out in a way that makes sense to them, when they are offered encouragement by teachers and peers, participate in hands-on activities, and made to feel that they are an important asset to the teaching and learning community, even struggling students can grow in ability and confidence.

Students enter a classroom environment with a wide variety of attitudes, behaviors, experiences, and abilities. When the teacher has created an optimal environment, “the classroom stimuli first observed by the student is the basis upon which the reciprocal determinism and learned behavior will evolve” (Crittenden, 2005, p. 962). Crittenden suggested an optimal teaching/learning environment would encompass (a) establishing high expectations and enthusiasm that encourages student preparation and participation; (b) an awareness of each student’s learning styles and capabilities; and (c) a well-prepared classroom management plan that fosters rewards and consequences aimed at shaping expected behaviors. Teacher participants in this study implied that it was a combination of good classroom management skills, students paying attention and doing the work, and a strong teacher-student relationship that led to a successful mathematics classroom. Student participants expected teachers to assist them in achieving their goals in the subject of math and in life in general. They expected the teachers to keep them engaged and know when they were struggling and needed help. Student participants expected the teacher to have control of the classroom. Zimmerman (2000) suggested that students are more likely to succeed when they are taught how to control and be accountable for their own learning. Student participants believed that to be successful in a math class, they needed to come to school, pay attention, and do the work.

The researcher designed this study so that it focused on the voices of ninth-grade students and their teachers and how they understood and described effective mathematics instruction. Although studies that included the voices of ninth-grade mathematics students were scarce, the researcher was able to connect the responses of the teachers and students, the examination of artifacts, and observations to existing literature. Although the focus of mathematics was once rote-learning, the data collected in this study show that teachers and students want relationships that lead to an improved attitude toward mathematics. Students are more interested in developing an understanding of mathematical concepts that can be used throughout their lives and teachers do not want to focus on the memorization of formulas. Students want to work in collaborative groups and teachers want students to be creative, curious, and use logic in the problem-solving process.

Delimitations

Purposeful sampling, which included set criteria, produced delimitations to this study. The researcher considered only ninth-grade students who had completed at least one year of direct instruction in a junior high math class within the regional charter system. Students must have been enrolled in the entry level high school mathematics course, within a direct instruction setting. Invitations were only given to those teachers within the system who had two years of experience teaching mathematics to ninth-grade students in a direct instruction classroom. These boundaries may have limited replication of this study not only in a traditional educational system but within the larger charter system itself.

Limitations

Qualitative research is prone to limitations. A qualitative study may include all or any of the following limitations: familiarity of the researcher with the organization or individuals, self-reporting, researcher bias, time constraints, and the inability to replicate the study (Merriam & Tisdell, 2015). This study was designed to investigate how a small number of students and teachers, within a particular organization, understood and described effective mathematics instruction. The organization was a single region within a larger charter system that provided instruction in a hybrid model; students learn through independent study, online courses, or direct instruction. Not all of the education centers within the larger charter system offer junior high direct instruction in mathematics. In addition, not all centers require ninth graders to enroll in a direct instruction math class.

Implications of the Results for Practice, Policy, and Theory

The data analyzed in this study showed how teacher preparation, teacher knowledge, teacher/student engagement, and the practices that lead to a positive classroom environment are interrelated in achieving effective mathematics instruction. The implications for practice, policy, and theory emerged through the voices of the participants. The voices lead to an understanding that it is a combination of factors that lead to success in mathematics.

Implication of the results for practice. The implications of the results of this study are applicable to all classroom teachers and their students. This study offered insight to what ninth-grade mathematics teachers and their students understood and described as effective mathematics instruction. The themes developed through the analysis of data collected centered on responses that identified teacher/student engagement, student/teacher expectations, making lessons relevant to real life, and creating a safe learning and teaching environment as best practices in providing effective mathematics instruction. The attributes discussed by the participants have the potential to create effective instruction regardless of subject matter or grade level of students. Teacher/student engagement, where students work together, but forth effort, and persevere in their attempts to succeed would benefit any classroom. Establishing expectations and adhering to them would create a teaching/learning environment where everyone understands their role, freeing up valuable time that normally might have focused on addressing behavior and management issues. Creating a safe teaching and learning environment would allow for the participation of all who occupied the space. Students would be more likely to contribute, and if their teacher was aware of the level of knowledge they possessed, fear of offering a wrong answer would be diminished. Finally, making lessons relevant to real life would give meaning to what was being taught. This would provide a deeper understanding of the concepts and an opportunity for students to use those concepts later in life. The attributes identified by the participants of this study are not limited to entry level high school mathematics instruction, but could be employed in any classroom, at any grade level.

