11-1-2019

Peer Tutoring in Middle School: How it Changes Student Achievement and Attitudes

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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

Transformational Leadership

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Concordia University–Portland

2019

Abstract

Research literature shows that mathematics is a gatekeeper to success. Providing alternative opportunities for students to strengthen mathematical reasoning over algorithmic computations while problem-solving in a collaborative environment helps to prepare students to compete locally and globally. The purpose of this qualitative case study was to investigate how an afterschool Peer Tutoring Club (PTC) affected academic performances and attitudes of Grade 6, at-risk or "at-promise," (Samuels, 2020), middle school mathematics students. The gap found in literature revealed a need for additional research involving rigorous multistep problem-solving within peer tutoring programs. This study collected data from 46, 1-hour, afterschool peer tutoring sessions between December 2017 and May 2018. Six PTC tutees were selected as participants. The participants received cross-age and same age peer tutoring while utilizing a district aligned curriculum that consisted of multistep problem-solving. This dissertation addressed the gap found in literature by collecting qualitative and quantitative data from four instruments: (a) district's math pre/posttest, (b) Attitudes Toward Math Inventory (ATMI), (c) participants' work, and (d) participants' exit interviews. Descriptive statistics were used to analyze both qualitative and quantitative data. The data was triangulated to answer the two research questions. The findings from the PTC study supported theory and empirical study evidence that peer tutoring improved academic achievement and attitudes toward math.

Keywords: at-risk students, middle school mathematics discourse, peer tutoring, collaborative learning, metacognition, inclusive education, zone of proximal development (ZPD).

Dedication

This dissertation is dedicated in memory of my parents who passed on a legacy of hard work, resilience, and Faith. My mother's stories surrounding her experiences with the one room schoolhouse concept are still relevant today. Many thanks to my siblings; you were conduits through which many blessings flowed. To my three sons and daughter, thank you for serving as motivators, each in your own special way. Lastly, thank you to all who provided divinely appointed words of encouragement and support.

Acknowledgements

I would like to first and foremost acknowledge Jesus Christ as my Lord and Savior. He has been my Waymaker and Comforter throughout this dissertation process. I would also like to acknowledge and thank Dr. Jillian Skelton, my dissertation chair, and my dissertation committee members. Many thanks to the research site administrators, technology support staff, teachers, Peer Tutoring Club (PTC) facilitators and sponsor, PTC Guidance Counselor, tutors, tutees, and the parents of the PTC members who generously gave of their time and support.

With man this is impossible, but with God all things are possible.

(Matthew 19:26)

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Chapter 1: Introduction

Introduction to the Problem

The Council on Foreign Relations (2012) indicated that every child should have an equal opportunity to succeed. Mathematics, according to Hattie (2017), is the gateway to success, and mathematical literacy is a vital part of the equation that propels communication that leads to problem-solving. One of the five strands of mathematical literacy proficiency is strategic competence, which involves the student's ability to solve mathematical problems (Kilpatrick, 2001). The National Research Committee's (NRC) Mathematics Learning Study, which took place from January 1999 to June 2000, found that problem-solving provided a context that enabled all the strands of mathematical proficiency to be developed (Kilpatrick, 2001). Research provided in a study of 339 linguistically and socioeconomically diverse middle school students concluded that students with academic language deficits had difficulty keeping up with the pace of mainstream classrooms due to their academic language limitations (Townsend, Pilippini, Collins, & Bianca, 2012). These limitations in academic language, including the language of mathematics, can contribute to barriers to academic achievement, which may place the student at risk of failure. Research also showed that this at-risk population, which becomes more evident between sixth and ninth grade, is in jeopardy of dropping out of school (Legum & Hoare, 2004).

The mathematical literacy phenomenon is of state, national, and global concern because dropouts have increased rates of unemployment, high poverty, and incarcerations (Council on Foreign Relations, 2012). For example, 75% of the citizens between the ages of 17 and 24 do not qualify for military service due to criminal records, physical unfitness, or inadequate education levels; approximately 30% of high school graduates do not know enough mathematics, science, and English in order to pass the mandatory Armed Services Vocational Aptitude Battery

(Council on Foreign Relations, 2012). Additionally, 63% of life science and aerospace industries report that they are having difficulty finding Americans with the necessary skills (Council on Foreign Relations, 2012). Further, the U.S. State Department and intelligence agencies are facing critical shortages in language-designated positions, such as Chinese, Russian, Korean, and Turkish (Council on Foreign Relations, 2012). Therefore, providing alternative resources for students who are at-risk of failing mathematics, the gatekeeper to success, will help to change a trajectory that may lead to an increase in the school dropout rate (Hattie, 2017). These alternative resources that have a positive impact on self-efficacy in mathematics will also help to prepare students to collaborate and compete locally and globally (Falco, 2019; Hattie, 2017).

Background, Context, History, and Theoretical Framework for the Problem

ABC Middle School is an educational institution that serves students in grades six through eight. The school offers a wide range of course offerings including foreign languages, computer applications, band, chorus, and art. It is one of seven middle schools located in a southeastern city of the United States. This diversely populated school district's student population narrowly exceeds 20,000 according to a 2017 online national school rating organization. The 2016–2017, school-wide, PTC served approximately 20 heterogeneously mixed sixth-, seventh-, and eighth-grade tutees per week. On average, 10 teacher-recommended sixth-, seventh-, and eighth-grade students served as tutors during this afterschool peer tutoring program. Math teachers served as facilitators during the 2016–2017 school year for 1-hour sessions after school for 3 days per week.

ABC Middle School's Standard of Learning (SOL) scores for Grade 6, Course 1 and Grade 7, Course 2 Mathematics had remained below a 65% pass rate from 2014–2015 to 2016–2017 school years. The school has maintained accreditation status; however, the benchmark for these mathematics courses were not achieved. The state accreditation standard since 1999 was a 70% SOL pass rate in all four content areas (Board of Education, 2013). The 2017–2018 goal for mathematics was 73% (Board of Education, 2013; State Department of Education, 2014). The SOL pass rate for Course 1 during the 2014–2015 school year at ABC Middle School was 64%; however, the 2015–2016 and 2016–2017 pass rates decreased to 48% and 54% respectively. The Course 2 pass rate at ABC Middle School remained at 43% from 2014–2017 school years (Virginia Department of Education, 2018). These results showed that significant progress was needed in order to reach a 73% pass rate by the end of 2017–2018. The students in Course 1 and Course 2 mathematics represent approximately 24% of the sixth-grade and seventh-grade population of students at ABC Middle School. This population of students had consistently fallen below the state's benchmark for mathematics since the more rigorous 2009 VA SOLs were implemented during the 2011–2012 school year.

The afterschool mathematics tutoring club continued to serve as an alternative math resource during the 2017–2018 school year at ABC Middle School. This PTC invited and served a diverse group of students in an individualized way. As a result of the investigator's interest in exploring research-based interventions for students who struggled in mathematics, a case study proposal was submitted to the school district. The school district granted approval of the investigator's research proposal in 2017, which led to the implementation of this case study.

Students at risk of academic failure are a phenomenon that has multiple implications. Implications relating to low achievement scores on high stakes tests as a result of achievement gaps, stereotype threat, lack of hope and resiliency, and/or student discouragement are indicators that additional scaffolding resources are needed (Flannery, 2018; Kramer, 2016; Sagor & Cox, 2004; Steele, 1997). Additional scaffolding resources, such as peer tutoring, help to increase a student's self-efficacy and resilience (Hattie, 2012; Mark & Wells, 2019).

The early warning indicators for at-risk behaviors in middle school include an absentee rate of more than 80%, disruptive classroom behaviors, and a failing grade in mathematics or language arts (Mertens, Caskey, & Flowers, 2016). A longitudinal study that tracked 13,000, sixth grade students through high school graduation, was conducted by Robert Balfanz of Johns Hopkins University and his colleagues (Mertens, Caskey, & Flowers, 2016). They found that at-risk middle school students who demonstrated any of the four previously mentioned indicators had nearly a 75% chance of dropping out of high school (Mertens et al., 2016). The five essential emotional needs, according to Sagor and Cox (2004), are: (a) the need to feel competent, (b) the need to feel a sense of belonging, (c) the need to feel useful, (d) the need to feel potent, and (e) the need to feel optimistic. Learning environments that support the essential emotional needs and academic needs of all students will help to enable all students to be successful. Additionally, research-based interventions that encourage student collaboration, increased engagement, and peer tutoring on the secondary level in mathematics could also help to facilitate an environment that supports the needs of all students.

The gap found in research studies called for additional research pertaining to the solving of word problems and rigorous computation problems during peer tutoring sessions for middle school mathematics' general education and special education students (Morano & Riccomini, 2017; Mulcahy, Maccini, Wright, & Miller, 2014; Tsuei, 2014). The research site selected for this study enabled the researcher to investigate which Grade 6, Course 1, math students were not successful problem solvers and provide opportunities to ask "why?" (Hattie, 2012).

Peer tutoring provides more opportunities for students to engage in math communication, receive and give feedback, and gain additional practice. According to Farber (2009), “the most effective way to learn and grow is to go out and actually do the very things we are trying to learn” (p. x). This cross-age and same-age approach to peer tutoring helps to motivate both special and general education students to review key concepts (Bond & Castagnera, 2006; Hott & Walker, 2012).

The academic and social impact of student collaboration as it relates to peer tutoring was evaluated in this single descriptive case study. The primary focus of the PTC at ABC Middle School was to provide peer tutoring for at-risk sixth- and seventh-grade, Course 1 and Course 2, mathematics students. An academic club consists of a school approved group of students whose intent is to generate enthusiasm for a subject or topic, encourage involvement, and enhance achievement (Chen, 2016). A club environment helps to create a sense of belonging, a club quality that can encourage a belonging mindset among students whose academic performance is low and may feel stigmatized and marginalized. Implementing a peer tutoring intervention comprised of volunteer tutors and volunteer tutees is a less controlling approach and does not “stigmatize students who are in need of help” (Yeager, Walton, & Cohen, 2013, p. 64). Providing students more opportunities to participate in research-based interventions that promote academics and a sense of belonging supports student learning and achievement. The success of peer tutoring, according to research, refers to students working together in order to learn or practice academic tasks (NEA, 2015). Providing additional mathematics practice to a diverse population of middle school students required the implementation of a differentiated learning experience. Building trusting relationships between tutors and tutees, providing engaging tasks that incorporated iPad/Chromebook use, utilizing the research-based Edgenuity virtual tutoring program, and encouraging student input into lesson planning and delivery allowed participants to gain exposure to their peers' varied learning styles and multiple intelligences (Walsh, 1999). A student-centered, peer tutoring program helped to create a trusting environment that encouraged an acceptance of differences, challenged each student to work collaboratively, and stimulated an intrinsic desire to achieve.

Peer tutoring is not a new practice; it can be traced back to the ancient Greeks (Topping, 1997). Similarly, the "Little Red School House" concept of older children teaching younger children during 19th and early 20th century United States is reminiscent of the peer tutoring concept (Karst, 2003). The research from the 1960s, however, revealed a preponderance of data that indicated that a student's ability to learn was determined by circumstances outside of the teacher's control, such as social factors (Guskey, 1985). Social influences, especially at the middle school level, are significant (Guskey, 1985). Bloom's perspective indicates that these social factors, though influential, could be altered by providing feedback to students and implementing formative assessments paired with corrective activities (Guskey, 1985). Peer tutoring experiences are embedded in collaborative interchanges that include feedback and formative assessment interactions. Peer assessment, as well as a student's self-assessment and reflection, are forms of formative assessment (Spector et al., 2016). Enabling tutees to receive corrective feedback from peers and facilitators helped to create a collaborative environment that was conducive to active student engagement. Additionally, from the Vygotskian perspective, which has become more prominent in the past 20 years, student achievement is linked to the incorporating of tasks that encourage students to think, interact, and talk about their ideas (Brown, Solomon, & Williams, 2016).

Research Propositions

In order to maximize reliability and minimize errors and biases in case study, the use of research propositions in the case study protocol is recommended (Yin, 2014). Therefore, the researcher used two research propositions as guides to align data and to help facilitate theme development (Yin, 2014).

Proposition 1. Based on Vygotsky's theory, peer tutoring enables participants to make academic improvements in mathematics by working collaboratively with a knowledgeable peer.

Proposition 2. Providing opportunities for student success through peer tutoring interactions improves participants' attitudes towards mathematics.

The selection of this case serves as a reminder that more than 65 years ago the Supreme Court acknowledged education was not just a privilege but was a right of all American citizens (Blachett, Mumford, & Beachum, 2005). Providing learning opportunities through peer tutoring collaboration increases the rate of academic engagement, and as a result, improves academic achievement (Bowman-Perrott, Burke, Zhang, & Zaini, 2014). "Fundamental to Vygotsky's theory is the idea that higher mental functions, such as thinking, logical memory, and human consciousness, have their origins in human social life" (Beliavsky, 2006, p. 2). Vygotsky's Zone of Proximal Development (ZPD) supports the concept that teaching and learning is a "collaborative effort between the child and a more knowledgeable partner" (Beliavsky, 2006, p. 2). That more knowledgeable partner could be a parent, teacher, or a peer. Vygotsky's ZPD measures the difference between the child's independent performance and aided performance which he believed was a more accurate way to measure development or potential (Beliavsky, 2006). Hence, based on Vygotsky's theory, as the child profits from collaborative work, the child's ZPD increases, which enables the child to do better in school (Beliavsky, 2006).

Gardner's theory of multiple intelligences (MI) purports that the intelligent or knowledgeable student "makes use of the intelligence distributed throughout his environment" (Beliavsky, 2006, p. 6). This contextualized view of intelligence suggests that there are various ways of acquiring and demonstrating knowledge (Beliavsky, 2006). The acquisition and demonstration of knowledge can be related to Gardner's theory of multiple intelligences. Gardner indicated that there are seven intelligences: (a) logical-mathematical, (b) linguistic, (c) musical, (d) spatial, (e) bodily-kinesthetic, (f) interpersonal, and (g) intrapersonal (Gardner & Hatch, 1989). Gardner's later works emphasized that intelligence is activated within cultural settings to solve problems or create products; therefore, certain intelligences may or may not be valuable (McGee & Hantla, 2012). Incorporating Vygotsky's ZPD to increase mathematical rigor and Gardner's MI theory to expand the ZPD helps to maximize the potential of each student.

Sagor and Cox (2004) described students who were at risk of failure as defeated and discouraged learners. Peer tutoring, however, is a resource that can be used to change attitudes towards mathematics and other subjects for the tutors and tutees (Hattie, 2017; Morano & Riccomini, 2017; Worley & Naresh, 2014). Additionally, a review of literature on peer and cross-age tutoring by Robinson, Schofield, and Steers-Wentzell (2005) suggested that peer tutoring in mathematics can produce positive changes in academic, attitude, and emotional behaviors for tutors and tutees. These changes may be the result of a peer tutoring environment that allows students from diverse educational and social backgrounds to collaborate and learn together (Worley & Naresh, 2014). Additionally, Hattie's (2017) research findings showed that peer tutoring not only changes student attitudes towards being willing to try mathematics, but peer tutoring programs also have an effect on academic achievement.

Statement of the Problem and Gap in Literature

According to Mulcahy et al. (2014), previous literature reviews show a small number of documented studies involving K–12 mathematics interventions. For example, Lane (2004) studied K–12 students with Emotional or Behavioral Disorders (EBD) from 1990 to 2003 and determined that there were only 10 mathematics intervention studies conducted (Mulcahy et al., 2014). Of those studies, two were at the middle school level and none were conducted at the high school level (Mulcahy et al., 2014). Lane (2004), according to Mulcahy et al. (20l4), indicated that his study concluded that the mathematics focus areas for these studies were basic skills, which included minimal problem-solving. Additionally, Mulcahy et al. (2014), as a result of studying mathematics literature from 1975 to 2012, found a need and recommended more research involving a rigorous focus on math concepts and problems solving. An additional study conducted by Hawkins, Musti-Rao, Hughes, Berry, and McGuire (2009) revealed gains in student performance on multiplication facts; however, problem-solving—which will be a focus area for this study—was not evaluated. Tsuei (2014) similarly found during her research on the impact of a synchronous peer tutoring system that research showed that peer tutoring improved computational math skills for secondary school students with disabilities, but there was no significant change found in application math skills on state-wide tests. The majority of the studies targeted basic math skills; therefore, the effectiveness of peer tutoring for at-risk and students with disabilities still need to be investigated (Tsuei, 2014). Word problems are an integral part of high stakes testing for middle school mathematics students. The prevalence of this gap in the literature study calls for additional research pertaining to the solving of word problems and rigorous computation problems during peer tutoring sessions for middle school mathematics’ general education and special education students (Jitendra et al., 2015; Morano, & Riccomini, 2017; Mulcahy, Maccini, Wright, & Miller, 2014; Tsuei, 2014).

Purpose of Study

The purpose of this qualitative case study was to investigate how an afterschool PTC affected academic performances and attitudes of at-risk, middle school mathematics students. In 2006, new SOL tests were introduced that met the No Child Left Behind (NCLB) requirement for annual testing in reading and mathematics and required students to demonstrate a deeper mastery of content (VA Board of Education, 2013). Additionally, in 2009, a SOL test more rigorous than the 2006 test was developed. The 2009 SOL test emphasized college and career-ready mathematics along with alignment with Common Core State Standards (Board of Education, 2013; VA Board of Education, 2013). The new SOLs consisted of multistep word problems and technology enhanced open-ended problems (VA Board of Education, 2013). The 2012 superintendent for public instruction in the investigator’s state emphasized teacher collaboration on lesson plans as a best practice to aid in student success (Garrow, 2012). The state’s 2014 superintendent for public instruction indicated that the 2013–2014 gains in mathematics could be attributed to teachers focusing on problem-solving and real-world applications (Bogues, 2014). However, the pass rate in mathematics in the investigator’s study district from 2012–2013 to 2013–2014 increased from a 67% to 69%, respectively (Bogues, 2014). These SOL results showed that interventions, especially within the at-risk populations, were needed.

The significance of this study was rooted in its potential to provide empirical evidence that described how peer tutoring improved tutees’ academic achievement in mathematics, including multistep problem-solving, and improved tutees’ attitudes towards mathematics.

Additionally, the cognitive and social benefits of student collaboration through peer tutoring, and the student bonding that occurs during these interactions may serve as a conduit to positive student interactions.

Research Questions

Yin (2003, 2009, 2014) posited that the decision to use the case study method depends on the research question(s). These "how" questions will enable the investigator to gain an in-depth understanding of the participants' experiences in order to answer the following research questions:

RQ1. How did participants perceive the impact of the afterschool Peer Tutoring Club on their academic performances in mathematics?

RQ2. How did the participants perceive the afterschool Peer Tutoring Club's influence on their attitudes toward mathematics?

Rationale, Relevance, and Significance of the Study

Using data to guide instruction and frequent teacher and student feedback is an effective instructional tool (Hattie & Yates, 2013; Katz, 2016). Allowing students to contribute to the instructional process and to provide feedback to peers will challenge students to raise their expectations of themselves and their peers. The National Forum to Accelerate Middle-Grades Reform has identified three interlocking priorities of successful schools: (a) academic excellence—they challenge all students to use their minds, (b) developmental responsiveness—sensitive to developmental challenges and respectful of students' needs and interests, and (c) social equity, democracy, and fairness—provide students with high-quality teachers, resources, and supports (Lipsitz & West, 2006). Being accountable to staff, students, and the community requires a transparency that is supported by understanding the strengths and weaknesses of staff and students (Lipzitz & West, 2006). Part of that realization involves implementing improvement strategies that will increase student and teacher performance.

Peer tutoring is a research-based intervention that enables students to work together in order to learn or practice academic tasks (NEA, 2015). Research has shown that peer tutoring improves academic achievement and changes attitudes toward learning. There was a gap found in the peer tutoring research literature pertaining to middle school tutees solving word problems and solving rigorous computation problems. Jitendra et al. (2015) indicated that the low performance in the United States of learning disabled and at-risk students in mathematics suggests the need for more effective problem-solving interventions. This study addressed this gap in literature by examining middle school tutees' academic performance on multistep math problems, as well as, their changes in attitudes toward mathematics. The results of this study provide empirical evidence on the academic performance and attitude changes of a diverse group of at-risk middle school math students working within a PTC. The results of this qualitative case study may benefit school and district administrators, counselors, teachers, curriculum leaders, parents, and students.

Definition of Terms

Peer tutoring. Peer tutoring is a research-based activity whereby students work in pairs or small groups to help one another learn or practice academic tasks (Carter et al., 2015; Hattie, 2012; Morano & Riccomini, 2017). For the purposes of this study, students do not have to be the same age.

After-school mathematics PTC A volunteer-supported, student-run, and teacher-facilitated club where students meet after school between 4:00 pm and 5:00 pm in a safe, structured environment. This academic club is a school approved group consisting of students and facilitators whose intent is to generate enthusiasm for a subject or topic, encourage involvement, and enhance achievement (Chen, 2016). Club facilitators provide supervision while students work in pairs and small groups to help one another learn or practice academic tasks.

Students at risk/at promise in mathematics. Students who are in danger of failing their math course and/or not meeting local or state standards on high-stakes mathematics tests. "At-Promise," according to Samuels (2020), has more of a positive connotation, however, the definition for at-promise remains the same as the definition for at-risk. California law, however, as of January 1, 2020, prohibits the use of the term "at-risk" in the state's educational and penal codes (Samuels, 2020). Specific to this study, however, the participants selected either did not earn the minimum mathematics score of 400 on the fifth grade Standards of Learning (SOL) and/or did not receive a passing grade for their sixth grade first quarter marking period.

Attitudes toward mathematics. A student's attitude towards mathematics is defined in terms of positive or negative feelings and beliefs as they relate to responses to confidence/self-concept, value, enjoyment, and motivation associated with performance in mathematics (Ajisuksmo & Saputri, 2017; Tapia & Marsh, 2002). These feelings and beliefs can impact whether the student enjoys and values mathematics and is self-confident and motivated to learn mathematics.

Mathematics intervention. A targeted set of instructional techniques and tasks that are tailored to meet the needs of individual students (NEA, 2011). These mathematical strategies and tasks are designed to provide additional support to enable students to master grade level skills.

Assumptions, Delimitations, and Limitations of the Research Design

Assumptions. An assumption is an assertion that the investigator believes to be true, or reasonable (Gay, Mills, & Airasian, 2011). It was assumed that participants (tutees) might have felt apprehensive about giving candid responses to interview questions. Therefore, a focused interview protocol consisting of open-ended “nonthreatening” questions enabled the participants (tutees) to provide a fresh commentary in a conversational manner (Yin, 2009). In addition, the investigator elected to relinquish her roles as facilitator and sponsor of the PTC the year prior to the start of the research study. Of the 16 tutees in the PTC, six volunteered to participate in the study. None of the six participants (tutees) had been students of the investigator. This helped to minimize possible investigator and participant bias. The confidentiality policy, also, helped to alleviate fears of sharing and provided the participants with added assurance of confidentiality.

Delimitations. Delimitations are choices that the researcher makes pertaining to the guidelines that are implemented in order to bound or narrow the scope of the research (Creswell, 1994). This study confined itself to one PTC at a middle school in the southeastern part of the United States. Students enrolled in Grade 6, Course 1 math, and Grade 7, Course 2 math, who were recommended by their math teacher to participate as a tutee in the PTC were invited to participate in the research study. A small sample size of Grade 6, Course 1 math tutees met the requirements to participate in the study. Data was collected from each of the tutee participants within the PTC in order to determine the tutees’ perceptions within a single case design. This case study was, also, delimited to start and end dates. The collection of data started in December of 2017 and ended in May of 2018.

Limitations. A limitation is an aspect of the research study that the investigator cannot control but believes that this aspect of the research may negatively affect the results of the study (Gay et al., 2011). A purposive, nonrandom form of sampling, was used to select participants; therefore, bias could be introduced. Random sampling provides the best opportunity to obtain unbiased samples (Gay, 2011). Random sampling for the peer tutoring participants was not a viable option because students were permitted to participate based on teacher recommendations and parental recommendations and permissions. Nonrandom sampling and small sample size will not provide support for generalizability of findings to all after-school peer tutoring programs. According to Yin (2009), “case studies, like experiments, are generalizable to theoretical propositions and not to populations or universes” (p. 15).

Lastly, even though participants worked on Virtual Tutor’s Edgenuity online assignments during the afternoon tutoring sessions, they were also able to work on these assignments outside of the peer tutoring setting anywhere there was Internet and Chromebook/computer availability. The investigator would not be able to control participants’ availability of computer/Chromebook access and internet access outside of the peer tutoring setting. Therefore, extrinsic factors involving the completion of online assignments outside of the study site could influence the study findings.

Summary and Organization of Subsequent Chapters in Study

Knowledge sharing and trusting relationships are fundamental to building a collaborative culture. The sense of belonging that embodies a collaborative environment can increase productivity. Providing additional support to a middle school population at risk in mathematics who, according to Legum and Hoare (2004), are in jeopardy of dropping out of school helps to ensure the success of every student. Vygotsky’s theory supports the collaborative principles that are embedded in the peer tutoring culture. These principles are also aligned with the investigator’s district’s mission of doing whatever it takes to ensure the success of each student. While this research study focused on a purposive sampling of Grade 6, Course 1, PTC tutees who were at risk in mathematics, the gap in research was addressed by incorporating a curriculum that included multistep problem-solving. As a result, the PTC provided its diversely populated members the opportunity to transfer knowledge by communicating, interacting, and working together (Hislop, 2013) while engaging in multistep problem-solving activities. The interactions enabled students to share their strengths in innovative ways in order to help other students to be successful while purposefully sharing tacit and explicit knowledge (Rosen, 2013). Through collaboration, socially constructed and culturally embedded knowledge was shared which improved academic progress and attitudes towards learning mathematics (Hislop, 2013). In summary, this study was designed to provide additional empirical evidence as it relates to academic achievement and changes in tutees' attitudes toward mathematics within a middle school mathematics' PTC.

This dissertation consists of four additional chapters. Chapter 2 provides a review of literature which focuses on the attitudes and stigmas that are associated with students who struggle with mathematics and the literature pertaining to the importance of mathematics (gateway to success) for all students. The review explores theories surrounding social interactions and collaboration and their influence on student achievement and attitude changes. Additionally, methodological issues in the historical and current peer tutoring studies are explored, described, and critiqued in order to identify gaps in literature and to determine the dissertation's position within the framework of previous studies. Chapter 3 follows with a discussion of the study's methodology, which includes the design choice, processes and procedures, and guidelines for data collection within the Peer Tutoring Club at ABC Middle School. This methodology chapter is supported by the literature, which includes seminal authors and the use of a thematic structure that is linked to the research questions. Chapter 4 includes a description of the research sample, an overview of support provided to PTC facilitators, a description of orientation and training provided to tutors, a description of orientation provided to tutees, a description of the data collection and data collection procedures, the data analysis process, and a summary of the research findings. Lastly, in Chapter 5, the researcher assessed how the findings in Chapter 4 addressed the study’s research questions. The summary and discussion of the results includes a synthesis of the findings as they related to the empirical literature. The limitations, implications, and recommendations for further study were also discussed.

