STRATEGIES PRINCIPALS IN NEW YORK CITY PUBLIC HIGH-NEEDS MIDDLE SCHOOLS USE TO INCREASE STUDENT ACHIEVEMENT IN MATHEMATICS

A Doctoral Research Project

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DEDICATION

The dedication of this doctorate is to God, whom I give praise and thanks for guiding and sustaining me throughout this journey. The doctorate experience is a testament to the limitless power of God, through him all things are possible.

I would then like to dedicate this doctorate to family and friends who stood by me and inspired me along the way. To my father, who is no longer here in the flesh but always in the spirit, you continuously reminded me during my formative years, that I would grow up to be an awesome leader. Dad, you were always correct, and to this day I am amazed at your foresight and wisdom. To my mother, who is humble but also so strong and steadfast. Mom, you taught me grit, how not to give up when times are challenging, and that failure is never an option. Both of you are the best parents in the world, thank you once again, for your high regards for education and your selfless love.

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ABSTRACT

Student achievement has been a focal point of concern for decades. American students continue to fall behind their counterparts mathematically in developing countries. The U.S. Department of Education (2009) warned that the current state of math performance "shortchanges our students' future and endangers our nation's prosperity and security" (p. 26).

Test results from the 2016 New York State Education Department (NYSED), for example, reported that 889,296 students took the Common Core Math State Exam last spring. The New York City (NYC) students who met the math proficiency level by ethnic subgroups were: Asian/Pacific Islander (67.2%), White (56.7 %), American Indian/Alaska Native (32.2%), Hispanic (24.3%), and Black (20%). These disproportionate scores reflect an objective picture of the persistent mathematics achievement gap in America. The low statistics about student achievement are not a new phenomenon, as year after year, the academic performance metrics consistently show thousands of middle school students who are underperforming on the state mathematics exams. The statistics consistently highlight that most students who fail to meet the expected academic standards are African American, Latino and are from a low socioeconomic background (NYSED 2016).

There have been numerous legislative reforms such as No Child Left Behind Act (NCLB), and Every Student Succeeds Act (ESSA) enacted to try and close the achievement gap. According to Williams, Kirst, and Haertel (2010), the gap in middle school for mathematics gets wider, and this is concerning because middle school math is an indicator for success in high school, college, and beyond.

Principals and their school communities search for instructional practices they can implement to increase student achievement with middle school math. This research study, *Strategies Principals in New York City Public High-Needs Middle Schools Use to Increase Student Achievement in Mathematics*, can be used to guide the work of improving student outcome in math. The research design for this study was quantitative and the instrument used was an electronic survey, that was emailed to middle school principals. There were 45 questions, the first 11 pertained to questions about the demographics of the principals; the other 34 questions were about math strategies principals should use to impact student achievement in mathematics. The sample size was 100 middle school principals, 73 of them responded. The data collected from the responses were analyzed using the statistical analysis software SPSS version 24.

The findings of this study showed that the following practices when implemented by the principal had a significant association with student achievement: The principal hiring of effective Math Lead Teachers, students grappling with assignments that are common- core aligned and on the level of the state exams and teachers writing responsive lesson plans to address students' misconceptions.

Key words: mathematics achievement, high-needs, and strategies for middle school mathematics.

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Background of the Problem

Despite decades of politicians and educators clamoring for reform of mathematics achievement, an inordinate number of American students continuously fail state and national level expectations. The U.S. Department of Education (2009) highlighted that the current state of math performance "shortchanges our students' future and endangers our nation's prosperity and security" (p. 26). The National Governors Association (2008) concurred that "America's global position is slipping not because U.S. schools are getting worse. Rather, America is losing ground because its educational outcomes have mostly stagnated while those in other countries have surged" (p. 16).