Implication of the results for policy. Recent focus in education and society was placed on preparing students for the 21st century, one that is entrenched in technology and encourages innovation (Koch & Wilhoit, 2011). Beers (2013) listed communication, collaboration, critical thinking, and creativity as the skills an individual needs to be successful in the 21st century. To prepare students for the 21st century the Common Core State Standards (CCSS) were created in 2010 to ensure that all students graduate from high school with the skills and knowledge necessary to succeed in college, career, and life, regardless of where they live. The Common Core State Standards were implemented in 42 states in 2014 (Common Core State Standards Initiative, 2017).

Common Core called for three major shifts in mathematics: (a) greater focus on fewer topics, (b) coherence—linking topics and thinking across grades, and (c) rigor—pursue conceptual understanding, procedural skills and fluency, and application with equal intensity (Common Core State Standards Initiative, 2017). Greater focus asks the teacher to spend more time on the major concepts for each grade. It is believed that greater focus creates a stronger foundation and a solid understanding of concepts and the ability to solve math problems inside and outside the classroom. The purpose of coherence—linking topics and thinking across grades is to interconnect ideas, skills, and concepts; to show how math is progressive and each concept is related to others and does not stand alone. Rigor requires the teacher to provide the students with the necessary lessons and tools to not only develop conceptional understanding and procedural fluency but also provide practice in real-life applications (Common Core State Standards Initiative, 2017). The learning goals of Common Core outline what a student should know and be able to do at the end of each grade. Beers (2013) stated, "The development of the Common Core State Standards (CCSS) was a vital first step in the process of defining the skills that will lead to future success in college and careers" (para. 2). The participants of this study listed collaboration, communication, creativity, and critical thinking as positive factors in determining the level of effectiveness of mathematics instruction. Participants also listed factors found in the mathematical practices defined by the *Mathematical Frameworks for California Public Schools* as positive attributes leading to effective mathematics instruction.

The *Mathematical Frameworks for California Public Schools* (2013) lists mathematical practices (MP), included in CCSS for Mathematics 1, the entry level high school course, as: (a) make sense of problems and persevere in solving them, (b) reason abstractly and quantitatively, (c) construct viable arguments and critique the reasoning of others, (d) model with mathematics, (e) use appropriate tools strategically, (f) attend to precision, (g) look for and make use of structure, and (h) look for and express regularity in repeated reasoning. Teacher participants of this study indicated all of the identified MPs as positive factors that led to effective mathematics instruction. Student participants listed MP 1, 2, 3, 4, 7, and 8 as positive factors. MP 5, 6 were not mentioned by the students, although the researcher did witness the strategic use of tools and students attending to precision when observing classes.

Common Core was implemented in California five years ago and the results of this study show that teacher and student participants have conformed to the overlying mathematical principles of the initiative and are ready to teach and learn in the 21st century. Teacher and student participants were not interested in the rote learning of the past. Teachers wanted to create lessons that allowed students to obtain a deep understanding of concepts and students wanted the knowledge and skills gained in mathematics to be particular and assessable throughout their lives.

The California Department of Education (CDE) is currently seeking input from credentialed teachers; school, district, and county administrators; college and university personnel representing academic departments and schools of education; and representatives of citizen groups or educational organizations to participate in the revision process for the

Mathematics Framework for California Public Schools. Approved applicants will form a Mathematical Curriculum Framework and Evaluation Criteria Committee (CFCC). The committee will look to revise the *Mathematics Frameworks* to include the latest research and best practices in TK–12 education. It is hoped the revision will be completed by 2021 (California Department of Education).