Chapter 2: Literature Review

Introduction to the Literature Review

Peer tutoring is not a new practice; it can be traced back to the ancient Greeks (Topping, 1997). The Little Red School House concept of older children teaching younger children during 19th and early 20th century America is reminiscent of the peer tutoring concept (Karst, 2003). Peers can influence learning by providing academic, social, and emotional support. This environment helps to create friendships and a sense of belonging (Hattie, 2012, 2017).

This chapter’s initial review of literature focused on the attitudes and stigmas that were associated with students who struggle with mathematics. I then transition to the importance of academic achievement for all students, especially in the area of mathematics. Hattie (2017) stated that mathematics is the gateway to success, and academic achievement influences an individual’s ability to obtain successful employment and adequate wages in adulthood (Fuchs et al., 2016; Phillips, 2013). The review explores theories that suggest social interactions and collaboration and differentiated teaching strategies can raise the level of potential development in students (Alegre-Ansuategui et al., 2018; Beliavsky, 2006).

The review then examines the literature surrounding peer tutoring studies conducted in K–12 education and higher education. Qualitative, quantitative, and mixed method research designs found in the literature were used by the researcher to scrutinize and analyze the effectiveness of peer tutoring on academic, social, and behavioral improvements on the elementary, secondary, and higher educational levels. Within this literature surrounding peer tutoring, researchers focused on the key attributes of peer tutoring, types and organizational methods, and the advantages and benefits of providing this resource as a viable option to students (Hattie, 2017; Morano & Riccomini, 2017; Olson, Roberts, & Leko, 2015; Topping, 2015, 2003;

Topping & Ehly, 2001). Databases used in this research study were JSTOR, Taylor and Francis, Sage Journals, Wiley Online, Science Direct, ERIC (ProQuest), Education Database (ProQuest), and Google Scholar. Key words used in the search were at-risk students, mathematics discourse, peer tutoring, collaborative learning, metacognition, inclusive education, and zone of proximal development (ZPD).

Attitudes and stigmas. Stigmas, half-truths, and distortions have been, and continue to be, associated with special education and regular education students who are at-risk of low performance (Kauffman & Badar, 2013; Sagor & Cox, 2004). Stigmas may be attributed to a lack of understanding and fear of the unknown. Fear, according to Hallowell (2011), "is the only true learning disability" (p. 54). Confronting and overcoming issues surrounding diversity in students' abilities will help to build the bridge towards acceptance of differences.

Due to the achievement gap in mathematics based on the National Assessment of Educational Progress (NAEP), several equity studies have been conducted, and, as a result, learning disabled (LD) and at-risk students have benefitted from standards-based mathematics instruction (Jitendra, 2013). The National Council of Teachers of Mathematics (NCTM) standards are strands of mathematics content which students should be able to understand and use as they progress from prekindergarten through Grade 12 (2017). These standards are descriptions of mathematics instruction in the following five content strands: (a) number and operations, (b) algebra, (c) geometry, (d) measurement, and (e) data analysis and probability (NCTM, 2017).

Word problems are in almost every strand of the mathematics curriculum from kindergarten through high school (Fuchs et al., 2016). Unfortunately, high stakes test results and students of all ability levels identify math word problem-solving as an area in need of improvement (Montague, Krawec, Enders, & Dietz, 2014). Performance on word problems, which according to Fuchs et al. (2016), is one of the best school-age predictors of achieving successful employment and wages in adulthood. However, the lack of empirical attention to the topic of multistep problem-solving raises questions as to how LD or at-risk students can fully access the content strands within the standards (Jitendra, 2013).

Jitendra et al. (2015) indicated that the “lackluster” performance in the United States of learning disabled and at-risk students in mathematics suggests the need for more effective problem-solving interventions. Access to the standards through research-based interventions that incorporate forms of learning recommended by the National Research Council (NRC) and NCTM, such as conceptual understanding, mathematical thinking, reasoning, and problem-solving will provide opportunities for student success (Jitendra, 2013; Montague et al., 2014; NCTM, 2017). More specifically, the NCTM Process Standards highlighted ways to acquire and apply content knowledge through problems solving, reasoning and proof, communication, connections, and representations (NCTM, 2017).

The use of mathematical communication, especially when solving word problems, provides opportunities for students to share ideas while using mathematical language to clarify their understanding through discussion and reflective practices (NCTM, 2017). Understanding and using the language of mathematics allows adolescents to increase their critical thinking abilities and move beyond number operations to more abstract problem-solving (Dunston & Tyminski, 2013). Collaborative learning provides more opportunities for student interactions and promotes mathematical literacy (NCTM, 2017). Common Core State Standards for Mathematical Practices (CCSSM) and NCTM Process Standards emphasize the importance of students being able to communicate their ideas and clarify understandings through listening, discussion, refinement, and reflection (NCTM, 2017; Worley & Naresh, 2014).

A Heterogeneous Peer Tutoring (HPT) program creates an environment where students from diverse educational, cultural, and socio-economic backgrounds can work together on key mathematical concepts (Worley & Naresh, 2014). Worley and Naresh's HPT study included 14, eighth grade, participants who worked on linear and nonlinear functions (2014). PreAlgebra tutees were paired with algebra tutors during a 4-month peer tutoring experience. This HPT model helped students to take ownership of their learning while improving math communication skills and developing positive attitudes toward math (Worley & Naresh, 2014). The findings from this study were not intended to be generalized; the intent was to share with other practitioners for future implementation (Worley & Naresh, 2014).

Peer tutoring interactions can not only raise academic achievement and change attitudes toward mathematics for the tutors and tutees, but these interactions can also help to remove stigmas associated with receiving tutoring (Daggett & Pedinotti, 2014; Robinson et al., 2005; Worley & Naresh, 2014). Inclusive practices inherent in student collaboration have helped to remove some of the stigmas associated with students with disabilities. The peer tutoring environment allows students from more diverse educational and social backgrounds to collaborate and learn together (Worley & Naresh, 2014). Additionally, Hattie's (2017) research findings showed that peer tutoring changes student's attitudes towards being willing to try mathematics.

School accountability. Academic achievement can define to what degree a person can take part in higher education and attain a sustainable livelihood (Steinmayr, MelBner, Weidinger, & Wirthwein, 2014). Additionally, academic achievement influences our nation's wealth and prosperity (Steinmayr et al., 2014). The importance of academic achievement for all students is reflected in changes in local, state, and national educational policy. With the passage of the Individuals with Disabilities Education Act (IDEA) of 1974, the No Child Left Behind Act of 2001 (NCLB), and the signing of its amended version the Individuals with Disabilities Education Improvement Act (IDEIA) of 2004, placed national attention on holding schools accountable for ensuring that all students' unique individual needs were met (Worley & Naresh, 2014). While the Every Student Succeeds Act (ESSA) of 2015 provided more flexibility as to how states increased the instructional rigor and provided comprehensive plans for closing the achievement gaps, the focus still remained on increased equity, improved instructional quality, and increased outcomes for all students (ESSA, 2014).

According to the National Center for Education Statistics (NCES), in 2013–2014, 13% of public school students—ages 3–21—received special education services (U.S. Department of Education, 2016b). Additionally, the 2015 and 2017 National Assessment of Education Progress (NAEP) reports indicated that 8 and 9%, respectively, of eighth grade students with disabilities achieved proficiency in math; whereby, 37% and 38%, respectively, of eighth grade students without disabilities achieved proficiency in math during 2015 and 2017 (Nation's Report Card, 2015; Nation's Report Card, 2017). Additionally, Black, Hispanic, Native Hawaiian/Other Pacific Islander, and American Indian/Alaska Native eighth graders achieved at or above proficiency ratings in mathematics between 18% and 29% during 2015 and 2017 (Nation's Report Card, 2017). These findings and IDEA's and ESSA's requirement of research-based instructional models and highly qualified teachers further led to widespread attention being placed on the standards by which schools were being measured.

Background of peer tutoring. The practice of peer tutoring can be traced back as far as the ancient Greeks, and research studies continue to show findings of academic, behavioral, and social benefits to both the tutor and tutee (Bonner, Keiler, & Mills, 2013; Hattie, 2017; Topping, 1996, 2003, 2015). The Bell-Lancaster system of peer tutoring was developed and named for two British educators (Fuchs, Fuchs, Mathes, & Simmons, 1997). Even though in 1817 over 100,000 children in England and Wales participated in this tutoring system, by the middle of the 19th century interest in peer tutoring decreased (Fuchs et al., 1997). In the United States, peer tutoring in the 19th and early 20th centuries within a one-room schoolhouse was common. However, peer tutoring was not rediscovered on a large scale until the late 1960s when American educators became concerned about underachievement among many poor and minority students (Fuchs et al., 1997). By 1970, according to Gerber and Kauffman, some type of after-school tutoring program had been implemented in more than 200 school districts within the Philadelphia, Pennsylvania and Newark, New Jersey areas as a result of their Youth Teaching Youth tutoring program (Fuchs et al., 1997).

Classroom Wide Peer Tutoring (CWPT) was created by University of Kansas researchers and teachers in the early 1980s as a way of providing help to students with learning disabilities or students from minority or disadvantaged backgrounds who were struggling academically (Arreaga-Mayer, 1998). Most of the research on CWPT since the University of Kansas study in the early 1980s has focused primarily on the effectiveness of peer tutoring in elementary schools (Ayvazo & Aljadeff, 2014; Maheady, Mallette, & Harper, 2006). Later, Fantuzzo and his colleagues developed the reciprocal peer tutoring (RPT) intervention as a cooperative strategy whereby students alternate between tutor and tutee roles and follow a structured format (Fantuzzo, King, & Heller, 1992). By having tutors and tutees to alternate roles during RPT sessions, study results revealed that better performance was achieved (Chu, Chen, & Tsai, 2017; Fantuzzo, King, & Heller, 1992). Chu et al.'s quasi-experimental designed study conducted in three elementary school classes in Taiwan consisted of 87 participants aged 10 to 11 years old (Chu et al., 2017). The experimental results from this study showed that the formative and conventional online peer tutoring methods improved academic achievement (Chu et al., 2017).

Increased curriculum rigor has led to more emphasis on higher order learning (HOL). Peer tutoring is an instructional strategy that can effectively target various types of learning objectives, including HOL objectives (Morano & Riccomini, 2017). One such HOL intervention called Peer Assisted Learning Strategies (PALS) originated in 1989 at Vanderbilt University. This intervention promoted both basic and higher order reading and mathematics skills (Fuchs & Fuchs, 2005; Fuchs, Fuchs, Mathes, & Simmons, 1997; Morano & Riccomini, 2017).

Peer-Led Team Learning (PLTL) which was revitalized in higher education in 1990 as a result of a dissertation written by Treisman in 1985 (Dreyfuss, 2013). Treisman's findings showed that calculus students were more successful in learning when they studied together than when they studied alone (Dreyfuss, 2013). As a result of these findings, City College of New York professor Gosser who was frustrated with the low numbers of students passing his General Chemistry courses applied for a grant with the National Science Foundation (NSF), and the first grant was awarded in 1991 (Dreyfuss, 2013). As a result of over 15 years of NSF funding, over 150 campuses in the United States have implemented PLTL workshops (Dreyfuss, 2013). The PLTL model continues to develop and has expanded to the high school level and continues to draw on the "untapped resource" of students as peer leaders (Dreyfuss, 2013).

The Peer Enabled Restructured Classroom (PERC), a PLTL model, is a National Science Foundation (NSF) funded partnership. PERC consists of high schools, higher education institutions, district administrations, and school support organizations referred to as the Math and Science Partnership in New York City (Bonner et al., 2013). PERC is a research-based, peer-facilitated instructional project that supports STEM academic development among urban high school students (Bonner et al., 2013). The PERC model is comprised of teacher recommended, trained tutors called Teaching Assistant Scholars (TA Scholars) who passed the math or science course and associated Regents exam the prior year (Bonner et al., 2013). Seven to eight TA Scholars assist tutees for 30 minutes of every class period while the teacher facilitates (Bonner et al., 2013). In addition to serving as facilitators, the teachers are instrumental in identifying their professional development needs and are vital stakeholders in the professional development process (Bonner et al., 2013). This collaborative process among teachers, TA Scholars, and tutees helps to eliminate classroom management problems, increases student time on task, and deepens cognitive demands (Bonner et al., 2013).

A PERC pilot study between 2008 and 2010 showed that the impact of PERC on the performance of students enrolled in Integrated Algebra (IA) and Living Environment (LE) classes was significant. Results from five New York City schools revealed that the students' pass rates on the Regents exams in PERC classes consistently surpassed the pass rates of non-PERC classes (Bonner et al., 2013). This in-class tutoring approach has proven to be successful in improving mathematics and science achievement for historically under-performing groups in urban high schools (Bonner et al., 2013).

For more than 40 years, various research studies of multiple types of peer tutoring interventions which included in class and after school arrangements have been applied in mathematics, reading, writing, social studies, science, and physical education for general education and special education students (Chu, Chen, & Tsai, 2017; Worley & Naresh, 2014).

These implementations have been successful with regular, special education, low achieving, and language minority students in kindergarten, elementary, middle school, high school, and college level environments (Arreaga-Mayer, 1998; Daggett & Pedinotti, 2014; Dietrichson, Bøg, Filges, & Jørgensen, 2017; Fuchs et al., 2016; Hattie, 2017).

Theoretical Framework

In this study, the theoretical framework was derived from Vygotsky's ZPD theory and Gardner's MI theory. Both theories emphasize the importance of social interactions and the exposure to multiple viewpoints as crucial factors to cognitive development (Beliavsky, 2006).

Vygotsky's ZPD. The Vygotskian perspective, which has become more prominent in the past 20 years, links student achievement to tasks that encourage students to think, interact, and talk about their ideas (Brown, Solomon, & Williams, 2016). These group interactions, especially small group interactions within a peer tutoring environment, can produce significant results and proceed according to theory (Alegre-Ansuategui et al., 2018). Peer tutoring is reflective of Vygotsky's theory that (a) supports social interactions as a catalyst for learning and (b) makes sense of solution strategies. According to Piaget, this learning from others or *social transmission* influences cognitive development (Woolfolk, Winne, & Perry, 2000).

"The role of instruction for enhancing cognitive development is a joint activity—a collaborative effort between the child and a more knowledgeable partner, such as an older sibling, a parent, a teacher, etc" (Beliavsky, 2006, p. 2). Vygotsky's theory of cognitive development supports the peer tutoring concept of providing a "knowledgeable" partner to raise the threshold or level of potential development of students (Beliavsky, 2006). The knowledge sharing that occurs during peer tutoring utilizes a student's willingness and ability to convert tacit knowledge into explicit knowledge through social interactions.

Gardner's MI theory. Gardner's belief that people are not innately smart or dumb supports the mindset that all students—general and special education students—are capable of making progress (Winn, 1990). In "Profile: Howard Gardner," during an interview with David Fernie, Gardner shared that he believed that there are many different kinds of intelligence (1992). Gardner's MI theory suggests that each person has seven to eight intelligences (Beliavsky, 2006). The implications of the MI theory provide teachers with an understanding of the importance of using varied teaching strategies and styles in order to incorporate multiple viewpoints and in order for students to better understand their physical and social world (Beliavsky, 2006). Based on Gardner's theory of MI, without the cultural and social opportunities, intelligence may not be realized (Beliavsky, 2006).

Summary. Vygotsky's Zone of Proximal Development (ZPD) and Gardner's Multiple Intelligence Theory (MI) suggest that cognitive development occurs as a result of social interactions (Beliavsky, 2006). Peer tutoring, not only results in positive academic and behavioral gains, but the supportive peer tutoring environment also helps to eliminate the stigma that students feel toward needing help or asking for help (Daggett & Pedinotti, 2014; Robinson et al., 2005; Worley & Naresh, 2014). This untapped resource of peer leaders (Dreyfus, 2013) can be utilized in various peer tutoring approaches, such as, CWPT, PALS, RPT, cross-age tutoring, and PERC. These collaborative interactions can be in class or after school arrangements and can be applied in mathematics, reading, writing, social studies, science, and physical education for general education and special education students (Chu et al., 2017; Worley & Naresh, 2014). Because regular education, special education, low achieving, and language minority students in kindergarten, elementary, middle school, high school, and college can benefit from peer tutoring, this resource supports the culture of ensuring that each student has equitable access in order to obtain mathematical proficiency (NCTM, 2000). Both Vygotsky's and Gardner's theories pertaining to the cognitive benefits of social interactions support peer tutoring as a viable intervention for academic achievement and positive changes in attitudes toward mathematics.

Review of Research Literature and Methodological Literature

A review of literature pertaining to the attributes of peer tutoring, types of peer tutoring, methods of peer tutoring, and effectiveness of peer tutoring was systematically analyzed and described in order to provide an in-depth understanding of peer tutoring. The literature showed evidence that peer tutoring has been used successfully in K–12 through higher education in various content areas. The goal of this review was to determine how and why peer tutoring impacts academic and attitude changes in students.

Key attributes of peer tutoring. The National Education Association (NEA) described peer tutoring as a research-based activity whereby students work in pairs to help one another learn or practice academic tasks (2015). A peer tutoring intervention encourages student collaboration, promotes student engagement and positive attitudes toward mathematics, and helps to improve student academic achievement (Franca, Kerr, Reitz, & Lambert, 1990; Hott & Walker, 2012; Worley & Naresh, 2014). Both tutor and tutee show improvements in academic achievement and attitudes toward learning (Hott, Walker, & Sahni, 2012). Key attributes of peer tutoring are (a) frequent verbal interaction and feedback, (b) positive reinforcement, (c) teacher or facilitator monitoring, (d) structured higher level thinking activities, and (e) supportive learning environment (Hattie, 2017; IRIS Center, 2010; Worley & Naresh, 2014). These key attributes of peer tutoring are instrumental to a successful intervention for at-risk mathematics students.

Frequent verbal interaction and feedback. Learning takes place during social interactions, and peer-mediated activities require students to engage in discourse (Dobbins, Gagnon, & Ulrich, 2014). Frequent verbal interactions and feedback were found throughout the literature. Peer tutoring generates verbal interactions and frequent opportunities for feedback. This communication and scaffolding of concepts which occur between learners help to develop a zone of proximal development (Vygotsky, 1978) that enables the learner to process information more effectively. When processing information within a peer tutoring environment, students are able to talk about their thinking processes. A metacognitive approach is essential when articulating the thought processes involved in solving word problems (Bernadowski, 2016). A study of 103 high school mathematics' students in Indonesia reported that metacognitive knowledge and metacognitive regulation were important aspects of learning (Ajisuksmo & Saputri, 2017). During peer tutoring interactions, questions, such as, "what is this problem all about?" is an example of a metacognitive comprehension question that can be used to improve mathematical reasoning (Coles, 2013). The National Council of Teachers of Mathematics (NCTM) standards (2000) recommend the use of interactive groups, which include direct questioning, feedback, and reflective practices.

Using the language that applies to mathematical concepts during pair and group discussions supports the acquisition of relatable math terminology (Topping, Campbell, Douglas, & Smith, 2003). This idea further supports peer tutoring as a venue that provides opportunities for students to explain and justify solution methods to one another, thus placing demands on communication skills (Topping, 2003, 2015; Topping et al., 2003). The non-threatening or relatively private environment that is created when working in pairs and small groups is an effective way for students to communicate mathematically (NCTM, 2000). The mathematical engagement that comes as a result of these interactions during peer tutoring assists students who are having difficulties to self-monitor while engaging with partner (Dobbins et al., 2014).

The majority of the research surrounding peer tutoring has been conducted in elementary schools or on the undergraduate level (Thomas et al., 2015). However, the results of a two-year quasi-experimental study which used an instructional model called the Peer Enabled Restructured Classroom (PERC) showed that peer tutoring had a positive effect on math achievement for a group of at-risk secondary students (Thomas, Bonner, Everson, & Somers, 2015). The PERC study included over two hundred Grade 9 and Grade 10 participants during each of the 2-year periods from six schools where 25% to 55% of students were failing the end of year examination in Integrated Algebra (Thomas et al., 2015). Frequent verbal interaction/questioning and feedback were considered to be particularly important in PERC (Thomas et al., 2015).

Positive reinforcement. Interventions that provide positive reinforcement for students with or without special needs can change attitudes toward learning. Peer tutoring requires tutors to use their communication skills in order to praise successes, encourage possibilities of success, express concern for students, express sympathy and empathy, and to reinforce tutees' feelings of ownership and control (Mackiewicz & Thompson, 2013). In this learning process of listening and communicating, both tutor and tutee are influential in developing cultural norms of helping and caring (Hattie, 2012; Topping, 2015).

Teacher or facilitator monitoring. "Educating our children is the most important task we face" (Ladson-Billings, 2013). Research suggests that special and general education teachers have difficulty interpreting and accessing the general education or core curriculum for all students (Dymond, Renzaglia, Gilson, & Slagor, 2007). Research based interventions, such as peer assisted programs, are valuable resources for providing academic and social learning experiences for at risk, disabled, and nondisabled students (Dymond et al., 2007; Hattie, 2017). These interventions, however, are dependent on the monitoring and facilitation practices of teachers and paraprofessionals. Facilitating discourse during student collaboration without curtaining students' initiative and ownership will help to strengthen engagement as it relates to the mathematical activity (Francisco, 2013).

In 2015, 94.8% of the 6,050,725 students ages 6 through 21 were served under IDEA while inside of the general education class for at least 80% of the school day (40th Annual Report, 2018). Peer assisted interventions can be implemented within the general education classrooms, as well as, within a supplemental morning or afterschool program. General education teachers, special education teachers, and/or paraprofessionals who serve as facilitators can monitor and provide guidance (Carter et al., 2015).

Research findings in an article written by Carter et al. (2015) suggest that the implementation and facilitation of peer support arrangements by teachers and paraprofessionals is one way of enabling the disabled and nondisabled students to benefit academically and socially. The article provides evidence from the authors' partnership with 21 high schools during a 4-year period across two states that tutors and tutees with the help of facilitators benefit from peer supported interactions (Carter et al., 2015). These findings, also, suggest that facilitators in secondary peer supported interventions can guide the peer interactions by (a) developing a peer support plan, (b) selecting and inviting peer partners, (c) orienting students to their roles, and (d) maintaining active monitoring during student interactions (Carter et al., 2015; Zambrano & Gisbert, 2015). One of the focal areas for the study conducted by Zambrano and Gisbert (2015) was to learn about the processes and management strategies used by the facilitators. This quasi-experimental and qualitative study was conducted in Spain and consisted of 127 elementary students whereby both students and families received three 1-hour sessions of initial training that discussed pairings, methodology training, tutor and tutee roles, and tutor/tutee norms (Zambrano & Gisbert, 2015). Similarly, researchers conducted a 3-year Class Wide Peer Tutoring (CWPT) study at three urban middle schools and one suburban middle and observed 75 students who were nominated by their teachers as low performers (Kamps et al., 2008). The results for this middle school study were similar to the elementary and high school studies in that findings indicated that facilitator monitoring promoted safe, structured, and productive learning environments where learning was accelerated for disabled and nondisabled students (Kamps et al., 2008)

Structured higher-level thinking activities. Vygotsky defined the Zone of Proximal Development (ZPD) as “the distance between the actual developmental level as determined by independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers” (Vygotsky, 1978). Vygotsky’s ZPD, according to Gredler (2012), requires the use of a child’s higher cognitive functions which are developed between ages seven and 12. Peer tutoring tasks can therefore include learning involving vertical relationships and conceptual understanding (Gredler, 2012). Also, the Socratic dialog of questioning and analyzing which occurs during peer interactions (Eun, 2017) generates higher levels of thinking for tutors and tutees. The cognitive demands on both tutor and tutee are embedded in communication skills (Topping, 2015; Topping & Ehly, 2001). “A participant might never have truly grasped a concept until having to explain it to another, embodying and crystallizing thought into language—another Vygotskian idea” (Topping, 2015, p. 5). Listening, explaining, questioning, summarizing, speculating, and hypothesizing are cognitively demanding skills that are present in peer tutoring interactions which provides opportunities for more rigorous tasks (Topping, 2015).

Supportive learning environment. Peer support is an integral part of young adolescents' quest for independence and freedom (Hester, Gable, & Manning, 2003). Having the opportunity to learn in a judgement free environment with peers fosters richer content-based discussions (Worley & Naresh, 2015). These content-based discussions are an integral part of peer tutoring.

A Heterogeneous Peer Tutoring (HPT) group of study participants consisting of middle school prealgebra tutees and algebra tutors worked in a supportive environment and realized that struggles could be embraced as a vital component of the learning process (Worley & Naresh, 2015). This HPT study by Worley and Naresh (2015) incorporated program attributes that were outlined in the Association for Middle Level Education's (AMLE) position paper from (NMSA, 2010) by (a) facilitating a safe and inclusive learning environment, (b) engaging tutors and tutees in active and purposeful learning that enabled them to be more receptive to challenging math tasks, and (c) empowering all participants to learn mathematics. Student engagement can be enhanced by incorporating the use of technology. A study by Yang, Cheng, and Chan (2016) revealed that the performance of the experimental group (RPT with computers) outperformed the control group on the math assessment (Yang, Cheng, & Chan, 2016).

Tutors and tutees share a similar discourse. Vygotsky' sociocultural theory (SCT) suggests that knowledge is co-constructed between a more and a less knowledgeable person (Shabani, 2016; Vygotsky, 1978). Mathematical discourse is an affective process that includes the purposeful exchange of ideas through verbal discussions and visual and written communications (NCTM, 2014). The facilitation of meaningful mathematical discourse is one of eight mathematical teaching principles that provides the framework for teaching and learning mathematics (NCTM, 2014). In examining peer tutoring as a viable resource to support students who were struggling in mathematics, studies revealed student discourse emerged as a result of carefully constructed activities and trained peer leaders, and showed evidence that students talked through the problem-solving process, wrestled with alternative perspectives, used content specific language to discuss problems, and learned to reflect on their own learning (Repice et al., 2016; Yang et al., 2016).

Financially efficient alternative. Peer tutoring is a cost-effective research-based resource when compared to other interventions (Thomas et al., 2015; Topping, 1996, 2005). Because teachers are able to spend more time facilitating student pairings, teachers can effectively serve more students (Topping, 1996). Research shows that peer tutoring provides more achievement per dollar than computer assisted instruction, class size reduction, and lengthening the school day (Martino, 1995).