Test scores from the 2016 New York State Education Department (NYSED) for example, revealed that a total of 889,296 students were administered the Common Core Mathematics State Exam in the spring of that year. The New York City students who met the mathematics proficiency levels by ethnic subgroups were as follows: Asian/Pacific Islanders 67.2%, Whites 56.7%, American Indian/Alaska Natives 32.2 %, Hispanics 24.3%, and Blacks 20 %. These disproportionate figures reflect an objective picture of the persistent mathematics achievement gap in America. This is not a new phenomenon, as year after year, the academic performance metrics show that tens of thousands of students are underperforming on the State Mathematics Exams. The statistics frequently show that most of students who fail to meet the expected academic standards are African American, Latino and those from low socioeconomic backgrounds (NYSED 2016). School achievement "disparities among sub-groups of the population have deep roots. They arrive early and stay late – beginning before the cradle and continuing through to graduation" (Barton, 2003, p. 4). School leaders and their communities should engage in school-improvement activities to intentionally close the mathematics achievement gap. They can begin by using data to identify students from all subgroups who need math intervention and schedule them to receive individualized math instruction.

It is an indisputable fact that strong foundational skills in mathematics are the gateway to 21st century lucrative careers. Raising the achievement level of students across the United States is often argued as a vehicle to stay competitive with other nations in mathematics (Ahuja, 2006; Bill & Melinda Gates Foundation, 2010; Hanushek, Peterson, & Wassermann, 2010; National Governors Association, 2008). A deep and thorough conceptual understanding of mathematics is essential to compete in the global job market (Ahuja, 2006; Bill & Melinda Gates Foundation, 2010; Hanushek et al., 2010; National Governors Association, 2008).

Basic math application skills are essential for real-life activities such as accounting, cooking and creating a budget. Beyond that level, a profound mathematical foundation is a prerequisite for high-income careers, such as engineering, architecture, accounting, banking, business, medicine, and ecology. Mathematics skills are indispensable in the information age of computing technology and software development. Mullich (2009) corroborated that the technical building blocks of our economy are math and science skills. According to Schoenfeld (2002), mathematics is a “critical filter,” and a student’s mathematics coursework is a crucial component of technological literacy and success in higher education and the job market.

There has been a continuous flow of rhetoric from politicians, educators, and the American public demanding a solution to the national crisis of student math underachievement. They all acknowledged the importance of closing this gap. Yet, unfortunately, the grim reality is that it persists. According to Williams, Kirst, & Haertel (2010) in middle school the gap for mathematics proficiency widens. This is concerning because middle school math is a prerequisite for success in high school, college and beyond. Despite a mathematical achievement disparity existing at every grade level, the middle school problems appear to be most critical (Akos, Schoffner, & Ellis, 2007).

Some educators tend to blame external variables such as students' families or their culture for the lack of mathematical performance. Noguera (2006) argued that society tends not to accept responsibility for student underachievement, attributing it to lack of effort or family backgrounds.

Williams et al. (2010) suggested that addressing the mathematics achievement gap at the middle school level is crucial since it is in these grades where many students fall behind. One of Congress' response to this issue was the enactment of the No Child Left Behind (NCLB) legislative reform. The initial objectives of the NCLB was to ensure every student meets the mandated state academic performance levels by 2014 (Schmoker, 2006).

The students on the other hand, attributed their failures to the teachers not being competent in math instruction and offering them low-level work that in no way challenged them academically (Haystan, 2001). Those interactions could result in students becoming less active learners and most likely losing interest in mathematics. In the traditional classroom instruction "the teacher is doing the active work, and the students are passively listening" (Fulton, 2012, p. 2). Pedagogy in the classroom should change, transitioning from a lecture-based model to integrating more interactive strategies in the teaching and learning cycle. In mathematics, this method will help the diverse student populations achieve academic success (Ravitch, 2010). Mathematics instruction must develop into a more collaborative and robust concept-based form of learning. The teacher-student and student-to-student dialogues can serve to deepen the conceptual understanding of mathematics and address the needs of all students (Piccolo, Harbaugh, Carter, Capraro, & Capraro, 2008).