Implication of the results for theory. The researcher investigated how ninth-grade mathematics teachers and their students described and understood effective mathematics instruction in relation to social cognitive theory (Bandura, 1986), self-regulated learning theory (Zimmerman, 2000), and Dweck's (2002) philosophy of fixed and growth mindsets. The data analysis process of this study found that teacher and student participants wanted an environment where logic, curiosity, and creativity were used in teaching and learning mathematics. Students wanted to be able to relate concepts learned in mathematics to real life and have the ability to use the concepts as they progress through the academic system and life in general. The teachers wanted their students to be open-minded and use anything and everything they knew to solve problems. Students wanted to be noticed, allowed to do what they could, and to be assisted with what they struggled with. Students wanted a learning environment that included all and the opportunity to learn from each other. They wanted the opportunity to make mistakes and be given the time to rethink and start over. In addition, students wanted teachers who are passionate and are willing to develop relationships with them. Teachers wanted students to feel free to ask questions and participate within a group. Finally, teachers understood the need to change students' attitude toward mathematics. Behaviors and actions that lead to effective mathematics instruction, as described by the teacher and student participants, aligned with the principles of social cognitive theory, self-regulated learning theory, and the philosophy of growth mindset.

The findings of this study implied that participants wanted to be noticed as human beings first, then assessed as students.

Recommendations for Further Research

The purpose of this qualitative case study was to examine the perspectives of teachers and students as they pertain to understanding and describing effective mathematics instruction, and how their perspectives might aid in further studies of what factors may lead to effective mathematics instruction. Because this study was limited to a small group of teachers and students within the same regional charter system further research is recommended.

Recommendation #1: When preparing pre-service teachers for mathematics instructions stress the importance of: (a) providing students with the opportunity to make mistakes, and time needed to rethink, and rework problems, (b) allowing students to figure things out on their own, and (c) ensuring students that mistakes do not define failure, but create important teaching and learning moments.

Recommendation #2: Develop a method to assess the attitude of pre-service teachers, so that only those with the highest level of humanistic characteristics, along with the necessary knowledge of mathematics and the ways in which students learn, are placed in classrooms.

Recommendation #3: Redesign teacher preparation programs so that pre-service teachers have the opportunity to engage in student teaching within the first two years of their program instead of after the completion of the program. Earlier experience would allow the teacher candidate to make other choices if they find the classroom is not really where they want to be.

Recommendation #4: The researcher did not take into account gender, culture, or learning differences. There is a possibility that if gender, cultural or learning differences of students were taken into account, responses would be different.

Recommendation #5: A longitudinal study targeting the growth in achievement of the student participants would be beneficial in validating the results of this study. This would require investigating growth scores on the California Assessment of Student Performance and Progress (CAASPP) from eighth and 11th grade and following student progress on the charter mandated growth assessment that is administered three times per year.

Recommendation #6: Extend the research so that it includes various educational levels (elementary, middle, and high) and models (traditional public school, private religious school, charter school). Taking into account the culture and nature of the various models as well as differences in class size. These factors may offer further insight into what teachers and students need to be successful in the teaching and learning of mathematics.

Recommendation #7: All but one teacher participant in this study went to college with the intent of becoming a mathematics teacher. It would be interesting to investigate how teachers who took a teaching assignment out of necessity described and understood effective mathematics instruction.

Each of the recommendations reflect a question that arose in the researcher's personal being at some time during the research process.

Conclusion

The purpose of this qualitative intrinsic case study was to examine the perspectives of teachers and students as to how they understood and described effective mathematics instruction. The results of this study were derived from participants' responses to semistructured interview questions, observations, and the examination of artifacts. Through the data collected from the six teacher participants and six student participants, the researcher was able to identify four themes: (a) engagement is essential to the level of effectiveness of mathematics instruction, (b) established expectations create a path to success in a mathematics classroom, (c) making lessons relevant to real life creates a more interesting and successful mathematics classroom, and (d) creating an environment of trust, where no one is afraid to participate, is essential to a successful mathematics classroom.

The analysis of the data showed that teacher and student participants revealed a need for teachers to develop a relationship with their students and know what they can and cannot do. Students expect their teachers to assist them in achieving, to provide help when needed, and to present examples that are relatable and apply to their daily lives. Teachers wanted students to use logic and be curious and creative in their efforts to achieve success in math. Teachers realized that many students have developed a bad attitude towards math, and it is this attitude that must be changed for real success to occur. Data showed that both teachers and students want to be respected and feel safe within their space. Finally, data showed that recognition for a job well done increases the desire improve and achieve. Existing literature and theories supported the findings of this study, although further research may be needed, as there are few studies that enlist the voice of ninth-grade students and their teachers.