Federal legislation as indicated in Every Student Succeeds Act (ESSA, 2015) mandates that evidence-based practices (EBPs) are supported by scientifically based research in order to meet the needs of each student (Hughes, Powell, Lembke, & Riley-Tillman, 2017). The government will provide funds for eligible students from Title 1 schools to receive Supplemental Educational Services (SES) provided through the Elementary and Secondary Education Act. SES are available to students from low-income families who are enrolled in Title I schools in the second and subsequent years of school improvement. Peer tutoring, however, is a more cost-efficient way of providing research-based and evidence-based supplemental services. This support meets the requirement for ensuring that the benefits and costs associated with providing effective interventions are considered when determining the least restrictive environment.

Types of peer tutoring. The four common types of peer tutoring are (a) cross-age tutoring, (b) Peer-Assisted Learning Strategies (PALS), (c) Reciprocal Peer Tutoring (RPT), and (d) Classwide Peer Tutoring (CWPT; Bond & Castagnera, 2006; Wexler et al., 2015). Cross-age tutoring pertains to older students tutoring younger students; PALS involves a structured method of tutoring in math or reading that occurs two or three times per week for approximately 30 minutes. RPT is a structured routine of tutors and tutees alternating roles while teaching, evaluating, and encouraging one another. Research has shown that reciprocal peer tutoring had higher gains in subjects such as language arts and social studies for students with emotional and behavioral disorders (Wang, Bettini, & Cheyney, 2013). CWPT is an approach that pairs a student with lower academic ability with a student with higher academic ability within a classroom setting (Bond et al., 2006; Wexler et al., 2015).

A study conducted by Franca, Kerr, and Lambert (1990), examined the effects of same-age peer tutoring on eight behaviorally disordered middle school students. Math achievement and social and attitude changes were measured and showed improvement in the participants' understanding of fractions and showed improvement in their attitudes toward mathematics. The synthesis of Hattie, Fisher, and Frey's (2017) meta-analyses, which included over 70,000 studies and 300 million students, was used to determine best practices in education. The findings from these studies revealed that peer tutoring increased engagement, problem solving abilities, and improved the students' abilities to judge their reasoning and other's reasoning (Hattie et al., 2017). Additionally, a heterogeneous peer tutoring study conducted by Worley and Naresh (2014) revealed improvements in mathematics and improvements in attitudes toward math for the tutor and tutee. The results of these studies revealed that the implementation of different types of peer tutoring models provides pertinent information that supports academic achievement and positive changes in attitudes for both the tutor and tutee (Hott, Walker, & Sahni, 2012).

Methods of peer tutoring. The methods used during peer tutoring interactions can be scaffolded with structured materials or interactive behaviors and effectively geared towards any materials of interest (Topping, 2015). Topping (1996) used 10 typological dimensions to describe peer tutoring. Topping and Ehly (2001) expanded this list to include three additional dimensions—Within or between institutions, Voluntary or compulsory, and Reinforcement—which increased the typological dimensions' list to 13 peer tutoring organizational methods that can be used. Topping and Ehly's (2001) organizational methods used to describe peer tutoring included curriculum content, grouping size and makeup of groups, as it pertains to homogeneity or heterogeneity, role continuity, time and place, tutor and tutee characteristics, objectives of intervention, voluntary or compulsory participation, and intrinsic motiviation or extrinsic reinforcement.

There are many types of peer tutoring programs; however, the organizational methods described by Topping and Ehly (2001) are found in peer tutoring studies in the What Works Clearinghouse (WWC). The WWC was established in 2002 within the Department of Education to review research, determine which studies met rigorous standards, and summarize the findings (What Works Clearinghouse, n.d.). When care is taken to implement a purpose driven peer tutoring intervention that best fits the population, research shows that there are significant academic gains for the tutor and tutee (Hattie, 2012; Topping, 2015)

Effectiveness of peer tutoring. Arranging students in pairs and asking them to work together is not a recommended strategy that leads to successful peer tutoring results. Determining the effectiveness of an intervention reveals the magnitude of its influence on student learning

(Hattie & Yates, 2013). According to Hattie and Yates (2013), "All interventions are likely to work: the question then should be what is the magnitude of any intervention?" (p. 24).

Encouraging collaborative interactions between middle school students helps to create trusting and supportive relationships. Implications for practice from a 128-participant meta-analysis consisting of single case designs on the effects of peer tutoring in pre-K through Grade 12 indicated that peer tutoring can be implemented in general, special, and alternative education settings with a high rate of academic engagement, in addition to, social and behavioral benefits (Bowman-Perrott et al., 2014). Because the peer tutoring atmosphere feels safe and is conducive to learning, it counteracts the peer victimization mindset (Swearer, Espelage, Vaillancourt, & Hymel, 2010). Lack of effective communication between students can lead to misunderstandings. Within a peer tutoring program, mathematical communication is emphasized.

According to Robinson et al., 2005, students who participated as tutors or tutees had improved classroom behaviors, increased attendance, and exhibited more positive behaviors toward school. Similarly, an action research, mixed method designed study of a same and cross age peer tutoring program at a suburban middle school revealed that 67% of the participants indicated that the program was somewhat helpful to very helpful (Grubbs & Boes, 2009). The tutoring program was comprised of 25 participants and was made available to students who needed assistance in mathematics, language arts, organizational skills, social studies, and science. Most of the students (67%) came because they needed help with mathematics (Grubbs & Boes, 2009). It was also observed by the researcher that the students who attended regularly were not very social with their peers outside of the tutoring program and liked the positive interactions within the tutoring environment (Grubbs & Boes, 2009). Additionally, an article by Olson, Roberts, and Leko (20l5) discussed how peer supports can be used as a resource to provide students with autism additional support as they access the general education curriculum. These supports can lead to increased social interactions, academic improvements, and increased student engagement (Olson et al., 2015).

Peer support according to Olson et al. (2015), is one part of a three-tier framework whereby teachers select, train, and facilitate same age tutors to support students with autism in accessing the general education. The use of multiple strategies and interventions help to ensure that students with disabilities and other at-risk students have full access to the general education curriculum. A study conducted by researchers involving reciprocal peer tutoring reports that participants demonstrated an increase in on-task behaviors and exhibited more self-control (Robinson et al., 2005). A cross-age peer tutoring study involving mathematical vocabulary with the use of games was conducted in Scotland where 11-year olds served as tutors and 7-year olds served as tutees (Topping et al., 2003). The majority of these triangulated findings for this pretest posttest design study were positive (Topping et al., 2003). These types of findings support the positive impact of peer tutoring experiences on tutors and tutees.

Okilwa and Shelby's (2010) synthesis of 12 peer tutoring studies examined the academic performance of students with disabilities in Grades 6 through 12. These 12 original studies were all published in peer-reviewed journals and their findings showed that peer tutoring has a positive academic effect on students with disabilities in Grades 6 through 12 (Okilwa & Shelby, 2010). This developmental age for students in Grades 6 through 12 is receptive to peer interaction and association (Okilwa & Shelby, 2010). CWPT was initially designed for at risk elementary students in reading and mathematics, but has generalized to higher grade levels (Ayvazo & Aljadeff-Abergel, 2015; Buzhardt, Greenwood, Abbott, & Tapia, 2007). A Classwide Peer Tutoring (CWPT) study was conducted at an inner-city charter school in the U.S. with 71 special educational and social needs students in physical education classes (Ayvazo & Aljadeff-Abergel, 2015). During this study 41, third grade students, and 30, eighth grade students received 2 to 3 hours per week (respectively) of CWPT lessons (Ayvazo & Aljadeff-Abergel, 2015). The study concluded that this evidence-based instructional strategy held the following multiple benefits for student learning: (a) high opportunities to respond, (b) development of fundamental social skills, and (c) performance improvement subsequent to immediate feedback (Ayvazo & Aljadeff-Abergel, 2015).

Doing more with less has increased interest in peer tutoring in higher education (Dreyfuss, 2013; Topping, 1996). Increased class sizes coupled with a traditional lecturing style of teaching creates less interactive teaching and learning (Dreyfuss, 2013; Topping, 1996). Researchers Moust and Schmidt (1993, 1994b), according to Topping (1996), found during an eight-week problem-based law course that dyadic interaction along with structure was associated with gains in achievement on pretest–posttests.

The effectiveness of peer tutoring as an intervention is evident in both conceptual and empirical research studies. In addition to the cost effectiveness of peer tutoring, the magnitude of these interventions on student learning is revealed in the academic, social, and behavioral benefits (Bowman-Perrott et al., 2014; Hattie & Yates, 2013; Thomas et al., 2015). The encouraging and collaborative interactions within the peer tutoring environment also helps to reduce the peer victimization mindset that may be present during adolescence years. Because adolescents are receptive to interacting with peers, peer tutoring becomes a viable resource whereby students can participate in academic collaborations and socialization interactions.

Review of Methodological Issues

Even though there is a preponderance of evidence that shows that peer tutoring has a positive effect on academic achievement and student attitudes, the gap found in literature revealed a need for additional research involving rigorous multistep problem-solving within peer tutoring programs on the secondary level. Additionally, there is a gap or lack of recent qualitatively designed studies, especially, case studies. Furthermore, most CWPT and other peer tutoring studies do not give recommendations for age specific pedagogy (Ayvazo & Aljadeff, 2014). This concern was noted in the article on CWPT within a physical education's martial arts class for third and eighth grade students. The students attended a charter school, and according to Ayvazo and Aljadeff, staff had the freedom to implement more innovative programs with the goal of improving student achievement (2014). The authors, also, suggested tailoring the pedagogy to include goal setting, especially for secondary students. Even though the reward incentives helped to motivate the third graders (Ayvazo & Aljadeff, 2014) and the fourth and fifth graders in the Fantuzzo et al.'s (1992) study, the extrinsic public postings in the Ayvazo and Aljadeff's study were not as effective for the eighth-grade students.

The Fantuzzo et al.'s (1992) RPT study consisted of 64 randomly selected fourth- and fifth-grade students in Philidelphia who were at high risk of failure. The study included four conditions: (a) structure plus reward, (b) reward, no structure, (c) structure, no reward, (d) no reward, no structure. The use of structure and group reward contingencies yielded the highest academic gains out of the four conditions implemented in the study (Fantuzzo et al., 1992). Additionally, one of the major instructional components of peer tutoring models, such as, CWPT, PALS, START, and Classwide Student Tutoring Teams (CSTT) is contingency rewards (Maheady et al., 2006). A CWPT math facts fluency study involving eleven, 10 and 11 year old participants within an urban charter school was conducted by Hawkins et al. (2009). The 15-week experimental designed study was facilitated by the math teacher and observed by the researcher twice a week for 15 minutes each session. The group contingency was facilitated by the math teacher and randomized in two parts—target behavior and/or 100% fact accuracy. This study provided additional evidence of significant gains in fact fluency during a structured CWPT program with randomized group contingency (Hawkins, 2009).

Contrastingly, Bowman-Perrott et al.'s (2014) meta-analysis of 20 peer tutoring studies support the use of rewards for students with learning disabilities, students with disruptive and off-task behaviors, and secondary students. Ayvazo and Aljadeff's study, also, suggests that secondary students be included in the process to determine if rewards should be given or what type of rewards should be considered during the implementation of peer tutoring programs (2014).

According to Topping (2014), studies with extrinsic rewards were more common in North America than elsewhere. Additionally, studies that emphasized higher order learning in mathematics (Bonner et al., 2013; Nawaz & Rehman, 2017; Worley & Naresh, 2015) relied more on intrinsic motivation for the tutors and sometimes the tutees as well. In Worley and Naresh's HPT program, students were able to take ownership of their learning, improve mathematical communication skills, develop peer relationships, and enhance their attitudes towards mathematics while studying linear and nonlinear functions (2015). These types of intrinsically derived benefits enabled the students to reach their goals. Additionally, the extrinsic reinforcements that were made available went beyond social praise and public postings to include certification, course credit, or tangible reinforcements such as money (Topping, 2015).

Synthesis of Research Findings

This literature review supports peer tutoring as an effective resource for at-risk students who need more than classroom instruction (Daggett et al., 2014). National and international studies recommend highly structured peer tutoring programs that include tutor training and facilitator monitoring. The majority of the studies used a quasi-experimental design. Classwide Peer Tutoring (CWPT) and Reciprocal Peer Tutoring (RPT) models were more frequently found in the literature. Even though CWPT was initially designed for at risk elementary students in reading and mathematics, it has been generalized to higher grade levels.

Peer tutoring studies on the elementary level outnumbered studies conducted on the secondary level. However, studies conducted on the secondary level revealed that this developmental age, Grades 6 through 12, were receptive to peer interaction and association (Okilwa & Shelby, 2010). Historically, drill and practice and procedural concepts and routines have been incorporated during peer tutoring with an emphasis on outcome over process (Topping, Campbell, Douglas, & Smith, 2003). More recently, studies on the effects of peer tutoring have included more rigorous content, more content areas, varied lengths of programs, different ages and ability levels of tutors and tutees, and various outcomes depending on the population of participants.

The common tread in peer tutoring studies is that peer tutoring programs show positive outcomes in academics and attitudes in both the tutor and tutee (Hattie, 2012; Robinson et al., 2005; Worley & Naresh, 2014). At-risk students, whether special needs students or general education students, with varying levels of academic, behavioral, and emotional challenges, work effectively in the peer tutoring environment (Dietrichson, Bøg, Filges, & Klint Jørgensen, 2017; Okilwa & Shelby, 2010; Wang, Bettini, & Cheyney, 2013). Because the majority of the peer-mediated intervention research has been on the elementary level, more research is needed on the secondary level, especially in mathematics, to add to the body of evidence on the effectiveness of peer tutoring for secondary students (Wexler et al., 2013). Although, a large percentage of research involving math peer tutoring pertains to lower level skills, more of the recent studies are based on more rigorous, cognitively demanding concepts. However, more research is needed to investigate the effectiveness of peer tutoring with multistep computation problems and word problems as opposed to lower level computation skills (Mulcahy et al., 2014; Tsuei, 2013). Classwide Peer Tutoring (CWPT), a form of peer-assisted instruction that enables a broad range of students within a class period to be grouped into tutoring dyads is a viable alternative to an after school or before school program (Tsuei, 2013). In the study conducted by Kamps et al. (2008), 975 middle school students in 52 classrooms, Grades 6 through 8 participated in the CWPT studies in reading, social studies, and science. Although math was not included in this study, it is worth noting that CWPT findings indicated that this intervention was more effective when activity formats, such as, multiple opportunities for students to actively engage in content materials were available (Kamps et al., 2008). Content materials involving problem-solving provides opportunities for higher level learning.

Critique of Previous Research

The procedures for the implementation of peer tutoring interventions included tutor and tutee training, pairing/grouping arrangements by facilitator, structured curriculum-based assignments, evaluation of performance, systematic feedback, error correction, and progress monitoring with or without rewards. The majority of the reviewed studies were experimental or quasi-experimental designs. Quasi-experimental designs are like experimental designs in that they both test causal hypotheses, however, a quasi-experimental design lacks random selection

(White & Sabarwal, 2014). The quantitative methodology used in the experimental and quasi-experimental studies enabled the researchers to efficiently and effectively procure large amounts of data within a relatively short period of time; thus, enabling organizations to act or respond to the findings more expeditiously (McCusker & Gunaydin, 2015).

Morano and Riccomini’s (2017) review of peer tutoring literature examined outcomes for middle and high school students with disabilities who participated in higher order learning (HOL) peer tutoring interventions. The review findings revealed that HOL objectives, such as, comprehension, application, and problem solving were difficult for students with disabilities to master. Even though peer tutoring is a highly recommended research-based intervention for basic computation and math facts recall, the findings for HOL studies for secondary students with disabilities showed significant gains for five out of nine studies (Morano & Riccomini, 2017). Only one out of five studies that showed significant gains used a comparison condition aligned with HOL objections and measured performance with a standardized assessment (Morano & Riccomini, 2017). The duration of this study in addition to the incorporation of basic skills during the tutoring sessions supported cognitive psychology research that suggests that basic skills mastery supports HOL mastery (Morano & Riccomini, 2017). Morano and Riccomini concluded that there were several beneficial directions for future research (2017).

The need for more comparison studies within HOL research to include proximal and distal assessments to measure outcomes is crucial in order to fill this research gap (Morano & Riccomini, 2017). Additionally, Mulcahy et al.’s (2014) review of literature pertaining to middle and high school students with emotional/behavioral disorders (EBD) found an insufficient number of EBD studies. The EBD studies reviewed consisted primarily of basic math computation and drill and practice. Another need for additional research involving HOL was expressed by Mulcahy et al. (2014) who recommended that peer mediated interventions include more rigorous math content with a focus on concepts and problem solving. Contrastingly, Tsuei's (2014; 2017) synchronous peer tutoring studies involved 34, third-grade and four, fourth-grade students respectively. These elementary participants were remedial mathematics students, however, their peer tutoring curriculum consisted of conceptual, computational, and applications problems (Tsuei 2014; 2017). Similarly, Chu, Chen, and Tsai (2017) investigated the effect of online peer tutoring on students' mathematics performance, behavior, and cognitive load. The 11 and 12 year old elementary participants completed peer tutoring assignments consisting of complex concepts in fractions. Even though there were rigorous mathematics activities and the findings indicated that the peer tutoring approaches significantly improved the students' learning achievement (Chu, Chen, & Tsai, 2017), the gap remained on the secondary level for rigorous mathematics peer tutoring interventions.

The qualitative design which provides in-depth descriptions including participant's voices and dialog were not an integral part of this body of research literature. A qualitative action research (AR) study, however, confirmed the effectiveness of a peer tutoring program through observations and informal discussion with tutees and tutors (Grubbs & Boes, 2009). This AR study also included survey data from students and teachers. The quantitative and qualitative designs depicted in the literature for this study rigorously followed a protocol that included the literature review, participants and setting, measures, general procedures, group or groups, data analysis, results, and discussion.

Chapter 2 Summary

Providing an appropriate pathway for tutors and tutees to engage in collaborative interactions helped to produce relevant assignment feedback (Hattie, 2012). Peer tutoring enabled students to make a contribution that made a difference. An important factor of knowledge sharing is the belief that the sharing of knowledge can make a positive difference. The potential benefits of sharing knowledge can be intrinsically rewarding (Hislop, 2015). As an educator, this investigator has observed that most students, after discovering that they have a valued mathematical skill, are willing to share. For example, when students work collaboratively, knowledge is shared for the good of the group or "public good." Selfless giving and elevating others, according to Farber, Lencioni, and Kelly (2009), will help to create a culture of productivity and camaraderie.

In addition to the personal rewards that come as a result of intrinsic motivation, extrinsic rewards can also be used as an incentive to participate in peer tutoring interventions. A study by Hawkins et al. (2009) used an alternative to the traditional reinforcement of individual recognition and rewards; the Hawkins et al.'s (2009) study implemented an effective randomized interdependent group contingency reward system. Incentives for peer tutoring, whether intrinsically or extrinsically motivated, provide rewarding opportunities for students to develop trusting relationships and improve mathematics skills.

Chapter 3: Methodology

Introduction to Chapter 3

Qualitative methods are used to answer questions about experiences, meaning and perspective, and give voice most often from the standpoint of the participant (Hammarberg, Kirkman, & de Lacey, 2016). Describing an intervention that addresses educational problems involving underachievement, achievement gaps, attitudes toward learning, and stigmatism threats require an in-depth analysis of how students feel and why they feel as they do about school and learning. "Understanding what school feels like for different students can lead to nonobvious but powerful interventions" (Yeager, Walton, & Cohen, 2013, p. 62). Understanding how students feel about academic interventions, especially interventions that are designed to provide assistance to "at-risk" students, is an important step to providing effective extended learning opportunities.

Evidence pertaining to decades of gaps in racial/ethnic achievements, the impact of encouragement, particularly for African American and Latino students, the risks involved in the use of the term *at-risk* are important factors to consider when analyzing student achievement from a student's perspective (Cooper, 2007; Hanselman et al., 2014; Ladson-Billings, 2007; Steele, 2004). Additionally, the use of the term *achievement gap* has become uncomfortable for some scholars and practitioners because it implies that there is a diminished intellectual group of students (Faulkner, Marshall, Stiff, & Crossland, 2017). According to Faulkner, Marshall, Stiff, and Crossland (2017), this achievement gap can be partially contributed to the adverse effects of tracking in mathematics that can produce decreased performance, decreased opportunities, and stereotypical implications for students in the lower track. Nevertheless, being negatively stereotyped can be mitigated by stressing what Dweck calls the expandability of intelligence while building the student's sense of self-efficacy (Dweck & Yeager, 2019; Steele, 1997). A peer tutoring environment helps to build self-efficacy by producing positive changes in academic, attitude, and emotional behaviors for tutors and tutees from diverse backgrounds (Robinson et al., 2005; Worley & Naresh, 2014).

This chapter describes the components of the study by explaining the design and the design rationale, data collection and analysis processes, and interpreting methods used to increase validity and the reliability of data. This chapter, also, discusses the expected findings and ethical issues, and provides a chapter summary. This logical alignment provides a cohesive structure designed to answer the research questions.

Research Questions

Yin (2003, 2009, 2014) posited that the decision to use the case study method depends on the research question(s). To gain an understanding as to how to formulate insightful questions, it was important to review previous research (Yin, 2003). This preliminary research aided in structuring the research questions and determining the appropriate method of study. How and why peer tutoring impacted the academic performances and attitudes of sixth-grade, at-risk, middle school mathematics students was the focus of this case study, which enabled the investigator to complete an in-depth study of peer tutoring within a real-world context (Yin, 2003, 2009, 2014).

These questions were designed to provide descriptive findings based on the triangulation of participant data.

RQ1. How did participants perceive the impact of the afterschool Peer Tutoring Club on their academic performances in mathematics?

RQ2. How did the participants perceive the afterschool Peer Tutoring Club's influence on their attitudes toward mathematics?

Purpose and Design of the Study

Purpose. The purpose of this qualitative case study was to investigate how an after-school PTC affected academic performances and attitudes of at-risk, middle school mathematics students. In 2006, new SOL tests were introduced that met the NCLB requirement for annual testing in reading and mathematics and required students to demonstrate a deeper mastery of content (VA Board of Education, 2013). Additionally, in 2009, a SOL more rigorous than the 2006 test was developed which emphasized college and career-ready mathematics (VA Board of Education, 2013). The new SOLs consisted of multistep word problems and technology enhanced open-ended problems (VA Board of Education, 2013). However, in the 2011–2012 school year as predicted by school leaders, local divisions saw double-digit drops in the math pass rates on the standards of learning tests (Garrow, 2012). In 2012, the superintendent for public instruction for the investigator's state emphasized teacher collaboration on lesson plans and the incorporation of multistep problem-solving as a best practice to aid in student success (Garrow, 2012). In 2014, the state superintendent for public instruction indicated that the 2013–2014 gains in mathematics could be attributed to teachers focusing on problem-solving and real-world applications (Bogues, 2014). The pass rate in mathematics for this investigator's study district from 2012–2013 to 2013–2014 increased from a 67% to 69% (Bogues, 2014). These minimal SOL increases showed that interventions, especially within the at-risk populations, were needed.

The 2011 Trends in International Mathematics and Science Study (TIMSS) report revealed that the United States was among the top 24 education systems in the world in mathematics with an average score for eighth-grade students at 509 which was higher than the TIMSS scale average of 500 (U.S. Department of Education, 2016b). However, other national and international testing results in mathematics show a need for continued interventions particularly for at-risk students in order for them to compete and succeed locally and globally. The 2009 Program for International Student Assessment's (PISA) results ranked U.S. students 25th in mathematics in the world (Klein, Rice, & Levy, 2012). Additionally, the 2012 Program for International Student Assessment (PISA) results showed 26% of the 15-year-olds in the United States scored below proficiency level two (on a five-level system) in mathematics (U.S. Department of Education, 2016b). According to 2012 PISA results, the achievement gaps between White and Black students and White and Hispanic students have remained about the same in eighth-grade mathematics—32 points and 22 points respectively (U.S. Department of Education, 2016b). The 2015 National Assessment of Educational Progress (NAEP) revealed that all math scores (Grades 4 and 8) were lower than scores in 2013. Therefore, there is a continued need to incorporate more research-based, student interventions into the curriculum. Peer tutoring is a cost effective, research-based, intervention that has a possible academic increase of one grade level for participants (Daggett & Pedinotti, 2014; Hattie, 2012; Hattie & Yates, 2013).

A peer tutoring, research-based intervention that incorporates student collaboration and real-world problem-solving served as an after-school resource for at-risk students who were recommended by their parent or guardian, school administrator, and/or their mathematics teacher. Even though ABC Middle School's district had a student pass rate for math that increased from 67% to 69% between 2012–2013 and 2013–2014, there was still a growing concern about the Math 6, Course 1 and Math 7, Course 2 test results within the district (Bogues, 2014). However, during the 2012–2013 and 2013–2014 school years, the district's Math 6, SOL pass rate dropped from 68% to 66% and Math 7 SOL pass rates increased from 24% to 38% (VDOE, 2017). ABC Middle School's SOL testing results for Course 1 and Course 2 students continued to fall below a 65% pass rate during the 2014 through 2017 school years (VDOE, 2017). For example, the SOL pass rates for Course 2 students from 2014–2015, 2015–2016, and 2016–2017 have been 43%, 47%, and 47% respectively (VDOE, 2017). The SOL pass rates for Course 1 students from 2014–2015, 2015–2016, and 2016–2017 have been 64%, 48%, and 53% respectively. The site district granted permission for this research study in October of 2017.

Historically, students placed in Course 1 and Course 2 math classes have failed the previous year's SOL test. These students generally struggle with math concepts involving word problems and multistep operations. As a result, this at-risk or "at promise" (Samuels, 2020) population of students is at-risk of not achieving school and state requirements for quarterly benchmarks and SOLs in Math 6, Course 1 and Math 7, Course 2 classes. Therefore, this PTC intervention gave participants the opportunity to work with a peer while practicing rigorous tasks, such as, multistep problem-solving. The National Education Association (NEA) describes peer tutoring as a research-based activity whereby students work in pairs to help one another learn or practice academic tasks (2015). Additionally, peer tutoring is a research-based practice that promotes academic and social development for both the tutor and tutee (Hott, Walker, & Sahni, 2012).

Research design. This qualitative, single descriptive case study design was selected because it enabled the investigator to explore the uniqueness of each individual's participation (Creswell, 2013). The qualitative approach allowed the investigator to explore a bounded system or case over time by conducting a detailed, in-depth collection and description of data (Creswell, 2013). Other qualitative approaches, like ethnography, phenomenology, grounded theory, narrative research, and participatory action research were not appropriate designs to use to answer the research questions. Ethnography describes a cultural group. Phenomenology is used to seek an understanding of participants' lived experiences. Grounded theory can be used when no theory or an inadequate theory exists. Narrative research is best when detailed stories will help to understand the problem. Participatory action research is recommended when a community issue needs to be addressed so that change can occur (Creswell et al., 2007). These qualitative designs were not best suited for this study because the purpose of this study was to analyze and describe participant data to answer the following research questions: (a) How did the participants perceive the impact of the afterschool Peer Tutoring Club on their academic performance in mathematics?, and (b) How did the participants perceive the afterschool Peer Tutoring Club's influence on their attitudes toward mathematics?

Describing the common lived experiences, which is a phenomenologist approach, would not provide the in-depth, triangulated data analysis needed in order to answer the research questions pertaining to the PTC. Phenomenology research describes what the participants experienced, how they experienced it, and the commonalities of those experiences (Creswell et al., 2007). Phenomenology research, with findings of commonalities of experiences, will not produce answers to the *how* questions relating to academic performances and attitudes toward mathematics that are posited in this study. The grounded theory was not a viable option because this study was based on existing theories, and in grounded theory, the investigator generates a theory from the research data (Creswell et al., 2007). A narrative research would not have provided data from multiple participants in order to create an in-depth description of the impact of peer tutoring experiences because narrative research tells the story of one or two participants

(Creswell et al., 2007). Lastly, a participatory action research (PAR) is not the best design for this study because the purpose of this study was not to provide a community action plan but answer the research questions and provide a theoretical generalization through external validity (Creswell et al., 2007; Yin, 2009, 2014). However, the dissertation report will be shared with school administrators and other stakeholders, which may be used as a decision- making resource for future peer tutoring interventions.

An in-depth study that was bounded by time and place was conducted that can inform the problem pertaining to how and why peer tutoring impacts academic performance and attitudes of at-risk students. A single case study methodology utilizes prior knowledge, experience, and the context of the case to scaffold the study and apply the findings in a similar context (Gay, Mills, & Airasian, 2011). Yin (2009) observed that case study research has been viewed as "less desirable" than experiments or surveys (Yin, 2009, p. 14). These beliefs may be attributed to claims of inadequate rigor or sloppy investigative work (Yin, 2009, p. 14). However, according to Morgan (2012) and Yin (2009, 2014), a case study is multidimensional and consolidates evidence to reveal a picture of one segment of society as it functions in its natural environment. Additionally, Yin (2009) further indicated that data and theory triangulation can be used to examine the case study characteristics as a contemporary phenomenon in its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Case study research incorporates methods that capture self-directed, reflective, and learner centered discourse. Furthermore, case study research is preferred when analyzing contemporary events since relevant behaviors cannot be manipulated (Yin, 2009). Descriptive case study research, also, provides opportunities for documentation of thick descriptions and the exploration of deeper meanings in addition to analyzing numerical statistical data (Davis, 2007). This in-depth study of a peer tutoring intervention provided a measurement of learning, which explained both quantitatively and qualitatively how social interactions inherent in peer tutoring impacted achievement and attitudes. Some or all of the following characteristics are found in qualitative research: (a) natural setting, (b) direct data collection, (c) rich narrative descriptions, (d) process orientation—the why or how behavior occurs, (e) inductive data analysis, (f) participant perspectives, (g) socially constructed meaning, and (h) emergent research design (McMillan, 2012). These characteristics supported the investigator's efforts to move from theory to practice-based findings.

Selecting the best research paradigm helped to maximize design quality. The research paradigm selection was guided by the focus of the study (Creswell, 1994), which was to describe the impact of peer tutoring on a small group of at-risk middle school mathematics' students. The researcher's background, the nature of the research problem, and the audience were all factors that influenced the paradigm selection (Creswell, 1994). For example, experiments and survey methods are used for quantitative research while ethnography, grounded theory, phenomenological studies, and case studies are methodologies used for qualitative research (Creswell, 1994). Since all methodologies have advantages and disadvantages and all can be used for exploring, explaining, or describing research, it is important to match the method to the phenomenon (Yin, 2009). These conditions include (a) type of research questions, (b) researcher control over behavioral events, and (c) level of focus on contemporary rather than historical events (Yin, 2009). Which methodology to use, such as experiment, survey, archival analysis, history, or case study can be decided based on Yin's (2009) three conditions.

The research questions that focus mainly on how or why may be better answered using the experiment, history, or case study method while research questions that focus mainly on who, what, where, how many, and how much are better studied using a survey or archival analysis methodology (Yin, 2009). According to Yin (2014), many descriptive case studies focus on the "how" and "why" of a phenomenon. This qualitative study utilized the single descriptive case study method to describe the real-world context of a single peer tutoring intervention (Yin, 2014). A single case study is analogous to a single experiment (Yin, 2014), both involve a detailed, rigorous, and systematic data collection process (Kratochwill & Levin, 2010). This case study addressed how and why peer tutoring impacted the academic performance and attitudes of 6, sixth grade, at-risk, and teacher recommended middle school mathematics students who were members of the ABC Middle School's PTC. This investigator used a single descriptive case study design, which incorporated both qualitative and quantitative evidence to describe the behaviors and outcomes involving the peer tutoring case. The qualitative data, however, remained central to the entire case study, which according to Yin (2009) is a strong analytic strategy. Therefore, it is important to understand that a case study does not have to only contain qualitative data (Yin, 2009). The qualitative, descriptive case study was chosen because it enabled the investigator to collect and describe multiple data sources for an in-depth investigation. The investigator used the qualitative, descriptive case study design to establish theory, triangulate data, and strengthen validity (Yin, 2009). To maximize reliability and minimize errors and biases, case study protocol was followed (Yin, 2009). The protocol included the five components important to case study research design: (a) case study questions, (b) propositions (if any), (c) unit(s) of analysis, (d) logic linking data to the propositions, and (e) criteria for interpreting the findings (Yin, 2014).

Peer tutoring program design. The afterschool, peer tutoring intervention provided an opportunity for at-risk students to interact and receive assistance from peer tutors while completing math assignments. According to Piaget, this learning from others or social transmission influences cognitive development (Woolfolk, Winne, & Perry, 2000). Additionally, when the teacher assumes the role of facilitator, the student can take more responsibility for his or her own learning by fostering peer collaborations, welcoming diversity, and helping others to learn (Mezirow, 1997). Taking responsibility for one's own learning is crucial to the development of critical thinking. Providing more opportunities for students to think aloud with peers will better enable them to determine what they understand or do not understand (Power Up What Works, n.d.).

Resources. Resources required for the implementation of the peer tutoring program were volunteer peer-tutors and tutees, Edgenuity's online Virtual Tutor program, paper-based curriculum aligned word problems, iPads or Chromebooks, parent/guardian support, administration support, and peer tutoring facilitators. A classroom was made available to accommodate student pairings or small groups. Whiteboards, markers, flash cards, calculators, virtual and/or concrete manipulatives, such as pattern blocks, fraction bars, counters, and algebra tiles, were available for use to create models and show work while interacting with paper-based and online Virtual Tutoring program. A peer tutoring handbook, which contained curriculum aligned word problems, lesson instructions, and program procedures was also provided. Rewards, such as "wings" from the sites' Positive Behavioral Interventions and Supports (PBIS) program and certificates of accomplishment were provided to tutors and tutees as incentives to encourage engagement and task completion.

Peer tutoring procedures. Edgenuity provided an online, multimedia, research-based curricula designed to meet state and national standards (Principles & Practices, 2016). This study incorporated the Virtual Tutor component of Edgenuity blended with curriculum aligned materials and multiplication facts remediation. Virtual Tutor is an interactive learning program that incorporates videos, lesson reviews, guided practice, independent practice, and assessments. Virtual Tutor (online) and paper-based assignments were provided for tutees, and the same age and cross age tutors received necessary resources and structure to create and guide feedback interactions.

Six primary instruments were used to investigate the research questions. The instruments were (a) District's Grade 6 Math Pretest, (b) Attitude Towards Mathematics Inventory (ATMI) pretest, (c) participants' math work (completed during peer tutoring), (d) district's Grade 6 math posttest, (e) Attitude Towards Mathematics Inventory (ATMI) posttest, and (f) tutees' exit interviews. These multiple sources of data were triangulated in order to answer each research question as illustrated in Table 1.

Table 1

Triangulation of Data Sources

Research question	Grade 6 math pretest	ATMI pretest	Participants' math work	Grade 6 math posttest	ATMI posttest	Participants' interviews
RQ 1 Academic achievement	X		X	X		X
RQ 2 Attitude towards math		X			X	X

The peer-tutors provided students with additional support by clarifying directions, providing problem-solving strategies as needed, checking for understanding, and assisting with error corrections. Positive feedback from these activities served as a tool for promoting academic progress through peer interactions (Hallowell, 2011). Students thrive on receiving feedback when the environment is nonjudgmental and accepting; however, to be of benefit, the feedback must be effective (Hattie, 2012). Implementation procedures encouraged participant feedback throughout the intervention process. Supervision of tutoring sessions by facilitators, analysis of participants' progress, and examination of participants' feedback was a consistent and integral part of the implementation process. A facilitator was always available to monitor behaviors and provide instruction and corrective feedback, when necessary.

Participants in the peer tutoring program were given the opportunity to attend three, 1-hour afterschool tutoring sessions each week. ABC Middle School teachers facilitated while tutors assisted tutees in the completion of the Virtual Tutor assignments, paper-based curriculum aligned multistep problems including word problems, and multiplication facts activities. Peer tutors provided assistance by clarifying directions, assisting with problem-solving, and providing guidance for error correction. As tutees completed their paper-based word problem assignments and their individually structured Virtual Tutor modules provided on checklists, tutors used the lesson strategies presented in Virtual Tutor and/or strategies presented during training to guide and provide constructive feedback. Tutees used the Edgenuity math software program to complete and submit their online assignments. Tutees were encouraged to use the four-step problem-solving template when solving the paper-based word problems provided during each session. The four-step problem-solving process required tutees to articulate the thought process used to answer the question while participating in the tutoring session. "The metacognitive approach to verbalizing one's thinking is essential to successful comprehending while reading any type of text" (Bernadowski, 2016, p. 5). What is referred to as think-alouds (Bernadowski, 2016) can be used when solving word problems with a peer. Tutees were encouraged to follow guidelines in the peer tutoring handbook on how to ask four kinds of metacognitive questions: (a) comprehension questions, (b) connection questions, (c) strategic questions, and (d) reflection questions (Coles, 2013). The qualitative and quantitative data collected by the investigator following each tutoring session was evaluated and analyzed for patterns and themes.

Risks and discomforts. The study presented minimal risk to participants based on the definition provided in federal regulations which states “that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests” (U.S. Department of Health & Human Services [USDHHS], Office of Human Research Protections [OHRP], Division of Regulations and Policy [DRP], Regulations 45 CFR 45, p. 132). However, as added support for participants/tutees, the investigator requested the on-site guidance counselor to serve as additional support to tutees should they have concerns or need to withdraw from the study. Additionally, the investigator protected the participants’ information according to federal regulation. Any personal information provided by participant was coded so it could not be linked to participant. Any name or identifying information was kept securely via electronic encryption or locked inside the investigator’s classroom or file cabinet. The investigator maintained the participants’ confidentially by assigning a number instead of a name to each tutee’s set of data. The investigator did not identify participants in any publication or report. Participants’ information was kept private, and the investigator will destroy consent forms 3 years after the study ends. All other participant data will be destroyed or deleted within 30 days after final approval of investigator’s dissertation.

Qualitative approach to peer tutoring. Quality ideas that are socially constructed and culturally embedded can emerge from case study observations, surveys, artifacts, and interviews (Hislop, 2013). Data can be categorized into themes and assertions and lessons can be identified from the case study (Flipp, 2014). This knowledge or the lessons learned provided additional insight into how theory becomes practice.

The investigator used information from Vygotsky's and Gardner's theories to inform the study. A parallel qualitative approach enabled the participants to add meaning as well as allowed the investigator to move from assumptions and theory to an interpretation of the problems (Creswell, 2013). The qualitative method with a case study framework allowed the participants to be heard (Creswell, 2013). In seeking to understand how and why a peer tutoring program impacted academic performance and attitudes about math, the case study was selected to allow the investigator to analyze the participants' roles in becoming contributors of learning. As reported in the district's 2016–2020 strategic plan, a key initiative calls for a "shift in the role of students to participants in and contributors to learning." Maximizing achievement for all students requires a supportive learning environment. In addition to effective teaching, the vulnerable or at-risk population of students may require additional opportunities to extend learning (Daggett & Pedinotti, 2014). Research shows that peer tutoring supports students in becoming more active contributors to their learning and the benefits are evident to both tutors and tutees (Daggett & Pedinotti, 2014; Wang, Bettini, & Cheyney, 2014). The case study design provides insight into and understanding of the peer tutoring program (Creswell, Hanson, Plano Clark, & Morales, 2007). An in-depth study of the program's objectives, curriculum, and participants provided the investigator with information that was used to describe the case and determine themes (Creswell et al., 2007; Yin, 2014). Additionally, "thick description captures the thoughts and feelings of participants as well as the often complex web of relationships among them" (Ponterotto, 2006, p. 543). The use of thick description, patterns, and themes helped to explain and describe why and how peer tutoring had an impact on at-risk students' academic performances and attitudes toward math (Wexler et al., 2015; Yin, 2009). The investigator used a single, descriptive case study to focus on concerns surrounding a small population of sixth grade, at-risk math students who were impacted by the peer tutoring program. The data triangulation which included participant assessment data, student work, interviews, and inventories, while incorporating the use of thick description, revealed the perceptions, attitudes, and experiences of study participants in a mathematics peer tutoring program which met during 1-hour, afterschool sessions, between December 2017 and June 2018. Each of the six participants attended between six and 41 tutoring sessions. A meta-analysis of findings from 50 independent studies of mathematics peer tutoring programs by Alegre-Ansuategui et al., 2018 concluded that short interventions can obtain very effective results.

Research Population and Sampling Method

The study participants were Grade 6, Course 1, mathematics students who were members of ABC middle school's PTC located in a southeastern city in the United States. A nonrandom purposive sampling was used to select participants from the members of the Peer Tutoring Club (Gay et al., 2011). Purposive sampling does not require a set number of participants (Etikan, Musa, & Alkassim, 2016). Qualitative studies could have from one to as many as 70 participants; however, it is unusual to have more than 20 (Gay et al., 2011). The sample size for this case study, according to Mason (2012), should be large enough to uncover the most important perceptions while focusing on data saturation. The meta-analysis of findings from 50 independent studies of mathematics peer tutoring programs by Alegre-Ansuategui et al. (2018), however, excluded studies with three or fewer participants due to publication bias. Sample size, according to Alegre-Ansuategui et al.'s study, was found to be a significant moderator whereby studies with more than 60 students had a lower effect size. When the peer tutoring group is smaller, the intervention is easier to manage, and they proceed more effectively according to theory (Alegre-Ansuategui et al., 2018). This study's sample size of six, Grade 6 tutees, were homogeneous because they met the "at-risk" in math criteria for acceptance as a participant. However, their diversity was evident in that the sample consisted of three males, three females, three special education tutees, and three general education tutees.

The participants chosen helped the investigator gain insight and understand the phenomenon being investigated (Gay et al., 2011). Since the investigator's goal was to generalize theories, like an experiment, the case study does not represent a sample (Yin, 2014). This investigator selected six tutee participants from the PTC who met the guidelines for being at-risk in mathematics. The tutee participants were required to attend at least 4 weeks for a minimum of six tutoring sessions. The following guidelines were used to select participants from the Peer Tutoring Club after obtaining parental consent (see Appendix A) and student assent (see Appendix B) on a first come first serve basis: (a) enrolled in Course 1 mathematics class and (b) teacher recommendation.

The tutee participants were from a segment of the school's population who were not meeting school and state requirements for quarterly benchmarks and SOL scores. The SOL scores for School Year (SY) 2016–2017 for Grade 6 Course 1 and Grade 7 Course 2 mathematics were below the 70% district goal. Grade 7 Course 2 students are traditionally students who were previously Grade 6 Course 1 students. Even though this study's participants consist of only Grade 6 Course 1 students, the PTC for SY 2017–2018 provided school-wide after school tutoring to Grade 6 Course 1 and Grade 7 Course 2, at-risk/at-promise, mathematics students. The PTC was student-driven and supported culturally, academically, and developmentally diverse students in improving their academic performance in mathematics. During SY 2016–2017, the PTC served approximately 20 heterogeneously mixed sixth-, seventh-, and eighth-grade tutees per week. On average, 10 teacher-recommended sixth-, seventh-, and eighth-grade students served as tutors during the after school peer tutoring sessions. Approximately, 13 of the club tutees were African American, 4 were White, 2 were Hispanic, and 1 was of two or more races. Forty-six percent of this diversely populated school was eligible for free and reduced lunches for the 2015–2016 school year according to a 2016 public school performance reporting agency.

Instrumentation

Multiple sources of data will strengthen validity, and maintaining protocol consistency will strengthen reliability (Yin, 2014). The following reliable instruments were used for data collection: (a) District's Course 1 pretests and posttests in mathematics, (b) Attitudes Toward Math Inventory (ATMI) pretests and posttests, (c) descriptive documents from Edgenuity's online Virtual Tutor program and paper-based assignments, and (d) exit interviews. In order to describe the peer tutoring intervention within its real-world context, the investigator analyzed and interpreted the data obtained from these six instruments.

District's Course 1 mathematics pretests/posttests. The Course 1 pre/post mathematics' tests were used district-wide to measure student growth in the following strands: (a) Number and Number Sense with a focus on relationships among fractions, decimals, and percentages and (b) Computation and Estimation with a focus on applications of operations with rational numbers. The Number and Number Sense strand contains problems, such as, identifying relationships, representing, and comparing and ordering fractions, decimals, and percentages; identifying, representing, ordering and comparing integers; comparing and describing ratios; investigating concepts of positive exponents and perfect squares; and demonstrating multiple representations of multiplication and division of fractions. The Computation and Estimation strand contains problems, such as, multiplication and division of fractions and mixed numbers; single and multistep problem-solving involving operations with fractions and decimals; and evaluation of numerical expressions using order of operations. The pretest/posttest for Grade 6 Course 1 consists of 20 problems; 12 of these problems are classified as Bloom's Level 3 multistep problems. The remaining eight problems are classified as Bloom's Level 2 or recall problems.

Attitudes Toward Mathematics Inventory (ATMI). This inventory is comparable to the Fennema-Sherman (F-S) Mathematics Attitude Scale of 1976 (Brookstein, Hegedus, Dalton, Moniz, & Tapper, 2011). The ATMI (Appendix C) was developed to fill the need for a shorter instrument that could withstand factor analysis (Tapia & Marsh, 2004). ATMI, according to Tapia and Marsh (2004), has a reliability coefficient alpha of .97 and can be used to analyze four factors: (a) self-confidence, (b) value of mathematics, (c) enjoyment of mathematics, and (d) motivation (Tapia & Marsh, 2004). The investigator initially proposed to administer the ATMI during the first and last week of the research study. However, the ATMI pretest was not administered until after tutoring sessions were resumed in March 2018. The results of the ATMIs helped guide the analysis of how success or failure in math performance is impacted by personal beliefs as they relate to abilities, importance of mathematics, enjoyment of mathematics, and the motivation to succeed (Tapia & Marsh, 2004). The tutees' pre/posttest scores in the four attitude subgroups: (a) self-confidence, (b) value of mathematics, (c) enjoyment of mathematics, and (d) motivation were used to determine changes in attitude during the research period.

Edgenuity's virtual tutor. Edgenuity provides multimedia curricula for Grades 6–12 in mathematics (Principles & Practices, 2016). The curricula includes core classes, career pathways, test preparation, and credit recovery courses (Principles & Practices, 2016). Edgenuity provides an online, multimedia, research-based curricula designed to meet state and national standards (Principles & Practices, 2016). This study incorporated the Virtual Tutor component of Edgenuity blended with district-aligned data driven objectives. Virtual Tutor is an online interactive learning program that incorporates videos, lesson reviews, guided practice, independent practice, and assessments. To address the needs of a diverse population of students, Edgenuity incorporated the Universal Design for Learning (UDL), which is a research-based approach to lesson development (Principles & Practices, 2016). Edgenuity applies the three essential principles of UDL: (a) multiple means of representation, (b) multiple means of action and expression, and (c) multiple means of engagement (Principles & Practices, 2016).

Interviews. Interviews in a case study are considered to be one of the most important sources of data (Yin, 2009). A focused, face-to-face interview, which is short, open-ended, and conversational, was conducted at the end of the study to gain an understanding from the tutees' perspectives about their experiences and feelings (Gay et al., 2011; Yin, 2009, 2014). The interview protocol included an introduction, statement to review the consent form, open-ended questions (adapted from CATCH interview questions), and a closing statement, and served as a procedural guide for the interview process (see Appendix D; Jacob & Furgerson, 2012; Smalley, 2013). The results of the face-to-face interview were member checked, manually coded, categorized for patterns, and analyzed for themes. This data was further analyzed using NVivo, a qualitative data analysis software program, to further interpret themes.

Data Collection Procedures

The tutors, tutees, and peer tutoring facilitators were instrumental in ensuring that the objectives of the case study were met. The investigator and peer tutoring facilitators were responsible for implementing the program and communicating with students, parents, and administrators. Club letters of introduction and a peer tutoring brochure and/or flyers were issued during the first, second, and third quarters of the 2017–2018 school year to inform parents and students and to invite students to participate in the PTC (see Appendix E). The investigator provided training for PTC tutors and provided orientation for tutees and facilitators using resources in the PTC handbook (see Appendix F). After site approval and IRB approval, the investigator began the study recruitment process and the consent and assent forms were distributed. Following the receipt of the signed consent and assent forms, the investigator began the case study data collection process.

What works clearinghouse guidelines. After all approvals from the Institutional Review Board (IRB), the research site staff, parents/guardians, and participants were obtained, the following What Works Clearinghouse guidelines were initiated (U.S. Department of Education, 2016a).

1. Identified students who were at-risk for potential mathematics difficulties.
2. Included curriculum-based instructional materials based on academic needs of students according to SOL and district’s pre-test results, which included rational number assignments pertaining to whole numbers, fractions, decimals and integers. This intervention, also, emphasized word problem-solving strategies.

3. Based structured intervention on two topics: a) explicit and systematic online delivery using Edgenuity's Virtual Tutor program which modeled problem-solving, verbalization of thought processes, guided practice, corrective feedback, and frequent review and b) peer tutors provided face-to-face support to students by explaining directions pertaining to the Student Goals' Checklist, provided assistance as students completed the Edgenuity online assignments and paper-based curriculum aligned word problems, explained concepts and example problems, provided encouragement, and engaged in pair/share sessions to provide opportunities to explain strategies for solving problems presented online and in paper-based format.
4. Used the four-step plan to solve real-world problems to reinforce the process for problem-solving. This explicit process was also used in tutees' math classrooms.
5. Worked with students using visual representations of mathematical ideas included in Virtual Tutor online assignments, as well as, during the completion of paper-based word problem assignments.
6. Used flash cards and/or worksheets for 10 minutes during each session to build fluent retrieval of basic multiplication facts.

Data collection time table. Investigator monitored and analyzed participants' progress using Virtual Tutor reports, District's pre/post mathematics tests and pre/post ATMI data, attendance reports, and interviews. Data collections from Edgenuity's Virtual Tutor assignments, interview, District's pre/post mathematics tests, and the ATMI were used to analyze the impact of peer tutoring on students' academic performance and attitude towards math. The District's pre/post mathematics tests were administered during the first and last week of the research study. The investigator initially proposed that the ATMI be administered during the first and last week of the research study. However, the ATMI pretest was not administered until after tutoring sessions were resumed in March 2018 following the investigator's 1-month hiatus. The ATMI posttest was administered during the last week of the study. Descriptive academic data (paper-based and online multistep problems, computation games) were collected during each tutoring session to evaluate the participants' academic progress or lack of progress. Exit interviews were conducted during the last week of study to get the participants' perspectives of their peer tutoring experiences pertaining to academic performances and attitudes toward mathematics. Table 2 displays a timetable of data collection which contains study tasks, dates, and tasks duration.

Table 2

Data Collection Timetable

Task	Timeline (2017–2018)
Recruiting Period	Dec 2017–Apr 2018
Orientation/Tutor Training	Dec 2017–Apr 2018
Pretests (District Math* & ATMI)	Dec 2017–Apr 2018
PTC sessions	Dec 2017–May 2018
Posttests (District Math* & ATMI)	May–June 2018
Tutees' Exit Interviews	May–June 2018

*Administered during regular class time by classroom teacher.

Identification of Attributes

Peer tutoring and peer-led learning interventions are research-based activities that allow students to work in pairs or groups to help one another on academic tasks (Hattie & Yates, 2013; NEA, 2015). The attributes of peer tutoring on student learning are evident in academic, social, and behavioral benefits (Bowman-Perrott et al., 2014; Hattie & Yates, 2013; Thomas et al., 2015). Vygotsky's sociocultural theory (SCT) and Vygotsky's ZPD suggest that peer interactions help to facilitate vertical relationship learning and conceptual understanding (Gredler, 2012; Shabani, 2016; Vygotsky, 1978). The attributes of peer tutoring can provide valuable learning experiences to at risk/at promise, disabled, and nondisabled students (Dymond et al., 2007; Hattie, 2017).

The effectiveness of peer tutoring is attributed to an environment that supports: (a) positive reinforcement, (b) supportive social interactions, (c) frequent feedback, (d) active engagement, and (e) evaluation and student reflection. According to Thomas et al. (2015), even though theory and empirical evidence support peer-to-peer learning, peer tutoring interventions are largely untapped on the secondary level in the United States. The attributes of peer tutoring that contribute to the academic, social, and behavioral improvements can improve the outcomes of a diverse population of an underserved population of students (Hattie, 2017; Thomas et al., 2015).

Data Analysis Procedures

Yin (2009) stated that pattern matching, linking data to propositions, explanation building, time-series analysis, logic models, and cross-case synthesis are five techniques that can be used for analysis. Linking data to theoretical propositions is considered by Yin (2009) to be the most preferred strategy because it makes an educated guess regarding the possible results of the study (Baxter & Jack, 2008). McMillan (2012) stated that a thorough case study analysis involves organizing, summarizing, using codes, and interpreting the patterns and themes. There are four principles that are foundational for quality analysis: (a) consideration of all evidence, (b) interpretation of major rival evidence, (c) addressing most significant aspects of case, and (d) use of researcher's priori knowledge and expertise (Yin, 2009). According to McMillan (2012), information provided by participants called emic data and the researcher's interpretation of that emic data, which is called etic data are organized by source. Multiple types of data, both qualitative and quantitative, were analyzed to enhance credibility. The qualitative data, however, remained central to the entire case study, which according to Yin (2009) is a strong analytic strategy.