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Appendix A: Teacher Interview Protocol

Introduction	Thank you for agreeing to participate in this study. My name is Debra Wecker Flores and I am a teacher within this organization. I am currently working on obtaining a Doctorate in Education. My research study involves finding out how teachers and students describe and understand effective mathematical instruction. Part of the research process involves interviews and observations. As a participant, you have agreed to be interviewed and may be observed in a classroom setting if you are in attendance. The interviews will be recorded and field notes will document the classroom environment observed. Your answers will be treated as confidential, as will your name or any other information that can be used to identify you. Your personal information will not be part of any written report. All identifying information will be destroyed after the study is published. As a participant, you will be given the opportunity to review your responses to the interview questions and revise, if you should find the need. You will also be given an open invitation to read the final report.

	Do you have any questions?
Topic 1	How would you describe academic success in general? How would you describe academic success in relation to mathematics and your students?
Topic 2	**Attitude/Beliefs** 1. Why did you choose to become a mathematics teacher? • **Probe:** What specific words would you use to describe your feelings toward teaching mathematics? 2. Describe a time when you felt most successful in your mathematics teaching methods. 3. Describe a time when you felt least successful with in your mathematics teaching methods.
Topic 3	**Setting the Scene (Environmental Factors) for Success** 1. Describe what is happening within the classroom when you feel most successful. • **Probe:** What were the students doing? • **Probe:** What are you doing? • **Probe:** What do you attribute the success to?
Topic 4	**Setting the Scene (Environmental Factors) for Struggles** 1. Describe what was happening when you felt least successful in conveying a topic, concept, or delivering a lesson. • **Probe:** What are you doing?

	• **Probe:** What were the students doing? • **Probe:** What do you attribute the struggles to?
Topic 5	**Description of Success** 1. How do you understand mathematical success? • **Probe:** What specific words or actions would you use to describe mathematical success?
Final Thoughts	**Thank you, this concludes the interview. Do you have any final thoughts you would like to share?** **Thank you for your time; I will let you know when your answers are ready for review so we can schedule a time to meet.**

Appendix B: Student Interview Protocol

Introduction	Thank you for agreeing to participate in this study. My name is Debra Wecker Flores and I am a teacher within this organization. I am currently working on obtaining a Doctorate in Education. My research study involves finding out how teachers and students describe and understand effective mathematical instruction. Part of the research process involves interviews and observations. As a participant, you have agreed to be interviewed and may be observed in a classroom setting if you are in attendance. The interviews will be recorded and the observations videotaped. Your answers will be treated as confidential, as will your name or any other information that can be used to identify you. Your personal information will not be part of any written report. All identifying information will be destroyed after the study is published. As a participant, you will be given the opportunity to review your responses to the interview questions and revise, if you should find the need. You will also be given an open invitation to read the final report. Do you have any questions?
Topic 1	**Ability**

	1. How would you describe academic ability? 2. How would you describe your mathematical ability? • **Probe:** Tell me about the math concepts that come easiest to you. • **Probe:** Tell me about the concepts that are hardest. 3. Describe times when you feel more successful understanding the concepts. • **Probe:** Describe what is happening in the classroom when it is easier for you to understand the concepts being presented.
Topic 2	**Attitude/Beliefs** 1. Describe your feelings toward mathematics. • **Probe:** What specific words would use to describe these feelings? 2. Describe a time when you felt most successful with mathematics. • **Probe:** What specific words would use to describe these feelings? 3. Describe a time when you felt least successful with mathematics. • **Probe:** What specific words would use to describe these feelings?
Topic 3	**Setting the Scene (Environmental Factors) for Success** 1. Describe what was happening when you felt most successful. • **Probe:** What was the teacher doing? • **Probe:** What were the students doing? • **Probe:** What do you attribute the success to?

	• **Probe:** What specific actions (teachers' and/or students') would you use to describe this feeling of success?
Topic 4	**Setting the Scene (Environmental Factors) for Struggles** 1. Describe what was happening when you felt least successful. • **Probe:** What was the teacher doing? • **Probe:** What were the students doing? • **Probe:** What do you attribute the struggles to? • **Probe**: What specific actions (teachers' and/or students') would you use to describe what leads to struggles with mathematics?
Topic 5	**Description of Success** 1. How do you understand mathematical success? • **Probe:** What specific words or actions would you use to describe mathematical success?
Final Thoughts	Thank you, this concludes the interview. Do you have any final thoughts you would like to share? Thank you for your time; I will let you know when your answers are ready for review so we can schedule a time to meet.