The six data instruments used to investigate the two research questions were: (a) district's Grade 6 math pretest, (b) Attitude Towards Mathematics Inventory (ATMI) pretest, (c) participants' math work (completed during peer tutoring), (d) district's Grade 6 math posttest, (e) Attitude Towards Mathematics Inventory (ATMI) posttest, and (f) tutees' exit interviews. The data collected from these instruments provided descriptive evidence as to how peer tutoring impacted academic performance and changed attitudes toward mathematics for Grade 6 tutees within a Peer Tutoring Club.

District's pre/post mathematics' test. The Grade 6 Course 1 pre/post mathematics' tests were used district-wide to measure student growth in the following strands: (a) Number and Number Sense with a focus on relationships among fractions, decimals, and percentages and (b) Computation and Estimation with a focus on applications of operations with rational numbers. The pretest/posttest for Grade 6 Course 1 consists of 20 problems; 12 of which are multistep problems, which are classified as Level 3, Application, in Bloom's Taxonomy (Assessment & Analytics, 2018). Descriptive statistics were used to analyze the Grade 6 mathematics pretest and posttest. The results of the pretest were used to determine each tutees' mathematical strengths and weaknesses within each test strand. Tutees' peer tutoring assignments were based on academic needs of students according to teacher feedback, 2017 SOL results, curriculum guides, and district's pretest results. However, because word problems were a primary focus for each tutee, the pretest and posttest results were analyzed to determine if tutees' multistep problem solving performance improved during the study period. This change in the tutees' academic performance was described using mean, standard deviation, and minimum and maximum values. The triangulation of descriptive data and empirical evidence from peer tutoring researchers such as John Hattie provided the investigator with a more holistic understanding of this study's research phenomenon. The triangulation of this pre/post math test data along with the five additional instruments was used to increase construct validity.

ATMI pretest and posttest. ATMI was used to analyze four factors: (a) self-confidence, (b) value of mathematics, (c) enjoyment of mathematics, and (d) motivation (Tapia & Marsh

2004). The investigator initially proposed that the ATMI be administered during the first and last week of the research study. However, the ATMI pretest was not administered until after tutoring sessions were resumed in March 2018 following the investigator's 1-month hiatus. IRB approvals, site approvals, parental consents, and tutee assents had been granted prior to collecting participants' data. The results of the ATMI helped to guide the analysis of how success or failure in math performance was impacted by personal beliefs as they relate to abilities, importance of mathematics, enjoyment of mathematics, and the motivation to succeed (Tapia & Marsh, 2004). Initially, the investigator intended to use the Wilcoxon matched-pairs signed-ranks test to assist in determining changes in tutees' attitudes toward mathematics based on the four attitude components (Brookstein et al., 2011); however, this test was eliminated because the investigator was not able to collect five paired samples of ATMI data due to participants' absences. Descriptive analysis was conducted using SPSS and Excel to show progress. The four attitude components or factors analyzed were: (a) self-confidence, (b) value of mathematics, (c) enjoyment of mathematics, and (d) motivation. The pre/post component data was used to describe changes in tutees' attitudes during the research period.

Descriptive assignment documents. Each tutee was provided with Edgenuity's (online) Virtual Tutor assignments—word problems were emphasized—in addition to paper-based word problems, a goal's checklist, attendance roster, and a peer tutoring handbook. A cognitive strategy approach to tutoring was emphasized though the use of the district approved 4-step problem-solving template. According to Jitendra (2013), a cognitive strategy approach emphasizes the development of thinking skills and processes in order to develop problem-solving skills. The tutees' work from their PTC folder was analyzed to measure growth as it pertained to the research questions.

Study data were manually and electronically organized and coded to identify categories, patterns, and themes (McMillan, 2012). Coding required the reading and rereading of transcripts to identify words, phrases, or topics that stood out to the researcher (manually coding; McMillan, 2012). Electronic analysis using NVivo was also performed to verify relationships between codes and code frequencies. Codes helped the researcher to reduce the data into manageable categories by recognizing the relationships between codes. The categories enabled the researcher to generate patterns and themes found within the data (McMillan, 2012). Using these qualitative data analyses steps enabled the researcher to use manual and electronic data analyses techniques to answer the two research questions.

Exit interviews. The interview protocol included an introduction, statement to review the consent form, open-ended questions, and a closing statement, and served as a procedural guide for the interview process (Jacob & Furgerson, 2012). Participants completed face-to-face interviews that contained five open-ended questions. The responses to the face-to-face interviews enabled the investigator to gain insight from the participants' perspectives as to why or how peer tutoring impacted their performances in mathematics. To provide additional credence to the five interview responses, with IRB approval, a sixth written response interview question was added. The interview question was read to the tutees by the investigator and they responded to this question in writing in a classroom at the research site two days following the first interview.

The interview responses were reviewed with participants for accuracy. The participants' reviews helped to increase construct validity (Yin, 2009, 2014). Next, interviews were manually coded, categorized for patterns, and analyzed for themes by investigator. This data were further analyzed using NVivo, a computer-assisted software, to further interpret themes.

Limitations of the Research Design

Purposive sampling, a nonrandom form of sampling, was used to select participants from the Peer Tutoring Club (PTC); therefore, bias could be introduced. Students were permitted to participate in the club based on the student's request and/or teacher recommendation and parental recommendations and permissions. Nonrandom sampling and small sample size did not provide support for generalizability of findings to all after-school peer tutoring programs. According to Yin (2009), “case studies, like experiments, are generalizable to theoretical propositions and not to populations or universes” (p. 15). Lastly, even though participants worked on Virtual Tutor’s Edgenuity assignments during the afternoon tutoring sessions, they were also able to work on these assignments outside of the peer tutoring setting anywhere there was Internet and Chromebook/computer availability. The researcher was not able to control participants’ availability of computer/Chromebook access and internet access outside of the peer tutoring setting. Therefore, extrinsic factors involving the completion of online assignments outside of the study site could have influenced the study findings.

Validation and Reliability

Credibility is one of the primary standards used to evaluate qualitative studies (McMillan, 2012). To determine the validity or credibility of the study, it was necessary to ensure that (a) the research was clearly written, (b) propositions, if applicable, were provided and substantiated, (c) the case study selected was appropriate for the research questions, (d) data collection was methodically managed, and (e) the data was correctly analyzed (Baxter et al., 2008). Additionally, multiple data collection sources are recommended to allow findings to be verified through a process called triangulation (Creswell, 1994, 2013; McMillan, 2012; Yin, 2009, 2014). Therefore, including multiple data sources in this study helped to provide credibility (Yin, 2009, 2014). For this single case study, external validity was addressed by generalizing the results of the study based on theory (Yin, 2009, 2014). Analyzing data to answer the "how" and "why" questions of peer tutoring provided generalizations to Vygotsky, Piaget, and Gardner's theories. Lastly, using a case study protocol helps to ensure that if the procedures are repeated, the same results will occur (Yin, 2009, 2014). Additionally, transferability, a form of external validation, was "enhanced by thick description of the site, participants, and procedures used to collect data" (McMillan, 2012, p. 305).

Data triangulation through the analyses of multiple sources of evidence, the establishment of a clear chain of events, and reviews of drafts by key informants [dissertation committee members] aid in establishing construct validity (Yin, 2003, 2014). Triangulation of data sources using member checking, negative case study analysis, external audits, researcher reflection, and thick description were used (McMillan, 2012). Data from academic pretests and posttests, attitudes toward math pretests and posttests, participants' math work, and participants' interviews were triangulated to strengthen construct validation (Yin, 2009). Internal validity, according to Yin (2009, 2014) is applicable to explanatory or causal studies, only not for descriptive or exploratory studies. However, the analysis of patterns in triangulated data and the corroboration of theoretical propositions helped to support some aspects of internal and external validation. This study is descriptive; therefore, the focus was on describing the experiences that impacted academic performances and attitudes toward mathematics while using theory, data triangulation, and protocol to establish construct validity, external validity, and reliability.

Expected Findings

A synthesis of peer-mediated interventions revealed moderate to high effects (Daggett & Pedinotti, 2014; Hattie, 2009; Wexler, Reed, Pyle, Mitchell, & Barton, 2015). The majority of the studies were conducted at the elementary level; so, more peer-mediated interventions need to be conducted on the secondary level (Wexler et al., 2015). A meta-analysis of findings from 50 independent studies of mathematics peer tutoring programs by Alegre-Ansuategui et al. (2018) concluded that short interventions can obtain very effective results. The effect scores for the secondary level studies with a duration between 5 and 15 weeks provided additional evidence that short interventions are effective (Alegre-Ansuategui et al., 2018). Also, research shows that peer-mediated studies support positive findings, which result in acceptance of differences, empowered experiences for both tutor and tutee, and improved attitudes toward mathematics (Worley & Naresh, 2014; Daggett & Pedinotti, 2014). Therefore, based on evidence depicted in the literature reviews in Chapter 2 of this study and my research study propositions, the expected results should reveal a positive effect on tutees' academic performance and attitudes toward learning mathematics. However, because the investigator had little control over events within the real-life context of a case study (Yin, 2009, 2014), the findings were based on descriptive analysis of the process and results. This investigator collected and analyzed multiple qualitative and quantitative data sets in order to answer the research questions pertaining to this case study. The findings are presented in Chapter 4.

Ethical Issues

Research must be conducted in an ethical manner and the researcher must protect the participant but also consider the results as a possible open door to additional research (Gay et al., 2011, p. 19). Ethical issues were considered prior to the start of this research study and throughout all phases of the research process (Creswell, 2013). Creswell (2013) provided six times where ethical issues can occur: (a) prior to conducting the study, (b) starting the study, (c) during data collection, (d) during analysis of data, (e) developing and reporting data, and (f) publishing study results. The investigator must receive approval from the Institutional Review Board (IRB), research site, parents/guardians, and participants prior to collecting study data (Creswell, 2013; Yin, 2014). Avoiding the use of deception and protecting each participant from harm are ethical practices vital to the research design (Yin, 2014). After the identified approvals were received, the data collection process was initiated. A consent form was provided to participants and parents/guardians indicating that participation was voluntary, and the study would not put the participants at undue risk (Creswell, 2013). The study presented minimal risk to participants based on the definition provided in federal regulations, which states:

> that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests. (USDHHS, OHRP, DRP, Regulations 45 CFR 45, p. 132)

However, as added support for participants/tutees, the investigator requested the on-site guidance counselor to serve as additional support to tutees should they have concerns or need to withdraw from the study. Lastly, the researcher ensured that all participants, participants' data, and the site was given confidentiality and security (Creswell, 2013). The investigator protected the participants' information according to federal regulation. Any personal information provided by participants was coded so it would not be linked to participant. Any name or identifying information was kept securely via electronic encryption or secured inside the investigator's classroom or file cabinet. Data provided to advisors, site administration, and/or other CU staff used codes to conceal participant's identity. Investigator used a secret code to analyze the data. For example, letters and numbers were used instead of names to conceal participants' identities and the identity of the site. Investigator did not identify participants in any publication or report.

Participants' consent forms will be kept then destroyed three years after the study is concluded. All other study documents will be destroyed at the conclusion of the study.

Chapter 3 Summary

Every child should have an equal opportunity to succeed (Council on Foreign Relations, 2012). The purpose of this case study was to describe how after school peer tutoring experiences change at-risk middle school students' academic performances and attitudes toward mathematics. Chapter 3 explained the design choice, outlined processes and procedures, and provided guidelines for data collection within the Peer Tutoring Club at ABC Middle School. The theory-based approach to this study added external validity. Even though quantitative methods are used more often in empirical studies than qualitative methods, McMillian (2012) emphasized the importance of remembering that qualitative research is no less scientific than quantitative research. This qualitative case study design produced an in-depth study within a bounded system. Using multiple data sources, both qualitative and quantitative, strengthened the construct validity of this single, descriptive case study. Data triangulation allowed the investigator to explore peer tutoring from multiple perspectives (Baxter et al., 2008; Yin, 2014). The triangulation of data supported credibility and transferability of study results.

Chapter 4: Data Analysis and Results

Introduction

National attention has been placed on holding schools accountable for meeting the unique individual needs of a diverse population of students (Worley & Naresh, 2014). The No Child Left Behind Act (NCLB) of 2002, which was an update of the 1965 Elementary and Secondary Education Act (ESE), increased the federal government's role in holding schools accountable for student's progress (Klein, 2015). The primary objectives of NCLB, which was signed by President George W. Bush in 2002, were to increase American's competitiveness and close the achievement gap in reading and mathematics between at-risk students and their peers who were performing at or above the proficiency level on high states tests (Klein, 2015).

Providing learning environments that encourage all students to take risks by questioning, explaining, and reflecting during the problem-solving process can change attitudes and help students to remain persistent in the face of failure (Sharma, 2015). The apprehension and sometimes fear associated with multistep problem-solving, especially for at-risk mathematics students, suggest a need for more effective problem-solving interventions that will incorporate mathematical thinking and reasoning activities in a learning environment that accepts risk-taking and "mistakes" as the norm for student success (Jitendra et al., 2015; NCTM, 2017; Sharma, 2015). The Vygotsky's Zone of Proximal Development (ZPD) and Piaget's social transmission perspectives both support the connection between cognitive development and social interactions (Brown et al., 2016; Woolfolk et al., 2000). Group and pair interactions are linked to student achievement and serves as a catalyst for learning between students with diverse levels of expertise (Alegre-Ansuategui et al., 2018; Brown et al., 2016; Robinson et al., 2005; Woolfolk et al., 2000; Worley & Naresh, 2014).

The purpose of this qualitative case study was to investigate how an afterschool PTC at a southeastern middle school affected academic performances and attitudes of at-risk mathematics students. This chapter includes a description of the research sample, an overview of support provided to PTC facilitators, a description of orientation and training provided to tutors, a description of orientation provided to tutees, a description of the data collection and data collection procedures, the data analysis process, and a summary of the research findings. These main points described in the findings provide a logical connection between this chapter and Chapter 5.

Linking data to theoretical propositions is considered by Yin (2009) to be the most preferred strategy because it makes an educated guess regarding the possible results of the study (Baxter & Jack, 2008). The propositions for this study were developed following an analysis of this study's empirical and theoretical literature review. The investigator's reliance on the following premises helped to shape the data collection (Yin, 2014). Based on Vygotsky's theory, peer tutoring enables participants to make academic improvements in mathematics by working collaboratively with a knowledgeable peer. Providing opportunities for student success through peer tutoring interactions improves participants' attitudes toward mathematics.

McMillan (2012) stated that a thorough case study analysis involves organizing, summarizing, using codes, and interpreting the patterns and themes. Quantitative and qualitative data were used to answer the research questions. Descriptive statistics were used to analyze both qualitative and quantitative data. The qualitative data, however, remained central to the entire case study, which according to Yin (2009) is a strong analytic strategy. All data were linked to theoretical propositions, and patterns were analyzed to determine whether the theoretical propositions coincided with the case study findings. This deductive reasoning approach was part of the study's research design which was determined beforehand based on the methodological needs of the study (Saldaña, 2009; Yin, 2014). Linking data to theoretical propositions is considered by Yin (2009, 2014) to be the most preferred strategy because it makes an educated guess regarding the possible results of the study (Baxter & Jack, 2008). In theoretical coding, the data is coded and categorized according to themes based on the theoretical propositions (Saldaña, 2009). Triangulation of data sources (see Table 3) which includes ATMI surveys, mathematics pre and posttests results, interview transcriptions, and participants' problem-solving documents were used to provide a summation of findings.

Table 3

Triangulation of Data Sources

Research Propositions	Research question	Grade 6 math pretest	ATMI pretest	Tutees' math work	Grade 6 math posttest	ATMI posttest	Tutees' interviews
Based on Vygotsky's theory, collaboration enables academic improvement	RQ 1 Academic achievement	X		X	X		X
Peer tutoring interactions improves attitudes towards mathematics	RQ 2 Attitude towards math		X			X	X

Lastly, the findings were used to answer the following research questions:

RQ1. How did participants perceive the impact of the afterschool Peer Tutoring Club on their academic performances in mathematics?

RQ2. How did the participants perceive the afterschool Peer Tutoring Club's influence on their attitudes toward mathematics?

Facilitator Recruitment and Support

This investigator recruited teachers at ABC Middle School to serve as volunteer facilitators for the math PTC. To communicate the need and encourage teachers at ABC Middle School to sign up to serve as facilitators, the investigator posted a sign-up sheet on the door of the teacher's mailbox room, sent emails soliciting volunteer facilitators, and made face-to-face requests for teachers to serve as volunteer facilitators. Eight teachers, six females and two males, agreed to volunteer as facilitators. Six of the eight facilitators agreed to facilitate for at least one of the three weekly sessions. Two of the eight facilitators served as substitutes. One facilitator agreed to serve as club sponsor.

PTC Recruitment, Orientation, and Training

The recruitment, orientation, and training process during this peer tutoring study provided an equitable way for students to join and receive the applicable orientation and training necessary for participation. A description of this process follows which provides the steps that the investigator used to recruit, orient, and train tutors, and the steps the investigator used to recruit and orient tutees into the PTC.

Recruitment. Students at ABC Middle School, located in a southeastern city of the United States, were invited to join the PTC as tutors and tutees. Invitation letters (see Appendix E), school-wide intercom and closed-circuit announcements, and a PTC brochure were used to recruit members. Fourteen tutees and 20 tutors were enrolled as members of the PTC.

PTC orientation and training. Prior to the PTC's first tutoring session, this investigator conducted three hours of orientation and training (see Appendix F) for the PTC tutors. During the orientation and training sessions, this investigator, along with a facilitator, provided PTC members with information regarding the club's vision, procedures, and expectations. Three tutor training lessons incorporated role playing and peer tutoring scenarios in order to teach real world lessons involving confidentiality, complementing as a motivational tool, and math tutoring strategies and procedures. Tutors were provided a PTC booklet, which contained orientation and training materials.

The investigator provided a 1-hour orientation session for tutees to discuss the club's vision, procedures, and expectations. Some of the key points discussed during orientation involved tutor, tutee, and facilitator responsibilities and tutee attendance expectations. A PTC booklet which contained orientation materials was issued to tutees as an added resource.

Description of the Sample

After IRB approvals were granted, a nonrandom purposive sampling was used within the PTC at ABC Middle School, located in a southeastern city of the United States, to invite Grade 6 Course 1 and Grade 7 Course 2 math tutees to participant in the study. Parental consent and student assent forms were issued to students in Grade 6 Course 1 and Grade 7 Course 2 math classes. As a result of this recruitment process, five, Grade 6 Course 1 tutees and one, Grade 6 Course 1 Honors tutee from the PTC agreed to participant. They returned their signed consent and assent forms and became participants in this case study. All six tutees had been recommended by their math teachers to receive peer tutoring. Four of the six participants did not pass the 2016–2017 Standards of Learning (SOL) end of the year test. The remaining two participants passed the 2016–2017 SOL; however, they received an F or D for the first quarter of the 2017–2018 school year. Of these six participants, three were male and three were female. Table 4 displays math course and data pertaining to study selection requirements for each participant. Due to the small sample size, race and gender were not included in order to maintain confidentiality

Table 4

Participant Data

Participant	Passed previous year's SOL	First quarter grade
P1	No	D
P2	No	C
P3	Yes	D
P4	No	D
P5	Yes	F
P6	No	C

Research Methodology and Analysis

Research site and IRB approvals, along with participants' signed consent and assent forms, enabled me to begin collecting data in December of 2017. The descriptive case study data were collected from sources outlined in Chapter 3. Table 5 shows data collected and the time frame that data were collected from participants. Three participants were absent on the day of the ATMI pretest and did not complete the ATMI pretest. The pretest was administered after tutoring sessions were resumed in March 2018 following the investigator's 1-month hiatus. Attendance for the three participants who were absent during the ATMI pretest was sporadic during this time period. Additionally, school-wide common assessment preparation, transportation, and other after school activities during this period of time caused some absences during afterschool club meetings. However, all participants completed the ATMI posttests.

Table 5

Data Sources

Data collected	Time frame
Pretest (Math & ATMI)	Dec 2017–Apr 2018
Participants ‘Math Work (Tutee Folder)	Dec 2017–May 2018
Posttests (Math & ATMI)	May–June 2018
Tutees’ Exit Interviews	May–June 2018

Data collection took place December 2017 through January 2018 and from March 2018 through June 2018. The Peer Tutoring Club held 46, 1-hour, afterschool sessions during this time period. The data findings are reported in tabular, graphing, and narrative forms. The subsequent chapter sections include a description and analysis of the school district’s math pretests and posttests, the Attitude Towards Math Inventory (ATMI), student work, and the exit interviews completed by tutees. The results of these findings, based on the research questions, are presented and a summary of Chapter 4 is provided. The findings are used to answer the two research questions:

RQ1. How did participants perceive the impact of the afterschool Peer Tutoring Club on their academic performances in mathematics?

RQ2. How did the participants perceive the afterschool Peer Tutoring Club’s influence on their attitudes toward mathematics?

Findings from multiple data sources provided the investigator with data saturation. Thick description was used to provide relevance and meaning to the data findings. The steps used to collect and analyze data findings for this case study are explained in the next sections.

Descriptive Data

Data were collected from six instruments during the 46 peer tutoring sessions of this qualitative case study. The triangulated evidence described the Grade 6, pretest and posttest math results, the pretest and posttest ATMI results, online and paper-based work completed by tutee participants, and exit interviews. Data sources from each tutee were collected, coded, and analyzed using manual and electronic methods. The collection, coding, and analysis processes that are presented next were used to answer the research questions.

Data Analysis Process

As presented in Chapter 3, the investigator linked the data to theoretical propositions. In theoretical coding, the data is coded and categorized according to themes based on the theoretical propositions (Saldaña, 2009). The data sources used were the District's Grade 6 mathematics pretest and posttest, Attitude Towards Math Inventory (ATMI), participants' online and paper-based math work, and open-ended exit interviews. As displayed in Figure 1, the data analysis process utilized a cyclical, comparative evaluation of research findings based on the theoretical propositions. The data collection and the analysis of data were convergent and reoccurring events. As a result of this process, the researcher was able to compare emergent categories, patterns, and themes with the theoretical propositions. Detailed triangulated analysis of the data provided data convergence and support for the case study events. Through triangulation, the data corroboration was completed, compiled, and described in this section and presented in its entirely in Chapter 5

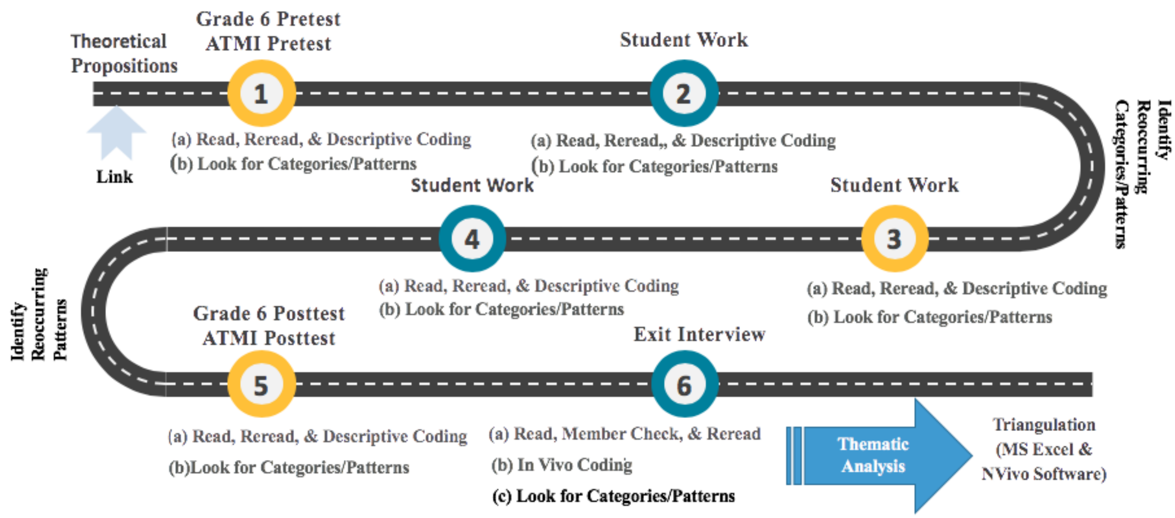

Figure 1. Data analysis process.

The data analyses for this descriptive case study included an initial analysis of data through the reading and rereading of data, descriptive statistics, thematic analysis, and triangulation. The data sources and the data collection and analysis process are described in the following paragraphs. These data instruments were analyzed independently and holistically to determine corroboration based on the study's research propositions.

Pattern matching was used to compare the study's empirical data with the predicted pattern, which was determined before the investigator collected data. The predicted pattern was based on theoretical propositions which were initially stated in Chapter 1. The two research propositions were used as guides to align the study's empirical data and to help facilitate theme development. One proposition was based on Vygotsky's theory, peer tutoring enables participants to make academic improvements in mathematics by working collaboratively with a knowledgeable peer. The other proposition stated that providing opportunities for student success through peer tutoring interactions improves participants' attitudes towards mathematics..

The pattern matching strategy used in this study enabled the investigator to organize and focus on the most importance data based on the theoretical propositions (Saldaña, 2009, 2015; Yin, 2014). Each of the six data sources for this study was initially analyzed independently followed by a constant comparison process. This cyclical process continued throughout data analysis to include the development of categories and themes as they related to the propositions and research questions (Baškarada, 2014; Yin, 2014).

After reading and rereading the data for a holistic analysis, the first cycle coding was initiated. Descriptive coding was used to provide a detailed account of the results from the tutees' pre/post math test, pre/post ATMI, and the math work provided in each tutee's peer tutoring folder. Descriptive coding summarizes in a word or short phrase the topics from a variety of data forms (Saldaña, 2009). In vivo coding was used to code the tutees' interview transcripts in order to capture the participants' language and perspectives. In vivo coding is also referred to as "Literal Coding" (Saldaña, 2009). In vivo coding extracts participant generated words and phrases from the actual data and enables the participant's "voice" to be acknowledged (Saldaña, 2009). Word and Excel documents were created to organize this first cycle of coding, and preliminary sorting was implemented which produced categories based on the theoretical propositions (see Appendix L). During the second coding cycle, patterns were compared and matched between the study's empirical data and the predicted patterns. In vivo interview codes were imported to NVivo software for additional verification of the manual codes. Manual and CAQDAS coding through the use of NVivo helped to develop and solidify the following themes: (a) able to make academic gains in mathematics, (b) supportive learning environment, and (c) positive influences relating to attitudes towards learning mathematics. The theoretical propositions, research questions, study instruments, and sample empirical evidence used for pattern matching are presented in Table 6.

Table 6

Pattern Matching Comparative Data

Theoretical propositions/predicted pattern	Research questions	Instruments	Sample study evidence
Based on Vygotsky's theory, peer tutoring enables participants to make academic improvements in mathematics by working collaboratively with a knowledgeable peer.	RQ 1 How did the participants' experiences in the afterschool Peer Tutoring Club impact their academic performances in mathematics?	Grade 6 Math Pre/Post Test Student Math Work Exit Interview & Reflection	Group Gain = 45 points Tutee's demonstrated significant improvement with Bloom's Level 3 problem-solving (see Table 3). Academic Gains "learned new things about fractions" "doing better" "Passed SOL""doing better" "get help and get better" "get answers right"
Providing opportunities for student success through peer tutoring interactions improves participants' attitudes towards mathematics.	RQ 2 How did the participants' experiences in the afterschool Peer Tutoring Club influence their attitudes toward mathematics?	Pre/Post ATMI Exit Interview & Reflection	Gains in each of ATMI categories: Confidence, Value, Enjoyment, & Motivation. "fun and peaceful" "feel better" "understand in easier way" "now I am good"

Because relying on theoretical propositions helps to shape the data collection (Yin, 2014), the results from this pattern matching strategy helped to formulate themes and corroborate the theory. These analytic strategies produced results that were later synthesized and triangulated to answer the two research questions.

The district's math pretest is routinely administered to math students at ABC Middle School, usually during the first two weeks of school. However, the study's consent and assent forms were approved by IRB on December 13, 2017 and December 14, 2017 respectively. In order to determine a baseline score, each of the six tutee participants were administered the district's math pretest for Grade 6 during the first week after their signed assent and consent forms were received. Five participants completed the math pre-test within their assigned math class during the regular school day. One participant completed his pretest in the peer tutoring room. The posttest was administered in the participants' regular class setting in May 2018. The math pre and posttests were analyzed to determine overall change in scores for each participant. The math pretest and posttest questions were color coded to specify Bloom's taxonomy level which was later used to determine gains in various levels of problem-solving.

The ATMI pretest and posttest results were analyzed to determine overall change in mean scores for participants who completed both pretest and posttest. Three participants did not complete the preATMI due to absences. The ATMI pretest and posttest data were initially categorized by subscales using MS Excel and analyzed to reflect subscale scores as they related to math confidence, math value, math enjoyment, and math motivation for each tutee and the group as a whole. Similarities and patterns were further analyzed for themes. SPSS software was later used to generate descriptive statistics for participants' pretest and posttest responses for each of the survey items. Tables and graphs were created in Excel and SPSS to display these results in order to corroborate patterns for the triangulation of data.

The two additional instruments used were online and paper-based student work and exit interviews. The student work documents were reviewed and coded to determine challenges and growth patterns pertaining to a specific content strand and Bloom's taxonomy level. The investigator accessed the participants' online Virtual Tutor program. Each participants' assignment data was analyzed to determine challenges, successes, and growth. Each tutee maintained a math folder which contained sample work from online and paper-based assignments. Participant folders were collected daily for analysis by investigator. All participants' work, however, was not kept in the participants' folders because tutees completed some of their work using whiteboards, blackboards, verbal response games, and by tutor and tutee verbal interactions. Therefore, the investigator did not have access to problem-solving data completed during these interactions. However, the sample online and paper-based math problems that were kept in each tutee's folder were reviewed, coded, and analyzed by the investigator. Samples of this data were recorded in a MS Word document and displayed in Table 10.

The handwritten exit interview responses for each tutee participant were typed into MS Word by the investigator as a document file and color coded for patterns and themes. This information was later transferred to NVivo where nodes were created to synthesize codes, categories, and themes. Word frequency queries and hierarchy visualizations were generated in NVivo to provide more understanding of data patterns.

Using all data to build codes, patterns, themes, and to make links to theory are techniques that provide a thorough case study analysis (McMillan, 2012; Yin, 2009). The investigator was able to use empirically-based patterns or common occurrences in the data to compare to the theoretical and research-based propositions stated previously in Chapter 1. The qualitative data remained central to the case study while the relevant quantitative descriptive analyses helped to provide a strong analytic strategy (Yin, 2009).

Summary of the Findings

The overarching propositions guided the data collection and analysis (Yin, 2009) for this case study, which explored the tutees' perceptions of how peer tutoring changed their attitudes and achievement toward mathematics. The propositions were based on theories involving Vygotsky's ZPD, Piaget's social transmission, and Gardner's MI as they relate to changes in student's attitudes and academic achievement within a peer tutoring environment. The pattern matching strategy was used to organize the data based on the theoretical propositions (Saldaña, 2009, 2015; Yin, 2014). A constant cyclical comparison process led to the development of categories, patterns, and themes pertaining to the propositions and research questions (Baškarada, 2014; Yin, 2014). Manual descriptive coding and in vivo coding were used to code and analyze interviews, student work, and attitudes toward mathematics surveys. Electronic analysis using NVivo software was also performed to verify relationships between codes and code frequencies. This coding process generated clusters of patterns that were consolidated into themes (Saldaña, 2015). The pattern matching process of comparing theoretical propositions with the empirical findings provided confirmation of "matched" connections between propositions and study findings. As a result of this pattern matching process, the following three themes were generated: (a) able to make academic gains in mathematics, (b) supportive learning environment, and (c) positive influences relating to attitudes towards learning mathematics.

The data analysis process revealed that the three themes were directly related to how the tutees' experiences in the Peer Tutoring Club influenced their attitudes toward mathematics and impacted their academic performance. The analyses of each study instrument and the connections found between the theoretical propositions, research questions, and sample empirical evidence used during the pattern matching process are discussed below.

Presentation of the Data and Results

All participants showed substantial growth from pretest to posttest on the Grade 6 math assessment and the ATMI (see Figure 2). There was also evidence in online and paper-based student work that the tutees' abilities to solve math problems, including multistep math problems had improved. Additionally, responses to exit interview questions revealed that the tutees perceived that their attitudes towards math and academic achievement had improved.

Math pretest and posttest. The district's mathematics 20 question pretest and posttest measured gains in Grade 6, Number and Number Sense and Computation and Estimation skills. All participants showed academic growth from pretest to posttest as displayed in Figure 2.

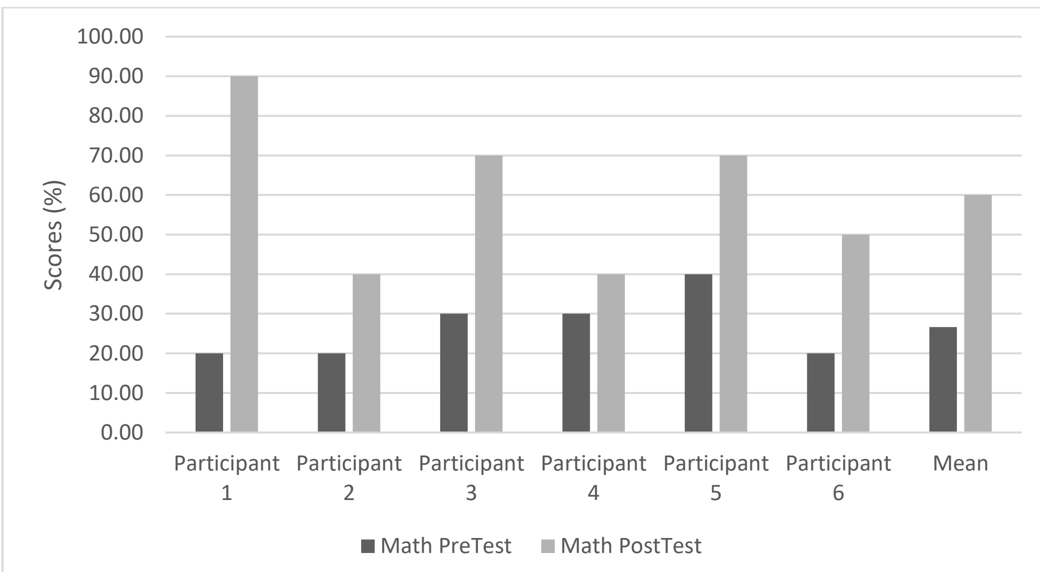

Figure 2. Tutees' math pretest and posttest results.

Descriptive statistics were used to analyze the Grade 6 mathematics pretest and posttest as shown in Table 7. A scale of 0–100 was used to evaluate the tests results. The mean score for the pretest was 26.67 and the mean score for the posttest was 60.00. The difference between the pretest and posttest means was 33.33 percentage points. This notable difference revealed substantial improvement in test scores. However, the standard deviations from pretest to posttest of 8.16 to 20.00 respectively showed a high degree of dispersion of scores within the posttest. This dispersion was further revealed within the posttest minimum and maximum values. Participant 1 scored 90 percentage points on the posttest which was 50 percentage points higher than the posttest minimum value. As a result of this score, the posttest mean and standard deviation were impacted. However, the pretest and posttest instruments were effective in measuring the tutees'academic growth in mathematics.

Table 7

Pretest/Posttest Descriptive Statistics

Test	Mean	Standard deviation	Minimum value	Maximum value
Pretest	26.67	8.16	20.00	40.00
Posttest	60.00	20.00	40.00	90.00

Since one of the primary focus areas for this research study was multistep problem-solving, the data analysis in Table 8 provides a description of the growth that occurred from pretest to posttest, as well as, growth involving the 12 multistep problems for each participant. The multistep problems were classified as Bloom's Category 3 problems. The Virginia Department of Education (VDOE, 2018) defined a multistep problem as any problem that requires two or more steps to solve.

Table 8

Pretest/Posttest Individual and Group Gains

ID	Math pretest	Math posttest	Pre/Post gain	Pre/Post multistep problems gain
Participant 1	20.00	90.00	87.50	100
Participant 2	20.00	40.00	25.00	33
Participant 3	30.00	70.00	57.00	51
Participant 4	30.00	40.00	14.00	27
Participant 5	40.00	70.00	50.00	33
Participant 6	20.00	50.00	38.00	30
Group average	26.67	60.00	45.25	45.67

Attitudes Towards Mathematics Inventory (ATMI). The Attitudes Towards Mathematics Inventory (ATMI) was used to measure changes in attitudes towards mathematics during the research period. This inventory is comparable to the Fennema-Sherman (F-S) Mathematics Attitude Scale of 1976 (Brookstein, Hegedus, Dalton, Moniz, & Tapper, 2011). The ATMI (see Appendix C) was developed to fill the need for a shorter instrument that could withstand factor analysis (Tapia & Marsh, 2004). ATMI, according to Tapia and Marsh (2004), has a reliability coefficient alpha of .97 and can be used to analyze four factors: (a) self-confidence, (b) value of mathematics, (c) enjoyment of mathematics, and (d) motivation (Tapia & Marsh, 2004). This investigator proposed that the ATMI be administered during the first and last week of the research study. However, the ATMI pretest was not administered until after tutoring sessions were resumed in March 2018 following the investigator’s 1-month hiatus. Three participants were absent on the day the ATMI pretest was given. Therefore, the resulting sample available for ATMI pre/post analysis was three participants, which is smaller than the recommended size of five suggested for performing the Wilcoxon match-paired test. The investigator grouped all participants' responses into the four subgroups, self-confidence, value of mathematics, enjoyment of mathematics, and motivation; then, the investigator coded each response, and input this data into an Excel spreadsheet for descriptive analysis. Next, the investigator used SPSS analyses software as a second round analysis tool to provide descriptive measures. Figure 3 shows the ATMI's pre/posttest results for each subgroup score.

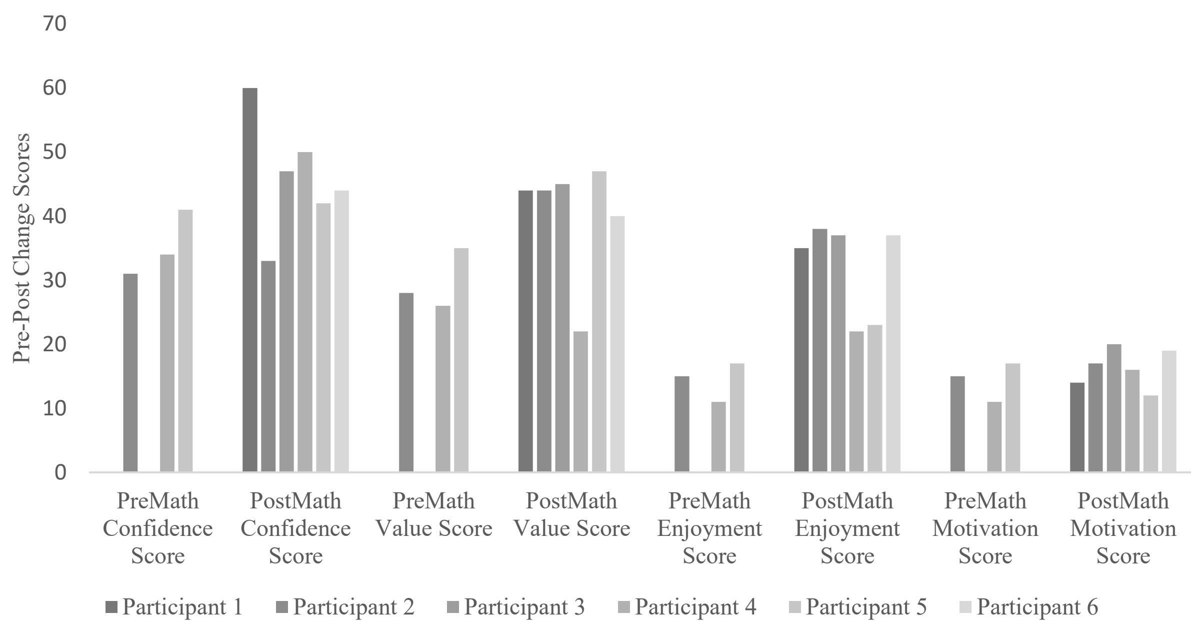

Figure 3: ATMI pre/post results.

Table 10 shows the measures of dispersion for the four ATMI subgroups pertaining to the three participants who took both pretest and posttests for the ATMI. The number of participants (*N*), minimum, maximum, mean, and standard deviation (*SD*) data for pretest and posttest are presented in Table 9 along with averages.

Table 9

ATMI Pretests/Posttest Results

Subgroups	*N*	Minimum	Maximum	Mean	*SD*
PreMath confidence points	3	31.00	41.00	35.33	5.13
PostMath confidence points	3	33.00	50.00	41.67	8.50
PreMath value points	3	25.00	35.00	29.33	5.13
PostMath value points	3	22.00	47.00	37.67	13.65
PreMath enjoyment points	3	11.00	17.00	14.33	3.06
PostMath enjoyment points	3	22.00	38.00	27.67	8.96
PreMath motivation points	3	11.00	17.00	14.33	3.06
PostMath motivation points	3	12.00	17.00	15.00	2.65
Averages	3	20.88	32.75	26.92	6.27

The ATMI questions and the participant responses to the 5-point, Likert scale items, are displayed in Appendix G. The pre/post mean and standard deviation (*SD*) were used to determine changes in attitudes toward mathematics. The four subscales and the item numbers were provided for my use by M. Tapia (personal communication, July 3, 2017) and are listed below:

1. Self-confidence: Items 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, & 40
2. Value: Items 1, 2, 4, 5, 6, 7, 8, 35, 36, & 39
3. Enjoyment: Items 3, 24, 25, 26, 27, 29, 30, 31, 37, & 38
4. Motivation: Items 23, 28, 32, 33, & 34

The tutee responses were coded in SPSS by subscales, and because items 9, 10, 11, 12, 13, 14, 15, 20, 21, 25, and 28 were negatively worded, they had to be reverse coded (M. Tapia, personal communication, July 3, 2017). With this 5 item Likert scale of 1 = highly dissatisfied, 2 =

dissatisfied, 3 = neutral, 4 = satisfied, and 5 = highly satisfied, the higher the participant's score indicated a more positive attitude towards mathematics. The analysis of ATMI data revealed that P4 scored 34 points on the PreMathConfid subscale. P4 scored 50 out of a possible 75 points on the PostMathConfid subscale. This is a gain of 16 confidence points. Of the three participants who took both pre and post ATMI, all made gains, however, P4 made the highest gain in math confidence. MS Excel and SPSS descriptive analysis results for the ATMI data are displayed in Table 10, Figure 3, and Appendix G. This data from the pretest and posttest ATMI results were used to compare areas of growth as it pertained to participants' Likert scale responses.

Math assignments. Grade 6 Course 1 pre/post mathematics' tests were one of six instruments used to measure the tutees' growth. The pretest strands and teacher recommendations guided the PTC curriculum. The district-wide math pretest and posttest were used to measure student growth in the following strands: (a) Number and Number Sense (NNS) with a focus on relationships among fractions, decimals, and percentages, and (b) Computation and Estimation (C&E) with a focus on applications of operations with rational numbers. Since these math strands are focus areas for the district, the curriculum for the PTC was based on NNS and C&E strands, in addition to, teacher recommended strands. The tutee participants solved problems involving fractions, decimals, percentages, integers, ratios, exponents, perfect squares, equations, probability, and evaluation of numerical expressions using order of operations. However, the primary focus was for tutees to solve application problems within the number sense and computation and estimation strands. Incorporating problem-solving within the NNS and C&E concepts provided participants with more understanding concerning the magnitude of numbers, how to judge the reasonableness of answers, and how specific arithmetic operations affect numbers (Dougherty & Crites, 1989; Louange, 2010). The sample problems in Table 10 provided opportunities for tutees to utilize NNS and C&E concepts while solving multistep problems. These problems are representative of the types of problems solved by participants which were completed using the online Edgenuity Virtual Tutor course and paper-based problems issued to tutees during their peer tutoring sessions. The Table 10 problems are classified as Bloom's Taxonomy, Level 3, Applying. Gallagher (2017) stated that the highest form of teaching occurs when students work cooperatively, solve open-ended problems, and use higher-order critical thinking. Bloom's taxonomy is a hierarchy of six levels of cognitive thought processes. These processes are Level 1: Know, Level 2: Comprehend, Level 3: Apply, Level 4: Analyze, Level 5: Evaluate/Assess, and Level 6: Create/Synthesize (Adams, 2015; Gallagher, 2017). Levels 3 through 6 require more cognitive processing and involves higher order critical thinking skills (Adams, 2015; Gallagher, 2017). The multistep, Level 3, problems in Table 10 are representative of questions that require the use of more than one definition, theorem, and/or algorithm, and according to Bloom, is where "real" learning begins (Edgenuity Principles & Practices, 2016; Gallagher, 2017). Table 11, also, shows examples of the types of problems solved incorrectly and solved correctly as participants transitioned, with help from tutors, through the peer tutoring sessions.

Table 10

Sample Multistep Problems Completed by Participants

Participant	Item	Response type	Source
1	Susan has 20 cups of flour. She used 7 ¾ cups of flour for a batch of bread and 3 1/3 cups of flour for a batch of cookies. How much flour did Susan have left after she baked the bread and cookies?	Open ended—Bloom's Level 3 4 5/12 (incorrect)	District Math Pretest—Grade 6 Computation & Estimation
1	There are three grades in John's middle school—sixth, seventh, and eighth. One-third of the students are in sixth grade and ¼ are in seventh grade. What fraction of the schools' students are in eighth grade?	Open ended—Bloom's Level 3 5/12 (correct)	Holt McDougal Math (paper-based) —Grade 6 Computation & Estimation
2	A board is 24 ¾ feet long. It is cut into 6 equal pieces. How long is each piece?	Open ended—Bloom's Level 3 4 ¾ feet(incorrect)	Paper-based—Grade 6 Computation & Estimation
2	4 2/3 ÷ 6 =	Multiple Choice—Bloom's Level 3 7/9 (correct)	District Math Pretest—Grade 6 Computation & Estimation
3	The runny track behind the local gym is ¾ mile long. The track and field team ran 2 2/3 laps around the track. How many miles did the team run?	Open ended—Bloom's Level 3 35/12 miles (incorrect)	Edgenuity(online)—Grade 6 Computation & Estimation
3	James runs 1 2/3 miles every Monday and 2 ¾ miles every Wednesday. With this routing, how many miles would he run in three weeks?	Open ended—Bloom's Level 3 13 ¼ miles (correct)	Paper-based—Grade 6 Computation & Estimation

Table 10 (continued)

Sample Multistep Problems Completed by Participants

Participant	Item	Response Type	Source
4	In 1900, there was an Olympic underwater swimming event. The score was calculated by giving one point for each second the swimmer stayed under water and two points for each meter that the swimmer traveled. Charles de Vendeville from France earned a gold medal for staying under water 68.4 seconds while traveling 60.2 meters. How many points did Charles de Vendeville earn to place first? Express the answer to the nearest tenth of a point.	Multiple Choice—Bloom's Level 3 88.8 pts. (incorrect)	Edgenuity(online) —Grade 6 Computation & Estimation
4	The ticket prices to a play are \$5.50 for teachers and \$2.75 for students. How much will it cost for a group of 5 teachers and 70 students to see the play?	Open ended—Bloom's Level 3 (correct)	District Math Pretest—Grade 6 Computation & Est.
5	What is the value of the expression? 28 -16 ÷ 8 – 4	Multiple Choice—Bloom's Level 3 24 (incorrect)	Edgenuity(online) —Grade 6 Computation & Estimation
5	Cathy must use the order of operations to evaluate the following expression. $4(6 + 2) – 4^2$ What should be the last step Cathy performs if she uses the correct order of operations?	Multiple Choice—Bloom's Level 3 32 – 16 (correct)	District Math Pretest—Grade 6 Computation & Est

Table 10 (continued)

Sample Multistep Problems Completed by Participants

Participant	Item	Response Type	Source
6	Chen is baking cookies and a cake for a party. He needs 3 1/5 cups of flour to make the cookies and 3 2/3 cups of flour to make the cake. Which is the best estimate of the number of cups of flour that Chen needs to bake both recipes?	Multiple Choice—Bloom's Level 3 8 cups of flour (incorrect)	Edgenuity(online)—Grade 6 Computation & Estimation
6	Sandy completed 1/9 of Saturday's crossword and 3/5 of Wednesday's crossword. In total, what fraction of these crosswords did Sandy finish?	Multiple Choice—Bloom's Level 3 32/45 (correct)	Paper-Based—Grade 6 Computation & Estimation

Face-to-Face exit interviews. After each response to each question, the researcher read the tutee's responses to him or her in order to check for accuracy. This allowed tutees to change wording, make deletions, or add new information to their responses. The participants' reviews helped to increase construct validity (Yin, 2009, 2014). The responses to the face-to-face interviews enabled the investigator to gain insight from the participants' perspective as to why or how peer tutoring impacted their attitudes and performance in mathematics.

Coding followed member checking. The interview data were initially coded in MS Word using highlighting and annotations. Next, MS Excel was used to refine the first round of coding by combining and rearranging categories. Finally, data were transferred to NVivo and nodes were created to synthesize codes, categories, and themes. Word frequency queries and hierarchy visualizations were generated in NVivo to provide more understanding of data patterns to aid in the development of themes.

Themes. The systematic analysis of the data provided by the participants produced the following themes: (a) able to make academic gains in mathematics, (b) supportive learning environment, and (c) positive influences relating to attitudes towards learning mathematics. Twenty reference codes were generated for academic gains; 39 reference codes were generated for a supportive learning environment, and 18 codes were generated for positive influences relating to attitudes. Four codes were generated that related to obstacles impacting progress, attitude, and environment. Using data from multiple sources from all participants to arrive at these major themes was critical to establishing construct validity (Yin, 2009, 2014). Data triangulation, theory, propositions, and adhering to protocol provided the investigator with an analysis process to ensure the findings represented an accurate description of the tutees' peer tutoring experiences. Giving a voice to the participants through this in-depth investigation established meaning to their experiences within the Peer Tutoring Club.

Summation of Results as they Relate to Research Questions

The results that emerged from the analysis of data from the four instruments used in this case study were recorded in Table 11. These results were used to address Research Question 1 (RQ1) and Research Question 2 (RQ2).

RQ1. How did participants perceive the impact of the afterschool Peer Tutoring Club on their academic performances in mathematics?

RQ2. How did the participants perceive the afterschool Peer Tutoring Club's influence on their attitudes toward mathematics?

Following is a detailed description of the data that supports each major theme and the research questions.

Table 11

Summation of Findings in Relation to Each Research Question

Research Question(RQ)	Themes	Subthemes	Meanings	Sample evidence
RQ1 RQ2	1) Academic Achievement 20 codes	Feedback Problem-solving Experiences Gains	The data reveals that PTC tutees made academic gains on district pre/posttest, paper-based multistep problems, and online multistep problem-solving.	*P1, a male, Grade 6, Course I math student, obtained a pre/posttest gain of 87.50%. *P1 stated during the exit interview, "when I joined the peer tutoring club, I got help and I started doing bett in math. I even passed my Math SOL!" *Tutee's group pre/post math effect size was 2.37.
RQ1 RQ2	2)Supportive Environment 39 codes	Trusting Relationships Belonging Collaboration acceptance	A supportive environment in the PTC was depicted in trusting relationships, tutor and peer collaboration, group acceptance, and a sense of belonging.	* All tutees stated that they were able to get help and/or that the tutors made it easier to understand. *P2, a male, Grade 6, Course 1 math student, stated that the environment "makes you feel better." *P3, a male, Grade 6, Course 1 math student, stated, "everyone is nice and doesn't get mad" *P4, a female, Grade 6, Course 1 math student, stated that the environment helps her to "not be afraid to ask questions"

Table 11 (continued)

Summation of Findings in Relation to Each Research Question

Research Question(RQ)	Themes	Subthemes	Meanings	Sample evidence
RQ1 RQ2	3)Positive Influences on Attitudes 18 codes	Optimism Increased Engagement Confidence Enjoyment	Data supports positive Influences on tutees' attitudes that reveal optimism, enjoyment, active engagement, and confidence during their participation in the PTC.	*P1 stated, "At first, I was nervous about mathematics, but then when I joined the peer tutoring club, I got help and I started doing better in math" *Tutees indicated that they were doing better, feeling better, and understanding more math since participating in PTC. *P2, P4, & P5 showed pre/posttest gains on the ATMI's enjoyment subscale of 15pts, 23pts, and 6 pts respectively. *P3 states that his attitude changed because "I know more and better ways to study with a group and by myself."

Results Related to Research Questions 1 and 2

In this section, data pertaining to RQ1: How did the participants' experiences in the afterschool Peer Tutoring Club impact their academic performances in mathematics? and RQ 2: How did the participants' experiences in the afterschool Peer Tutoring Club influence their attitudes toward mathematics? is placed into thematic categories. The thematic categories were formed from coded, categorized, analyzed, and synthesized data. Data triangulation aided in the development of three themes. Each theme was supported by evidence from the research instruments. The findings that emerged from the data analysis were rooted in data triangulation. This section contains each thematic category followed by evidence that provided answers to the research questions.