Appendix C: Observation Protocol

Introduction	Thank you for agreeing to participate in this study. My name is Debra Wecker Flores and I am a teacher within this organization. I am currently working on obtaining a Doctorate in Education. My research study involves finding out how teachers and students describe and understand effective mathematical instruction. Part of the research process involves observations. As a participant, you have agreed to be observed in a classroom setting. Observations will be documented with the use of field notes. Your personal information will not be part of any written report. All identifying information will be destroyed after the study is published. As a participant, you will be given the opportunity to review the written documentation of the observation. You will also be given an open invitation to read the final report. Do you have any questions?
Teacher	
Center	

Date	
Time	
Course	
Number of Students Enrolled in Class	
Pre-Observation (personal meeting to be scheduled prior to the actual date of the observation)	Provide the teacher with the opportunity to describe the lesson and the anticipated outcomes
Observation - Listed is what is to be documented by observer.	
Preparation: what materials are being used, equipment, resources are being used	
Variety of Activities: describe what is happening (lecture, group work, hands-on, independent work	

Physical Set-Up of Classroom: describe the physical environment	
Environmental Climate as It Pertains to Humans: describe the sense of atmosphere, is it relaxed, tense, welcoming, etc.	
Development of Content: how is the material being presented (teacher as sole player or all inclusive)?	
Teacher to Student/Student to Teacher/Student to Student: describe how each relates to the other	

Student Cooperation/Self-Regulation: describe any noticeable expectations put on the students by the teacher or self-imposed expectations	
Student Participation: describe willingness of students to participate	
Post Conference with Teacher (Debriefing): share findings and provide opportunity for the teacher to elaborate on observed behaviors and actions.	
Thank you, this concludes the observational process, do you	

have any final thoughts you would like to share? Thank you for your time. I will be in touch when the final report has been completed.	

Appendix D: Coding Categories

Category: Teacher/Student Engagement	
Code: Engagement	Code: Lack of Engagement
Subcodes (teacher responses)	Subcodes (teacher responses)
communicating, students communicating with each other and the teacher, encourage, collaborating, encourage kids to think for themselves, students enjoy being in class, conversations among students concerning topic at hand, student questions make class more interesting, positive energy /exchange in mathematical ideas exciting and fun, student engagement brings life to the class in groups, teacher walking around, doing the work asking questions, sharing methods and answers with others, students working in groups, walking around answering questions, students on task, students trying new ways to solve a problem, checking others' methods, engaged with material, circulate around the room and provide helpful insight, engaged in group work using technology, engaged, using critical thinking, logical, creative	not allowing the student a chance to question, frustrated that students are not using resources, students taking notes without understanding, waiting to tell them how to solve the problems, lack of interest, not bought into the class, bored of note taking, rushed, going around the classroom giving students one on one help, students taking notes mindlessly, trying to get students to work together, trying to re-explain things in a different way, students were in groups but not working, sneaking peaks at their cell phones, quiet/ not talking to one another

Subcodes (student responses)	Subcodes (student responses)
very good help from teacher, teacher connecting information, more focused, engaged, students paying attention, everyone on the same page, teacher giving examples, everyone is understanding, everyone is getting it, everyone knows each other, achieving, knowing what I am doing, really good math teachers, understanding, supportive teachers, engagement with teacher, teacher helping, teacher makes math fun, teacher checks how well we are doing, being presented with steps, getting help from teacher, tutor, special ed teacher, teacher working with students, students working in groups, teacher explaining things, students doing their work, everyone moving at the same pace, changing groups, collaborating	trying to learn on my own, unengaged, unfocused, little help made it hard, didn't do work, didn't know how, didn't like math, didn't understand, teacher not explaining things, studying something for only one day, taking a test on the second day, teacher didn't help, working independently, not working in groups