Thematic category 1: Ability to make academic gains in mathematics. The findings of this case study revealed substantial evidence that tutees made academic gains during their peer tutoring experiences. This theme was related to the first research question. The district's math pretest and posttest results show that the participants gained an overall average of 45.25 percentage points from pretest to posttest. The average multistep problem-solving gain for this test was 45.67 percentage points. P1 who scored a 20% on the pretest and a 90% on the posttest for a total overall gain of 87.5 percentage points, also made a 100 percentage point gain in solving the multistep problems contained in the pre/posttest. P1's math work supported a consistent application of problem-solving strategies while working with tutors; this added to his overall improvement in mathematics. P1 was able to solve the following multistep problem correctly during a peer tutoring session: Susan has 20 cups of flour. She used 7 ¾ cups of flour for a batch of bread and 3 1/3 cups of flour for a batch of cookies. How much flour did Susan have left after she baked the bread and cookies? During the exit interview, P1 stated, "when I joined the peer tutoring club, I got help and I started doing better in math. I even passed my Math SOL!" P3 and P5 both made pretest/posttest gains of 57 and 50 percentage points respectively, and made gains on the multistep problem-solving portion of the test of 51 and 33 percentage points respectively. Even though the math pretest revealed that all tutees showed weaknesses in fraction operations and multistep problem-solving, gains were consistently evident in student work and posttest results. P1 enthusiastically stated, "I learned new things about fractions and stuff." P4 stated that she was challenged by fractions, however, she stated, "being able to learn how to do fractions better and making an A" was described as a challenge overcome while participating in the PTC. Hattie's (2017) research findings show that peer tutoring not only changes student attitudes towards being willing to try mathematics, but peer tutoring programs also have a 0.55 effect size on academic achievement. Additionally, Vygotsky's Zone of Proximal Development theory (ZPD) emphasizes the importance of social interactions as crucial factors to cognitive development (Beliavsky, 2006). All tutors' responses during the interview indicated that working with tutors and being a part of the PTC helped them to get help and better understand their math work. Figure 4 displays a word frequency chart created using NVivo software that includes words used by participants during the exit interview to describe their academic experiences.

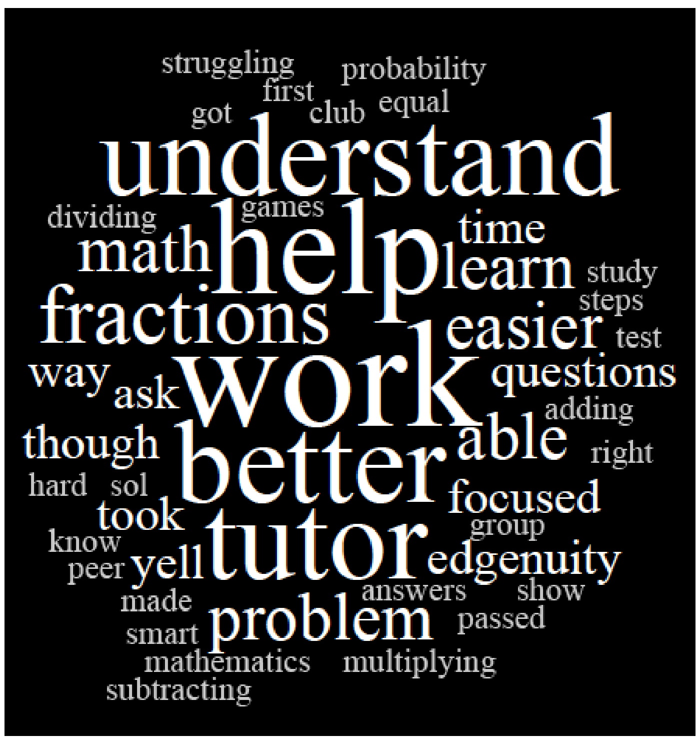

Figure 4. Academic word frequency cloud depicts words used most often during interview to describe tutees' academic achievement experiences.

Thematic category 2: Supportive learning environment. "Being able to not be afraid to ask questions" was the response P4 gave in reference to the PTC environment. A supportive peer tutoring environment encourages tutors and tutees from diverse backgrounds to collaborate and learn together which can produce positive changes in academics and attitudes (Robinson et al., 2005; Worley & Naresh, 2014). This thematic category was related to the first and second research questions. The results from the pre/post Attitudes Toward Math Inventory (ATMI) showed that participants made gains from pretest to posttest in confidence, value, enjoyment, and motivation scores. This five-point Likert scale inventory revealed that the highest posttest, subscale score was in enjoyment. An emotional factor, such as, enjoyment can contribute to optimal brain/mind functions which can have a positive impact on academics and attitudes (Hallowell, 2011). Three of the six participants took the pre and post ATMI.

Pre and post ATMI test. Of the three participants who took the pre and post inventory—P2, P4, and P5—gains were made in all four ATMI subgroups: self-confidence, value, enjoyment, and motivation. The largest gain was made in the enjoyment subgroup for P2, P4, and P5. Even though comparative ATMI data was not available for P1 and P6, their "posttest" data was included in Figure 4 as a means of providing a visual description of all ATMI data collected from participates. This provides evidence that P2, P4, and P5's average subgroup scores increased from pretest to posttest. Additionally, evidence is supported by empirical studies that have found that peer tutoring environments can change attitudes and improve academic progress. It is important for students to be able to communicate their ideas and clarify understandings through listening, discussion, refinement, and reflection (NCTM, 2017; Worley & Naresh, 2014). A Heterogeneous Peer Tutoring (HPT) program creates an environment where students from diverse educational, cultural, and socioeconomic backgrounds can work together on key mathematical concepts (Worley & Naresh, 2014). These group interactions, especially small group interactions within a peer tutoring environment, can produce significant results and proceed according to theory (Alegre-Ansuategui et al., 2018). Evidence from the participants' exit interviews about the peer tutoring environment supports the theory that peer tutoring improves attitudes and academic achievement. The participants' responses were as follows when asked to describe the peer tutoring environment:

P1: "Fun and peaceful and not as loud as regular classes."

P2: "Makes you feel better."

P3: "Safe environment—how everyone is nice and doesn't get mad."

P4: "It's fine; the people."

P5: "Tutor can sometimes be annoying; he reminds you to do work and take earbuds out; fun."

P6: "we can stay focused."

Thematic Category 3: Positive influences relating to attitudes towards learning mathematics. This thematic category was related to the first and second research questions. Influences that impact attitudes toward learning can also impact academic achievement (Hallowell, 2011; Hattie, 2012). Gains in pre/post subscale scores for ATMI and exit interview responses supporting positive attitude changes towards mathematics were additional findings that helped to answer research questions 1 and 2.

Findings from the NVivo word query of coded exit interview data generated the word cloud that represented atmosphere and influences of the PTC. Words with the highest frequency were help, tutors, fractions, math, better, and understand. This cross-age and same-age approach to peer tutoring helped to motivate both special and general education students to review key concepts (Bond & Castagnera, 2006; Hott & Walker, 2012). The influences of cross-age and same-age peer tutoring that occurred within the PTC were represented by the words used by the tutees to describe how the experiences in the PTC influenced their attitudes toward mathematics. Figure 5 displays a word cloud created using NVivo that depicts the participants' responses to the exit interview question that pertained to their perception of how the PTC influenced their attitudes toward mathematics.

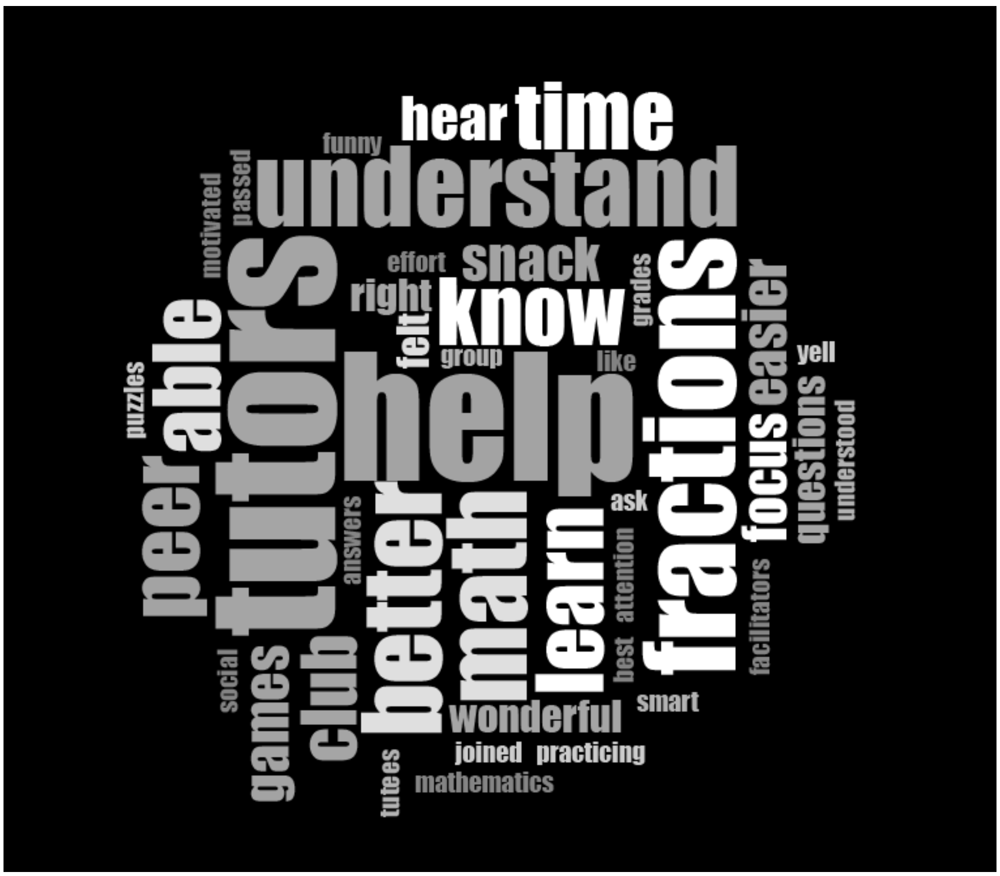

Figure 5. Frequency cloud showing words used by participates that describe their attitude towards mathematics.

The interview written reflection question stated, "What change or changes in your attitude (feelings) towards mathematics would you say came as a result of having participated in the Peer Tutoring Club? The students' responses revealed their positive attitudes toward receiving help and making progress in math.

P1: "At first, I was nervous about math." "When I joined the peer tutoring club, I got help and I started doing better in math."

P2: "Peer Tutoring makes me smart." "[Peer Tutoring] makes me get help." "So, you can get all the answers right if you do all the work."

P3: "I know more and better ways to study with a group and by myself."

P4: "I feel good about it." " . . . the club help[ed] me be able to understand my work in an easier way."

P5: "It's kinda more easier in math now because the [facilator] helped me with probability which I was struggling on a lot, and it got me [from a] D [to a] C+ in math now."

P6: "Before Peer tutoring Club I felt ok because it was getting hard and I did not know what to do and now I am good and learning better."

Further evidence of experiences that changed participants' attitudes toward mathematics was found in the ATMI pretest and posttest results. Of the three participants who took both pre and posttest—P2, P4, and P5—gains were made in all four ATMI subgroups: self-confidence, value, enjoyment, and motivation. The largest gain was made in the enjoyment for P2, P4, and P5. Even though P1 and P6 did not complete the pre ATMI, their post scores were comparable to P2, P4, and P5 subgroup posttest scores.

Triangulation of Data Sources

The multiple sources of data collected from 46 peer tutoring sessions provided a saturation of triangulated evidence to answer the research questions. The data sources revealed the following three major themes: (a) Able to make academic gains in mathematics, (b) Supportive learning environment, and (c) Positive influences relating to attitudes towards learning mathematics. These three themes were evident in the qualitative and quantitative data collected during this case study.

Academic gains in mathematics. The math pre/posttests gains, including gains made in the multistep problem-solving questions on pre/posttests, were substantial. The participants overall gains on the solving of multistep problems from pre to posttests were 45.67 percentage points. The multistep problems were classified as Bloom's Category 3 problems and required at least two or more steps to solve.

Gains in attitudes towards learning mathematics. The Attitudes Towards Mathematics Inventory (ATMI) was used to measure changes in attitudes towards mathematics during the research period. This 40-question, 5-point Likert scale, inventory was used to analyze four factors: (a) self-confidence, (b) value of mathematics, (c) enjoyment of mathematics, and (d) motivation (Tapia & Marsh, 2004). Of the three participants who took both pre and posttest—P2, P4, and P5—gains were made in all four ATMI subgroups: self-confidence, value, enjoyment, and motivation. The largest gain was made in the enjoyment for P2, P4, and P5. Even though P1 and P6 did not complete the pre ATMI, their post scores were comparable to P2, P4, and P5 subgroup posttest scores.

Supportive learning environment. The supportive learning environment of the PTC was reflected in interview responses from participants. These responses ranged from feeling better about mathematics to feeling smarter. Some of the high frequency words used by tutees during their exit interviews were help, tutors, math, better, and understand. These high frequency words found during the NVivo word query of interview responses provided evidence that the tutees felt supported within the PTC environment.

The findings within these triangulated data sources support theory and empirical study evidence that peer tutoring improved academic achievement and attitudes toward math. The math pre and posttests, Attitudes Toward Math Inventory (ATMI), participants online and paper-based work, and the exit interviews all provided evidence that academic achievement and improvement in attitudes toward mathematics occurred for all participants in the study. This authentic data collected from the six tutee participants enabled the researcher to conduct a comprehensive analyses of the findings through the convergence of data from multiple data sources.

Chapter 4 Summary

The purpose of this qualitative case study was to investigate how an afterschool Peer Tutoring Club (PTC) affected academic performances and attitudes of at-risk, Grade 6, middle school mathematics students. The case study was conducted within the PTC of an urban middle school located in the southeastern part of the United States. This chapter described the recruitment process and the orientation and training provided to the PTC's tutors, tutees, and facilitators. A description of the sample size of six teacher recommended tutees was provided while maintaining each participants' confidentiality. The curriculum used within the PTC consisted of Grade 6 mathematics with a focus on online and paper-based multistep problem-solving. Data collection included math pretests and posttests, attitudes towards math pre and post surveys, online and paper-based math work, and exit interviews. This chapter summarized each data source as it related to the research questions. The investigator analyzed the data using an iterative and reflective process. MS Word, MS Excel, and SPSS software was used to analyze descriptive data from quantitative instruments—pre/post math assessment and Likert scaled ATMI survey. Codes were created, categorized, and sorted during the initial phase of qualitative data analyses using MSWord and Excel software to help identify themes related to the research questions. Next, the data from the exit interviews was transferred to NVivo and nodes were created to synthesize codes, categories, and themes. Word frequency queries and hierarchy visualizations were generated in NVivo to provide more understanding of data patterns to aid in the finalization of the development of themes.

Chapter 5: Discussion and Conclusion

Introduction

At-risk students, according to Sagor and Cox (2004), are defeated and discouraged learners. However, peer tutoring changes attitudes towards mathematics for the tutors and tutees (Worley & Naresh, 2014). Providing students access to a club that serves to encourage involvement and enhance achievement helped to reverse attitudes of defeat and discouragement (Chen, 2016). Mathematics, according to Hattie (2017), is the gateway to success, and mathematical literacy is a vital part of the equation that propels communication that leads to problem-solving. Many students, however, have difficulties solving multistep problems, especially word problems (Fuch et al., 2016; Montague, Krawec, Enders, & Dietz, 2014). The gap found in research studies pertains to limited research relating to the solving of word problems and rigorous computation problems during peer tutoring sessions or other interventions for middle school mathematics general education and special education students. The academically at-risk population and the achievement gap phenomenon are of state, national, and global concern. Providing all students more access to research-based programs that promote a community of rigorous academic achievement, collaboration, and encouragement, such as, peer tutoring will give students who are "at-risk" a chance to demonstrate their capabilities.

In Chapter 5, the researcher will assess how the findings in Chapter 4 address the study's research questions. The summary and discussion of the results will include a synthesis of the findings as they relate to the empirical literature. The limitations, implications, and recommendations for further study will also be discussed.

Summary of the Results

This study implemented Yin's five components of case study design: (a) research questions, (b) research propositions, (c) unit of analysis, (d) logic linking data to propositions, and (e) criteria for interpreting the findings. The two theoretical propositions and two research questions guided the data collection and analysis for this qualitative case study. Data pertaining to academic and attitude changes of six tutees within a middle school Peer Tutoring Club were triangulated using four instruments (a) Grade 6, mathematics pre and posttest, (b) attitudes towards mathematics survey, (c) online and paper-based student work, and (d) exit interviews.

The investigator followed Yin's (2014) and Saldaña's (2009) methods for data analysis. Saldaña's (2013) In vivo coding was used during first cycle coding to capture the participants' language and perspectives found in the exit interview data. Additionally, descriptive coding was used to summarize words and short phrases from a variety of data (Saldaña's, 2013). During Second Cycle coding, patterns and themes were compared and matched between the study's empirical data and the predicted patterns (Saldaña, 2013; Yin, 2014).

The themes identified from the data analysis process were: (a) able to make academic gains in mathematics, (b) supportive learning environment, and (c) positive influences relating to attitudes towards learning mathematics. The data from the matched patterns between the propositions and the themes from the empirical findings answered the two research questions:

RQ1. How did participants perceive the impact of the afterschool Peer Tutoring Club on their academic performances in mathematics?

RQ2. How did the participants perceive the afterschool Peer Tutoring Club's influence on their attitudes toward mathematics?

Discussion of the Results

Mulcahy et al. (2014), as a result of studying mathematics literature from 1975 to December 2012, found a need and recommended more research involving a rigorous focus on math concepts and problems solving. This qualitative, descriptive case study focused on multistep problem-solving within the PTC at a middle school in the southeastern part of the United States. This diversely populated school district's student population narrowly exceeds 20,000 according to a 2017 online national school rating organization. ABC Middle School is one of seven middle schools located in this southeastern city. Grade 6, Course 1 and Grade 7, Course 2 math students were invited to participant in the PTC study. This study investigated how an afterschool PTC affects academic performances and attitudes of at-risk, middle school mathematics students. Six, Grade 6, tutees—three male and three female—volunteered and were selected from the PTC to participant in the study.

Qualitative and quantitative data was collected from four instruments: (a) district's math pre/posttest, (b) Attitudes Toward Math Inventory (ATMI), (c) participants' work, and (d) participants' exit interviews. The data from these instruments was triangulated to address the two research questions:

RQ1. How did participants perceive the impact of the afterschool Peer Tutoring Club on their academic performances in mathematics?

RQ2. How did the participants perceive the afterschool Peer Tutoring Club's influence on their attitudes toward mathematics?

Data from participants' assignment folders showed the strategies used by the tutees when completing math problems. The district's 20 question, Grade 6, mathematics pre and posttest was used to measure gains in Number and Number Sense and Computation and Estimation problem-solving skills. Since one of the primary focus areas for this research study was multistep problem-solving, the data analysis provided a description of the growth that occurred from the overall pre to posttests, as well as, growth involving the 12 multistep problems. The multistep problems were classified as Bloom's Category 3 problems. Strategies included the 4-step problem-solving plan (Montague et al., 2014), which provided tutors and tutees guidance for the application of an effective strategy, whether paper-based or online. Participants' online and paper-based work showed improvement from an initial approach of writing an answer to the incorporation of the 4-step plan. Tutors and tutees had the option of working some of their problems on dry erase boards; therefore, I was unable to evaluate all work strategies. However, evidence from the quantitative data sources supports empirical studies (Daggett & Pedinotti, 2014; Franca, Kerr, & Lambert, 1990; Hattie & Yates, 2013; Hott, Walker, & Sahni, 2012) and this study's Research Question 1 that peer tutoring increases academic achievement.

Attitudes toward mathematics influences academic gains, especially for students who are at-risk of failure due to academic or behavioral concerns. A peer tutoring environment helps to build self-efficacy by producing positive changes in academic, attitude, and emotional behaviors for tutors and tutees from diverse backgrounds (Robinson et al., 2005; Worley & Naresh, 2014). Evidence pertaining to the impact of encouragement and the risks involved in the use of the term, *at-risk*, are important factors to consider when analyzing student achievement from a student's perspective (Cooper, 2007; Hanselman et al., 2014; Ladson-Billings, 2007; Steele, 2004). The qualitative data findings came as a result of in-depth analysis using manual and electronic coding. The ATMI data was categorized into the subgroups confidence, value, enjoyment, and motivation. The results revealed that pre/post ATMIs showed the most gain in the enjoyment subgroup. The other three subgroups were ranked as follows: 2nd highest gain = Value, 3rd highest gain = Self-Confidence, and lowest gain was in motivation. P2, P4, and P5 tutees who took both pre and post ATMI made gains in their attitudes toward mathematics. These results were instrumental in answering RQ2.

The exit interviews were the last instrument administered to participants. The findings in this analysis correlated with the findings depicted in the District's Pre/Post Math Test, the participants' online and paper-based work analysis, and the ATMI results. The words most frequently used during the exit interviews were help, tutors, fractions, math, better, and understand. The major categories that resulted from the interview codes were help from tutors and facilitators, good environment, no fear, feeling better, and getting better. A response from P1 during the interview that was representative, in some way, of all participants was "at first, I was nervous about mathematics. But then when I joined the peer tutoring club, I got help and I started doing better in math. I even passed my Math SOL!" These findings were also instrumental in answering RQs 1 and 2.

Discussion of the Study Results in Relation to the Literature

The National Education Association (NEA) describes peer tutoring as a research-based activity whereby students work in pairs to help one another learn or practice academic tasks (2015). Peer tutoring, of course, is not a new practice; it can be traced back to the ancient Greeks. A review of literature on peer tutoring suggested that peer tutoring in mathematics can produce positive changes in academic, attitude, and emotional behaviors for tutors and tutees (Ayvazo & Aljadeff-Abergel, 2015; Hattie, 2012; Robinson et al., 2005; Topping, 2015; Worley & Naresh, 2014). The findings of this empirical study of peer tutoring within the PTC at ABC Middle School confirm the theories and propositions posited in this study and corroborates the findings in research literature on peer tutoring. The research questions were designed to provide descriptive findings based on the triangulation of participant data.

Discussion of the Study Results and Theory

The nonthreatening or relatively private environment that is created when working in pairs and small groups is an effective way for students to communicate mathematically (NCTM, 2000). Participant 1 who had a gain of 87.5 percentage points from the math pretest to the math posttest also showed comparative high posttest scores in the ATMI's confidence, value, and enjoyment categories. In this learning process of listening and communicating, both tutor and tutee are influential in developing cultural norms of helping and caring (Hattie, 2012; Topping, 2015). Although participants' attitudes toward mathematics improved in all categories, results of this case study revealed that the highest gain on the ATMI's subscale categories of confidence, value, enjoyment, and motivation was in the enjoyment category. Participant 4, however, who made the lowest gain from math pretest to math posttest, scored high on the confidence level for the post ATMI, but scored the lowest in the post ATMI's enjoyment and value categories.

The environment created within a PTC can produce significant results and proceed according to theory (Alegre-Ansuategui et al., 2018). Participant 2 stated during the exit interview that the environment "makes you feel better." Participant 1 stated that the environment was "fun and peaceful." Peer tutoring interactions can not only raise academic achievement and change attitudes toward mathematics for the tutors and tutees, but these interactions can also help to remove stigmas associated with receiving tutoring (Daggett & Pedinotti, 2014; Robinson et al., 2005; Worley & Naresh, 2014). Participant 4 stated that the PTC environment helped students to "not be afraid to ask questions . . . , and to understand my work in an easier way."

The Vygotskian perspective, which has become more prominent in the past 20 years, links student achievement to tasks that encourage students to think, interact, and talk about their ideas (Brown, Solomon, & Williams, 2016). Participants in this study interacted with tutors and facilitators and received help while completing paper-based and online multistep math problems. The responses from tutees during their exit interviews revealed that tutees were able to get help and/or that the tutors made it easier to understand the problems. Study participants/tutees, also, stated during the exit interview that they were doing better, feeling better, and understanding more math since participating in the PTC. Participant 1 stated, "At first, I felt nervous about math, but then I joined the peer tutoring club and got help." Participant 1 scored 100% on the mathematics posttest on multistep problems solving. Participant 1's work folder contained multiple examples of word problems that had been completed using the 4-step problem solving or Polya's plan (Kilpatrick, 2001). Participant 3's understanding of "how to understand" was also reflective of the participants' engagement in metacognitive activities during the problem solving process (Coles, 2013). Academic gains made by tutees during this study on the more rigorous multistep math problems helped to corroborate Vygotsky's theory that links peer tutoring to cognitive development and raises the threshold or level of potential development of students (Beliavsky, 2006).

Using the language that applies to mathematical concepts during pair and group discussions supports the acquisition of relatable math terminology (Topping, Campbell, Douglas, & Smith, 2003). This idea further supports peer tutoring as a venue that provides opportunities for students to explain and justify solution methods to one another, thus placing demands on communication skills (Topping, Campbell, Douglas, & Smith, 2003; Topping, 2015). Tutor training incorporated questioning strategies to guide tutees through problem solving techniques.

Evidence from tutees' peer tutoring folders showed examples of how tutees' utilized the 4-step problem-solving plan for solving word problems. Help was one of the high frequency words used by tutees during the exit interview. During the exit interview, tutees were asked "What kinds of questions or statements would you like to see included in an evaluation of the Peer Tutoring Club?" Participant 3 said, "What helps you best to learn? and What keeps you motivated?" Having opportunities to ask questions and receive immediate feedback enabled the tutees to explain, justify, and/or modify their solution strategies. The cognitive demands on both tutor and tutee are embedded in communication skills (Topping & Ehly, 2001; Topping, 2015). "A participant might never have truly grasped a concept until having to explain it to another, embodying and crystallizing thought into language—another Vygotskian idea" (Topping, 2015, p. 5). Listening, explaining, questioning, summarizing, speculating, and hypothesizing are cognitively demanding skills that are present in peer tutoring interactions which provides opportunities for more rigorous tasks (Topping, 2015). Hattie's (2017) research findings also supports peer tutoring as an effective academic intervention. Hattie's findings showed that peer tutoring programs have high gains on academic achievement scores. The average standard deviation gain for the math pre/posttest for the participants of this study were between 1.67 and 2.37, respectively, when calculated using the posttest standard deviation and averaged.