Category: Teacher/Student Expectations	
Code: Expectations	Code: Lack of Expectations
Subcodes (teacher responses)	Subcodes (teacher responses)

reached or come close to potential in all subject areas, demonstrating mastery of common core standards, reach their respective potentials, influence students to do well, not only in math but in life as well, good classroom management, developing student relationships, most succeed at reaching those expectations, put forth the time and effort to make sure students are successful, set high expectations for students, ability to communicate effectively, student's ability to learn independently, conversations amongst the students concerning the topic at hand, students were paying attention, put forth effort to learn, do their work, live up to expectations, improving, persistence students achieve own goals, do better and d understand, good grades, trying hard, do well, pay attention, in my best interest to do better, give time to teachers, paid more attention, good teachers, knowing what you are doing, having a strong desire for math, a strong desire to learn, take time to perfect it, teacher	more off task, talking about matters other than math, students who are not interested in learning, sneaking peaks at their cell phones, unorganized, say they will never use math in their futures, student who would not even try a problem, teacher didn't teach well, took time off of school, did not learn beginning concepts, when people are talking, listening to music, watching anime on the computer, being distracted, teacher allowing everyone to talk, everyone doing whatever they want, not paying attention, no help, no examples, noise, commotion, not paying attention

should know what students can and can't do, come to school, pay attention, do your work, get a diploma, getting work done, high school diploma, simple degree, master's degree, get a degree, passing tests, achieve, get a diploma or degree, understand, students do their work	

Category: Creating Safe Environment	
Code: Safe Environment	
Subcodes (teacher responses)	Subcodes (student responses)
encouraging efforts to solve problems, encouraging to think of different ways to solve problems, encouraging to talk to each other, genuinely interested in their lives, use of curiosity and grit, encouraging to think of possible ways to solve the problems, look for patterns, similarities in problems, encouraging them to ask each other questions, seek help from each other, encourage to put anything they know about the problem on papers, respect, want to do well in my class, improving, confident, not being intimidated	most stuff makes sense with a little help, teacher makes math fun, checks how well we are learning, feel welcomed, everyone is not helpful, stressed out, trying hard, everyone is on same page, everyone moving at the same pace, everyone is understanding and learning, everyone is getting it, learning from each other, understanding uniqueness, teacher should know what students can and can't do, some people are too afraid to ask for help, need a relationship, the teacher needs to know who their students are, appreciate them,

by the subject, having fun in class, utilizing previous knowledge, create a positive class culture, students feel safe to be themselves and learn, put forth the time and effort to make sure students are successful, push students to change attitudes about math, try to boost their confidence feel comfortable when doing math, turned math haters into math lovers	students respect teachers who respect their students, some students are embarrassed, knowing what kids can do depends on the teacher and how they relate to kids

Category: Making Lesson Relevant	
Code: Real life	
Subcodes (teacher responses)	Subcodes (student responses)
demonstrating mastery of common core standards, thinking creatively and logically, learn to reason how to approach and solve a problem, ability to work with numbers/measurements/apply to real life, formulas are tools to be used logically to solve real world problems, students use math concepts to solve non-mathematical problems, class discussions help students understand the lesson, math practices go beyond individual	more successful in education, better for longer span of life, understanding of material, teachers connecting information, using examples kids can relate to, helping kids remember, uses tv examples, you're understanding, being able to remember it later in life, understanding and not memorizing

investigation/ written examples, using past experiences to solve more complicated concepts, students becoming curious how to use a concept for everyday use, utilizing previous knowledge, how math concepts relate to real life is cool or interesting, when the math transferred to real-world applications, students could not see any concrete examples in the real world, understanding is the ultimate goal	

Appendix E: Preliminary Codes from Raw Data

Leads to Mathematical Success

Teacher Responses	Student Responses
Learning the material	Student achieves own goals
Effort to understand	Do better and understand
Complete the tasks at hand	Engaged with teacher
Student buy in	Good help from teacher
Dedication	Teacher connecting information
Student curiosity	Teacher helping
Willing to have an open mind to learning	Teacher making math fun
Ability to communicate effectively	Teacher checking for understanding
Ability to learn independently	Being engaged
Reach or come close to potential in subject	Being focused
Demonstrating mastery of Common Core Standards	Being presented with steps
Engaged with the material	Teacher making themselves heard
Feel accomplished or smart when learning math	Passing tests
Improving math skills and knowledge	Students working in groups
Understanding math concepts	Feeling welcomed
Thinking logically to complete a task	Not being stressed out
Keeping an open mind	Trying hard
Successfully accomplish something by themselves	Students paying attention

Appendix E (continued)

Learning the approach to solve a problem	Teachers helping kids to remember
Reaching respective potential	Teacher makes lessons more engaging
Have fun learning	When everyone is on the same page
Ability to work with numbers and measurement	When everyone is moving at the same pace
Ability to apply what is learned to real life	Groups change
Having strong sense of numbers	Everyone knows each other
Ability to communicate number sense with others	Collaborating
Encourage students to think for themselves	Being able to remember later in life
Students are understanding what is being taught	Learning from each other
Students enjoy being in the class	Understanding uniqueness
Students conversing about the topic at hand	Not memorizing
Circulating the room to provide insight to the task at hand	Teacher is comfortable with students
Majority of students interested in lesson	Teacher knows their students
Students making comments and asking questions about what is being taught	Teacher offers support
Students bringing life and sense of discovery to class	Teachers and students respect one another
Positive energy in the exchange of mathematical ideas	Understanding what is being written and done (notes)
Using technology, notes, and one another as resources	Having an interest in excelling

Appendix E (continued)

Good classroom management	Getting help from teacher, tutor, and others
Create a positive teaching and learning culture	Teacher making students feel special and smart
Set high expectations	Teacher using examples kids can relate to
Push to change students' poor attitude toward math	
Turn math haters into math lovers	
Boost students' confidence	
Putting forth time and effort to make sure students are successful	

Appendix F: Preliminary Codes from Raw Data

Leads to Less Mathematical Success

Teacher Responses	Student Responses
Students could not see any concrete examples in the real world	Unengaged
I assumed that students knew what I shared with them	Teacher not explaining things
Student asks me if a formula will be on a test	Studying topic for only one day
Requiring students to memorize formulas and equations	Having to work on my own
Students are off task and talking about matters not related to math	Can't pass unit or test
Students not interested in learning	Teacher didn't teach well
Students not engaged in group work	Teacher didn't teach me
Not supporting a lesson with past knowledge	Didn't do the work
When I am rushed	Didn't know how to do the work
When students are not given time to ask questions	Not getting a chance to improve score
Students mindlessly taking notes	Feeling alone
Frustrated students are not using resources	Not working in groups
Trying to get students to work together.	Teacher allowing everyone to talk
Students complaining about the concepts being too hard	Students listening to music or watching YouTube

Students are taking notes without understanding	Teacher is angry about something
Sneaking peaks at their cell phones	Not paying attention
Not explaining some concepts well because of dislike of concept	Being too afraid to ask for help
Student's lack of interest	Teacher assumes student doesn't know anything
Student's poor attitude/lack of effort	Teacher not knowing what students can do
Student's negative attitude toward math	Unorganized teacher
Students not understanding why math is important	

Appendix G: Statement of Original Work

The Concordia University Doctorate of Education Program is a collaborative community of scholar-practitioners, who seek to transform society by pursuing ethically-informed, rigorously- researched, inquiry-based projects that benefit professional, institutional, and local educational contexts. Each member of the community affirms throughout their program of study, adherence to the principles and standards outlined in the Concordia University Academic Integrity Policy. This policy states the following:

Statement of academic integrity.

As a member of the Concordia University community, I will neither engage in fraudulent or unauthorized behaviors in the presentation and completion of my work, nor will I provide unauthorized assistance to others.

Explanations:

What does "fraudulent" mean?

"Fraudulent" work is any material submitted for evaluation that is falsely or improperly presented as one's own. This includes, but is not limited to texts, graphics and other multi-media files appropriated from any source, including another individual, that are intentionally presented as all or part of a candidate's final work without full and complete documentation.

What is "unauthorized" assistance?

"Unauthorized assistance" refers to any support candidates solicit in the completion of their work, that has not been either explicitly specified as appropriate by the instructor, or any assistance that is understood in the class context as inappropriate. This can include, but is not limited to:

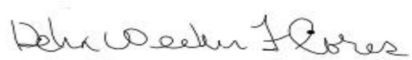
- Use of unauthorized notes or another's work during an online test
- Use of unauthorized notes or personal assistance in an online exam setting
- Inappropriate collaboration in preparation and/or completion of a project
- Unauthorized solicitation of professional resources for the completion of the work.

Statement of Original Work (Continued)

I attest that:

1. I have read, understood, and complied with all aspects of the Concordia University–Portland Academic Integrity Policy during the development and writing of this dissertation.

2. Where information and/or materials from outside sources has been used in the production of this dissertation, all information and/or materials from outside sources has been properly referenced and all permissions required for use of the information and/or materials have been obtained, in accordance with research standards outlined in the *Publication Manual of The American Psychological Association*



Digital Signature

Debra Wecker Flores

Name (Typed)

July 30, 2019

Date