A Heterogeneous Peer Tutoring (HPT) program creates an environment where students from diverse educational, cultural, and socio-economic backgrounds can work together on key mathematical concepts (Worley & Naresh, 2014). Worley and Naresh's HPT study included 14, eighth grade, participants who worked on linear and nonlinear functions (2014). PreAlgebra tutees were paired with algebra tutors during a four-month peer tutoring experience. This HPT model helped students to take ownership of their learning while improving math communication skills and developing positive attitudes toward math (Worley & Naresh, 2014). Similarly, this study enabled a heterogeneous group of middle school tutors and tutees to work collaboratively on rigorous math problems during a four-month peer tutoring experience. The tutors for this investigator's study, however, consisted of Algebra I students, geometry students, pre-Algebra students and two high school students. The two high school students were alumni of ABC Middle School and had previously volunteered as tutors in the PTC. The tutors were able to assist tutees with paper-based and online rigorous math problems by providing strategies that helped to guide them successfully through the problem-solving process. This help that the tutee received from collaboration with a more capable peer is rooted in Vygotsky's Zone of Proximal Development or ZPD (Vygotsky, 1978). The ZPD is defined as "the distance between the actual developmental level as determined by independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978).

Peer tutoring interventions have been successful with regular, special education, low achieving, and language minority students in kindergarten, elementary, middle school, high school, and college level environments (Arreaga-Mayer, 1998; Daggett & Pedinotti, 2014; Dietrichson, Bøg, Filges, & Jørgensen, 2017; Fuchs et al., 2016; Hattie, 2017). Small group interactions within a peer tutoring environment can produce significant results and proceed according to theory (Alegre-Ansuategui et al., 2018). The investigator's study findings have a common tread with other peer tutoring studies in that peer tutoring programs show positive outcomes in academics and attitudes in both the tutor and tutee (Hattie, 2012; Robinson et al., 2005; Worley & Naresh, 2014). At-risk students, whether special needs students or general education students, with varying levels of academic, behavioral, and emotional challenges, work effectively in the peer tutoring environment.

Limitations

A limitation is a potential weakness of the study (Creswell, 1994). This study was limited to a sample of six, Grade 6, math tutees in the PTC at one school site in the southeastern part of the United States. Data collection took place between December 2017 and June 2018. Forty-six peer tutoring sessions where held during this time period, however, participants attended between six and 41 sessions. Data was not collected from January 23rd through March 4th due to my nonenrollment status at my university. Some attendance fluctuations occurred with facilitators, tutors, and tutees partly due to club and other mandatory obligations. This may have impacted consistency in PTC procedures.

Implication of the Results for Practice, Policy, and Theory

The majority of the peer tutoring research studies have targeted basic math skills; therefore, the effectiveness of a rigorous peer tutoring program for at-risk and students with disabilities still need to be investigated (Tsuei, 2014). High stakes test results for students of all ability levels identify math word problem-solving as an area in need of improvement (Montague et al., 2014). Access to the standards through research-based interventions that incorporate forms of learning recommended by the National Research Council (NRC) and NCTM, such as conceptual understanding, mathematical thinking, reasoning, and problem-solving will provide opportunities for student success (Jitendra, 2013; Montague et al., 2014; NCTM, 2017). The focus of this case study was to investigate the research in order to complete an in-depth study of peer tutoring within a real-world context. The results of this study indicates that peer tutoring continues to be an effective way for students to make successful academic and attitude changes.

Providing opportunities for students to share their strengths through collaboration within a cross-age or same age peer tutoring environment promotes academic and social development for both the tutor and the tutee. Additionally, student collaboration within a synchronous (online) peer tutoring environment also improves academic achievement and attitudes. This study's findings showed evidence of gains in Attitudes Toward Math Inventory's (ATMI) subgroups pertaining to self-confidence, value, enjoyment, and motivation for the participants. The highest subscale score was in enjoyment. The data of this study were collected from the tutees in order to describe results from the tutees' perspective. The tutees' perspectives from the findings in this study can be used to effect policy change pertaining to peer tutoring initiatives within the research site's district.

Recommendations for Further Research

Recommended areas for improvement for this study include the following: (a) multiple subject area peer tutoring programs or clubs and (b) tutor, tutee, and facilitator feedback surveys and/or interviews at regular intervals. This case study was specific to a small segment of this middle school's population. Since the majority of Grade 6, Course 1 students are placed in Grade 7, Course 2 classes during the next school year, the findings from this study can be used to provide effective interventions that will support these students' academic success.

This data can, also, be used by stakeholders when making decisions pertaining to the implementation of school-wide response to intervention (RTI) programs. District support for flexible scheduling and additional innovative programs (Ayvazo & Aljadeff-Abergel, 2015; Bonner et al., 2013) will help to facilitate a climate that promotes peer tutoring supports during the school day. Flexible and innovative supports for students can also include virtual, synchronous online peer tutoring. Synchronous online peer tutoring and "in class" peer tutoring can be used to increase student feedback, support self-efficacy, and serve as a Response to Intervention (RTI) resource (Hattie, 2017; Tsuei, 2014).

Implementing for-credit classes for tutors would increase the number of available and trained tutors and, as a result, provide opportunities for in-class tutoring services for tutees. Even though afterschool tutoring is a viable option for some students, scheduling conflicts and transportation problems eliminate this as an option for other students. The site district and community are dedicated to ensuring the success of every student; adding additional afterschool and in-class support for students—by students—will not only help to promote a climate of collaboration, but it will also improve academic achievement for a diverse group of students.

Research shows that peer tutoring improves academic and attitude progress in subjects other than math, such as, language arts, social studies, and science (Driscoll, 2015; Wang et al., 2014; Wexler et al., 2015). Therefore, providing this alternative resource for all core subjects would benefit a population of students who are at risk of failure. Finally, further research studies could collect and analyze feedback from, not only tutees, but tutors and facilitators, as well. Survey and interview data could be collected at regular intervals and this data could be used to make cyclical improvements in the program.

Conclusion

This chapter is a discussion of the synthesis of findings from the peer tutoring study. The conclusions drawn from the analyses of the case study instruments were used to answer the two research questions. The participant findings from the PTC study supported theory and empirical study evidence that peer tutoring improved academic achievement and attitudes toward math. Pre/posttest data from the math assessment and attitudes towards math inventory showed gains for all participants. This dissertation addressed the gap in literature and the call for research pertaining to peer tutoring studies involving multistep math problems. The focus of this study's curriculum content was multistep problem-solving with an emphasis on word problems. The study findings showed that all tutee participants made significant gains in multistep problem-solving. Their exit interview responses all suggested that getting help was key to their progress. As one participant stated, "before Peer tutoring Club I felt ok because it was getting hard and I did not know what to do and now I am good and learning better." The case study methodology used for this study enabled the investigator to answer the research questions through the triangulation of findings that revealed insight into the participants' experiences within the PTC.

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Appendix A: Informed Consent Form

Research Study Title: Peer Tutoring in Middle School: How It Changes Student Achievement and Attitudes
Principal Investigator: Lois Wright
Research Institution: Concordia University–Portland
Faculty Advisor: Dr. Jullian Skelton

Purpose and what you will be doing:
The purpose of this case study is to investigate how an after school Peer Tutoring Club (PTC) will impact academic performances and attitudes toward math for Grade 6, Course 1, and Grade 7, Course 2, middle school mathematics students. I expect between five and 10 volunteers. No one will be paid to be in the study. The recruitment period was started in November 2017 and ended in December 2017. Recruitment and research will resume in April 2018. To be in the study the tutee will 1) attend orientation (30 min), 2) complete the District's Mathematics pre and post tests, 3) complete the Attitudes Toward Mathematics Inventory (ATMI) pre and post tests, 4) attend after school Peer Tutoring Club at least 2 days per week from 4:00–5:00 pm for at least 4 weeks, 5) complete Virtual Tutor and paper-based assignments, and 6) participate in a five question face to face interview during the last week of study.

Timeline:

1) Participant Recruiting Period – April 2018
2) Orientation – March-April 2018
3) Peer-Tutoring Sessions Start – Week of March 19th (3 days per week from 4–5 pm) until May 2018
4) Tutee's District Math Pretest and ATMI Pretest – March-April 2018
5) Tutee's District Math Posttest and ATMI Posttest – May-June 2018
6) Tutee's Post Interviews – May-June 2018

Participants'(Tutees') data to be used in study:

1) District's Math Pre and Post test results
2) Pre and Post Attitudes Toward Math Inventory (ATMI)
3) Descriptive Documents: Edgenuity online Virtual Tutor assignments and paper-based word problems/Tutee Goals Checkpoint
4) Tutee face-to-face Interviews – 6th or 7th week of study

The peer tutoring interviews will be conducted at school by the investigator during the last week of the study and should last no more than 30 minutes. Tutees and their parents/guardians will be provided with Pre and Post Test results, Virtual Tutor progress checks, and a transcript of the interview. Participants will review interview transcripts for accuracy.

Tutees will need to bring their fully charged, school issued, Chromebooks to each tutoring session.

Risks:
There are no anticipated risks involved in participating in this study other than providing your information. However, we will protect your information. Any personal information you provide will be coded so it cannot be linked to you. Any name or identifying information you give will be kept securely via electronic encryption or locked inside the investigator's file cabinet. When I or my university advisor/s look at the data, none of the data will have your name or identifying information. We will only use a secret code to analyze the data. We will not identify you in any publication or report. Your information will be kept private, and the consent form will be destroyed by the university advisor 3 years after the study ends. All other study data will be destroyed or deleted at the end of the study.

Benefits:
The Information participants provide will help the investigator to conduct an in-depth case study of the impact of peer-tutoring on academic achievement and attitudes toward math. The study findings will add to the limited research pertaining to a peer-tutoring intervention that incorporates multistep operations and word problems.

Confidentiality:
This information will not be distributed to any other agency and will be kept private and confidential. The only exception to this is if the participant tells us of abuse or neglect that makes us seriously concerned for his/her immediate health and safety.

Right to Withdraw:
Your participation is greatly appreciated, but we acknowledge that the questions we are asking are personal in nature. You are free at any point to choose not to engage with or stop the study. You may skip any questions you do not wish to answer. This study is not required and there is no penalty for not participating. If at any time you experience a negative emotion from answering the questions, we will stop asking you questions.

Contact Information:
You will receive a copy of this consent form. If you have questions you can talk to or write the principal investigator, Lois Wright at [redacted] If you want to talk with a participant advocate other than the investigator, you can write or call the director of our institutional review board, Dr. OraLee Branch (email obranch@cu-portland.edu or call 503-493-6390).

Your Statement of Consent:
I have read the above information. I asked questions if I had them, and my questions were answered. I volunteer my consent for this study.

Participant Name	Date
Participant Signature	Date
Parent/Guardian Name	Date
Parent/Guardian Signature	Date
Investigator Name	Date
Investigator Signature	Date

Investigator: Lois Wright email: [redacted]
c/o: Professor Dr. Jullian Skelton
Concordia University–Portland
2811 NE Holman Street
Portland, Oregon 97221

Appendix B: Assent to Participate in Research

Department of Education, Doctoral Program, Concordia University–Portland
Assent to Participate in Research

March 2018

1. My name is Lois Wright and I will be conducting research on peer tutoring within the Peer Tutoring Club.

2. I am asking your participation in a research study because I am trying to learn more about how your experiences as a tutee changed or impacted your academic performances and attitudes toward learning mathematics.

3. If you agree to participate in the study, you will be expected to: a) attend orientation, b) complete district's pre and post mathematics assessments, c) complete Attitudes Toward Math pre and post surveys, d) bring a charged iPad or Chromebook to peer tutoring sessions, e) attend math peer tutoring for at least 2 days per week from 4:00pm–5:00pm for at least 4 weeks, f) follow Peer Tutoring Club expectations, g) complete online and paper-based assignments, h) maintain Goals/Assignment Checklist, and i) participant in a five-question interview during the last week of the study.

4. Sharing your information and experiences will be valuable to the study of peer-tutoring. There are no anticipated risks involved in this study. All of your information will be protected.

5. Please talk this over with your parents before you decide whether or not to participate. I will also ask your parents to give their permission for you to take part in this study. But even if your parents say "yes" you can still decide not to do this.

6. If you don't want to be in this study, you don't have to participate. Remember, being in this study is up to you and no one will be upset if you don't want to participate or even if you change your mind later and want to stop.

7. You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me at [redacted]

8. Signing your name at the bottom means that you agree to be in this study. You and your parents will be given a copy of this form after you have signed it.

Name of Participant:________________________________ Date:______

Signature:____ Date: _____
Adapted from UCLA assent form

Appendix C: Survey and Author Permission

ATTITUDES TOWARD MATHEMATICS INVENTORY

Directions: This inventory consists of statements about your attitude toward mathematics. There are no correct or incorrect responses. Read each item carefully. Please think about how you feel about each item. Darken the circle that most closely corresponds to how the statements best describes your feelings. Use the following response scale to respond to each item.

PLEASE USE THESE RESPONSE CODES:
A – Strongly Disagree
B – Disagree
C – Neutral
D – Agree
E – Strongly Agree

1. Mathematics is a very worthwhile and necessary subject.
2. I want to develop my mathematical skills.
3. I get a great deal of satisfaction out of solving a mathematics problem.
4. Mathematics helps develop the mind and teaches a person to think.
5. Mathematics is important in everyday life.
6. Mathematics is one of the most important subjects for people to study.
7. High school math courses would be very helpful no matter what I decide to study.
8. I can think of many ways that I use math outside of school.
9. Mathematics is one of my most dreaded subjects.
10. My mind goes blank and I am unable to think clearly when working with mathematics.
11. Studying mathematics makes me feel nervous.
12. Mathematics makes me feel uncomfortable.
13. I am always under a terrible strain in a math class.
14. When I hear the word mathematics, I have a feeling of dislike.
15. It makes me nervous to even think about having to do a mathematics problem.
16. Mathematics does not scare me at all.
17. I have a lot of self-confidence when it comes to mathematics
18. I am able to solve mathematics problems without too much difficulty.
19. I expect to do fairly well in any math class I take.
20. I am always confused in my mathematics class.
21. I feel a sense of insecurity when attempting mathematics.
22. I learn mathematics easily.
23. I am confident that I could learn advanced mathematics.
24. I have usually enjoyed studying mathematics in school.
25. Mathematics is dull and boring.
26. I like to solve new problems in mathematics.
27. I would prefer to do an assignment in math than to write an essay.
28. I would like to avoid using mathematics in college.
29. I really like mathematics.

30. I am happier in a math class than in any other class.
31. Mathematics is a very interesting subject.
32. I am willing to take more than the required amount of mathematics.
33. I plan to take as much mathematics as I can during my education.
34. The challenge of math appeals to me.
35. I think studying advanced mathematics is useful.
36. I believe studying math helps me with problem-solving in other areas.
37. I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.
38. I am comfortable answering questions in math class.
39. A strong math background could help me in my professional life.
40. I believe I am good at solving math problems.

Appendix D: Tutee Face-to-Face Interview

Time of Interview:
Date:
Place:
Interviewer/Investigator: Lois Wright
Interviewee/Tutee Code:

Interview Introduction
Hello my name is Lois Wright. I am a doctoral student at Concordia University and I am conducting research on the Peer Tutoring Club. Today I would like to ask you five questions about your experiences as a tutee in the Peer Tutoring Club. This interview may take approximately 20 minutes. Please don't worry if I ask you any questions that you do not know how to answer. There are no right or wrong answers, and all of your answers will be kept confidential. You are free to stop the interview at any time. Please look over the previously signed consent form, and if you have questions about the form, I will be glad to answer them.

1) Leadership role (What allowed you to be a successful leader of the Peer Tutoring Club?)

2) Obstacles (What were the most consistent challenges you faced?)

3) Successes (How were obstacles overcome in the Peer Tutoring Club?)

4) Environment (How would you describe the environment in the Peer Tutoring Club?
    a. Discuss why you think this type of environment exists in the Peer Tutoring Club?)

5) Recommendations for an evaluation of the Peer Tutoring Club (What kinds of questions or statements would you like to see included in an evaluation of the Peer Tutoring Club?)
    a. Adapted from CATCH interview questions (Smalley, 2013).

6) The reflection prompt will be written as follows and tutees will respond in writing: What change or changes in your attitude towards mathematics would you say came as a result of having participated in the Peer Tutoring Club? Explain each change. If you feel that participating in the Peer Tutoring Club did not change your attitude towards mathematics, explain why you feel that there was no change?

Thank you for agreeing to be interviewed and answering the questions about your experiences as a tutee in the Peer Tutoring Club. I am going to restate your answers so that you may verify that I have recorded your answers correctly. If I have not recorded your answer correctly, please let me know and I will change it. Again, thank you for participating in the peer-tutoring study.

Appendix E: Peer Tutoring Club Invitation Letter

08/31/2017

Dear Parents/Guardians,

The mathematics department at ABC Middle School is looking to expand our Peer Tutoring Club. We are extending an invitation to your student because they have displayed both leadership qualities and excellent achievements in mathematics. By joining the club your student will not only gain excellent tutoring experience by helping their peers but they will be able to earn extra credit for class or earn Wing points. Tutors will be allowed to volunteer to tutor in a specific skill, or area of math, in which he/she is proficient. For example, if your child enjoys and does an excellent job explaining strategies for learning multiplication facts, solving fraction and decimal problems, or solving percent and proportion problems, then, he/she will be matched with a student who may be having some difficulty with this skill. The tutor will be required to come prepared with a lesson or other materials, i.e., use iPad/Chromebook or whiteboard to write steps and show examples, then give the tutee a chance to ask questions and practice some problems. Peer tutoring is a win-win situation because the tutor becomes even more of an expert by teaching, and the tutee is given the opportunity to learn from a peer. A teacher, or teachers, will be available should the tutor or tutee need additional assistance. Please fill out the bottom half of this paper and have your student bring it with them before Sept. 8, 2017.

Sincerely,

Peer Tutoring Club Coordinators
ABC Middle School Math Teachers

Please check day/s that your child will be able to participate starting Monday, Sept. 11th, 2017 from 4–5pm in rooms ___ and ____.

Mon. __________ Wed.__________ Fri.__________

I ____ give my permission for
Parent Signature

____ to participate as a peer tutor.
Student's Name

Please contact L. Wright at [redacted] with any additional questions or concerns.

Dear Parents/Guardians,

The mathematics department at ABC Middle School has a Peer Tutoring Club this year. We are extending an invitation to your student to receive additional assistance on the following skills:

____

____

____

The Peer Tutoring Club is comprised of a diverse group of students from ABC Middle School who are strong leaders and math students who want to help their peers in the area of mathematics. A teacher, or teachers, will be available during each club meeting should the tutor or tutee need additional assistance. Please fill out the bottom half of this paper and have your student bring it with them by Sept. 8, 2017.

Reminder: All students will need to be picked up promptly at 5:00 at the main entrance to ABC Middle School each day they attend a meeting. Club Coordinators reserve the right to ask students to leave the Peer Tutor Club if this request is not adhered to. Thank you for your understanding and cooperation.

Sincerely,

Peer Tutoring Club Coordinators
ABC Middle School Math Teachers

- -

Please check day/s that your child will be able to participate starting Monday, Sept. 11th, 2017 from 4–5pm in rooms ___ and ___.

Mon. ___________ Wed.___________ Fri.___________

I ____ give my permission for
Parent Signature

____ to participate as a tutee.
Student's Name

Please contact L. Wright at [redacted] with any additional questions or concerns.

12/14/17

Dear Parents/Guardians,

ABC Middle School, again this year, would like to provide a math Peer Tutoring Club for our students. We are extending an invitation to your student because they have displayed both leadership qualities and excellent achievements in mathematics. By joining the club, your student will not only gain excellent tutoring experience by helping their peers, but they will also be able to earn extra credit for class or earn Wing points. Tutors will be allowed to volunteer to tutor in a specific skill, or area of math, in which he/she is proficient. For example, if your child enjoys and does an excellent job explaining strategies for learning multiplication facts, solving fraction and decimal problems, or solving percent and proportion problems, then, he/she will be matched with a student who may be having some difficulty with this skill. The tutor will receive peer tutoring training and will be provided with curriculum materials in order to provide tutoring to students within the Peer Tutoring Club. They will use lesson materials, i.e., use Chromebooks or whiteboards to write steps and show examples, then give the tutee a chance to ask questions and practice some problems. Peer tutoring is a win-win situation because the tutor becomes even more of an expert by teaching, and the tutee is given the opportunity to learn from a peer. A teacher, or teachers, will be available should the tutor or tutee need additional assistance. Please fill out the bottom half of this paper and have your student bring it with them by Dec. 19, 2017.

Sincerely,

Peer Tutoring Club
ABC Middle School

Please check day/s that your child will be able to participate starting Tuesday, Dec. 19, 2017 from 4–5pm in room A.6 or other designated location within ABC Middle School.

Tues. __________ Wed.__________ Thurs.__________

I ____ give my permission for
Parent Signature

____ to participate as a peer tutor.
Student's Name

Please contact L. Wright at [redacted] with any additional questions or concerns.

12/14/2017

Dear Parents/Guardians,

ABC Middle School will have a Peer Tutoring Club again this year. We are extending an invitation to your student to receive additional assistance with a primary focus on Multistep Problem-solving and Math Facts.

The Peer Tutoring Club is comprised of other students from ABC Middle School who are strong leaders and math students that want to help their peers in the area of mathematics. A teacher, or teachers, will be available during each club meeting should the tutor or tutee need additional assistance. Please fill out the bottom half of this paper and have your student bring it with them by Dec. 19, 2017.

Reminder: All students will need to be picked up promptly at 5:00 at the main entrance to ABC Middle School each day they attend a meeting. Club Facilitators reserve the right to ask students to leave the Peer Tutor Club if this request is not adhered to. Thank you for your understanding and cooperation.

Sincerely,

Peer Tutoring Club
ABC Middle School

- -

Please check day/s that your child will be able to participate starting Tuesday, Dec. 19, 2017 from 4–5pm in room A.6 or other designated location within ABC Middle School.

Tues.__________ Wed.__________ Thurs.__________

I ____ give my permission for
Parent Signature

____ to participate as a tutee.
Student's Name

Please contact L. Wright at [redacted] with any additional questions or concerns.

Appendix F: PTC Handbook Outline

I. ORIENTATION (1 Hour)

A. Tutor and Tutee expectations

B. Peer Tutoring Club Procedures

C. Facilitator/Teacher Role

D. Overview of PTC's Mathematics Curriculum

E. What Parents Should Know About Peer Tutoring

II. TRAINING MODULES

A. Day 1: Confidentiality (1 Hour)
- Tutor and Tutee Confidentiality Letter

B. Day 2: Compliments as a Motivational Tool (1 Hour)

C. Day 3: Math Tutoring Strategies and Procedures (1 Hour)

III. INDUCTION INTO PEER TUTORING CLUB

A. Acceptance Notifications

B. Tutor PTC Badges Issued

Appendix G: Pre-PostTest ATMI Results

Inventory Statement	*N*	Pretest		*N*	Posttest	
		Mean	*SD*		Mean	*SD*
Math does not scare me at all.	4	3.75	1.25	6	3.50	1.51
I have a lot of self-confidence when it comes to math.	3	2.66	1.52	6	3.00	1.78
I am able to solve math problems without too much difficulty.	4	3.00	.81	6	3.16	1.32
I expect to do fairly well in any math class I take.	4	3.66	.57	6	4.50	.83
I learn math easily.	3	3.00	1.73	6	3.66	1.21
I believe I am good at solving math problems.	3	2.50	.70	6	3.66	1.36
Math is a very worthwhile and necessary subject.	3	3.66	.57	6	3.33	1.50
I want to develop my math skills.	3	3.66	.57	6	4.66	.51
Math helps develop the mind and teaches a person to think.	3	3.00	1.00	6	3.66	1.50
Math is important in everyday life.	3	4.00	1.00	6	4.16	1.60
Math is one of the most important subjects for people to study.	3	4.33	.57	6	4.00	1.54
High school math courses would be very helpful no matter what I decide to study.	3	2.33	1.52	6	4.16	.98
I can think of many ways that I use math outside of school.	3	3.66	1.15	6	3.66	1.63

Appendix G (continued)

Inventory Statement	Pretest			Posttest		
	N	Mean	*SD*	*N*	Mean	*SD*
I think studying advanced math is useful.	3	2.66	1.52	6	3.66	1.63
I believe studying math helps me with problem-solving in other areas.	3	4.33	.57	6	4.33	.81
A strong math background could help me in my professional life.	3	3.66	.57	6	4.66	.51
I get a great deal of satisfaction out of solving a math problem.	3	3.66	1.15	6	3.66	.81
I have usually enjoyed studying math in school.	3	2.00	1.00	6	3.33	1.50
I like to solve new problems in math.	3	4.00	.00	6	3.50	1.04
I would prefer to do an assignment in math than to write an essay.	3	2.66	.57	6	2.33	1.63
I really like math.	3	2.00	1.00	6	3.33	1.36
I am happier in a math class than in any other class.	3	3.33	.57	6	3.16	1.60
Math is a very interesting subject.	3	2.66	.57	6	3.83	.75
I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	3	2.66	2.08	6	3.00	1.26

Appendix G (continued)

Inventory Statement	*N*	Pretest Mean	Pretest *SD*	*N*	Posttest Mean	Posttest *SD*
I am comfortable answering questions in math class.	3	4.00	1.00	6	3.50	1.51
I am confident that I could learn advanced math.	3	3.00	1.73	6	2.83	.98
I am willing to take more than the required amount of math.	3	1.66	.57	6	3.00	1.41
I plan to take as much math as I can during my education.	3	3.66	1.52	6	3.50	1.37
The challenge of math appeals to me.	3	3.66	.57	6	3.33	.81
Math is one of my most dreaded subjects.	3	2.00	1.00	6	2.83	1.60
My mind goes blank and I am unable to think clearly when working with math.	4	3.25	.95	6	3.66	1.50
Studying math makes me feel nervous.	4	2.75	1.70	6	4.16	1.32
Math makes me feel uncomfortable.	4	2.50	1.29	5	4.20	1.30
I am always under a terrible strain in a math class.	4	2.50	1.00	6	4.16	.98
When I hear the word math, I have a feeling of dislike.	4	3.25	1.70	6	3.50	1.51

Appendix G (continued)

Inventory Statement	*N*	Pretest		N	Posttest	
		Mean	*SD*		Mean	*SD*
It makes me nervous to even think about doing a math problem.	4	3.50	.57	6	3.16	1.32
I am always confused in my math class.	3	4.66	.57	6	3.66	.81
I feel a sense of insecurity when attempting math.	3	3.00	1.00	6	3.16	1.83
Math is dull and boring.	3	2.66	.57	6	2.33	1.03
I would like to avoid using math in college.	2	3.50	.70	6	3.66	1.21

Appendix H: 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.*

Lois Arnell Wright

Digital Signature

Lois Arnell Wright

Name (Typed)

November 29, 2019

Date