The principals' instructional leadership roles are often associated with students' academic achievement. The leader must be a "transformer," adopting a vision-looking ahead to the direction he or she would like his or her school to go, adopt a mindset that success is inevitable, focus on instructional leadership, be accessible, dissect the data, and be a change agent (Public Agenda, 2007). Quinn (2002) reaffirmed that a principal acknowledging ownership of being an instructional leader directly influences student performance. He further acknowledged that effective principals who are strong instructional leaders are in the schools that excel academically. Conversely, principals who are not focused on instruction tend to be in low-achieving schools. Studies have consistently agreed with the assumption that principals who are highly effective, possess the skills necessary to lead high-performing schools. (Thompson & Barnes, 2007). Leithwood, Seashore, Anderson, & Wahlstrom (2004) suggested, "two factors that significantly influence student learning. The first one was classroom instruction, the second was student learning. Leadership accounts for about a fourth of total school effectiveness. Furthermore, leadership is the primary factor that contributes to differences in schools' effectiveness in producing student learning outcomes"
(p. 17).

Some principals tend to shy away from instructional duties. Research highlighted that when mathematics education-related leadership responsibilities are required, fewer school leaders are involved (Spillane, 2005). Considering the impact of the principal on student outcomes, it is imperative that principals guide the mathematics instruction at their schools. Schoenfeld (2005) recommended the following four conditions that are necessary to make it possible for all students to receive mathematics instruction that are robust (1) high-caliber curriculum; (2) teaching community that is well-informed, and proficient with the content; (3) curricula goals that is generated from assessment and (4) structures to support the implementation of the assessment and professional development cycle that is aligned to the curricula.

Although there is an evolving body of research on principals' practices to improve student achievement, there is a scarcity of studies that focus on middle school principals in general and urban middle school principals in high-needs areas. There is also limited research on New York City principals in public high-needs middle schools and the strategies they use to improve student performance in mathematics. The scarcity of research regarding middle school principals and the role they play in improving mathematics achievement in high-needs schools prompted this research. The consensus among researchers on the topic of leadership is that there is a strong correlation between school leadership and student achievement (Leithwood et al., 2004; Thompson & Barnes, 2007; Glatthorn & Jailall, 1997; Lezotte, 1991; Edmonds, 1979; Hallinger & Heck, 1996; Crum & Sherman, 2008).

Principals who are leaders of mathematics are responsible for their students' achievement. Many researchers concluded that when determining the effect of principals' leadership on student achievement it is only second to teaching in the classrooms (Dufour & Marzano, 2011; Leithwood et al., 2004; Marzano, Waters, & McNulty, 2005).

The purpose of this quantitative study is to discover Strategies Principals in New York City Public High-Needs Middle Schools Use to Increase Student Achievement in Mathematics. The participants for this study are New York City public middle school principals in high-needs locations.

Research Questions

This study is guided by the following questions:

1. To what extent do principals ensure teachers implement rigorous math instruction to increase student achievement?

2. To what extent do principals' collaborative structures impact student achievement in mathematics?

3. Does the principal's background (content area expertise, experience) impact his/her strategies in improving mathematics achievement?

4. To what extent does the principal's use of the assessment cycle influence students' performance in mathematics?

5. Is there any relationship between a principal's monitoring of students' progress in math and student achievement?

Significance of the Study

Success in mathematics is a required 21st-century skill. There is an inordinate number of students who are chronically underperforming in the math classroom; this experience is further compounded by how they perform on their summative state exams. The fact that the achievement gap remains significant as highlighted in the Common Core Mathematics State Exam results is concerning. Bill Gates' foundation provided the main source of private funding for the Common Core Standards. He said in a recent interview that a primary goal of the nationalized standards is to address the substandard educational outcomes of low-income students compared to their more affluent suburban counterparts.

This study will be beneficial in numerous ways. It will provide additional information to the existing study regarding the role of mathematics education in improving classroom instruction to close the achievement gap. When principals intentionally evaluate the mathematical practices that teachers utilize in the classrooms, student outcomes will improve. This information will be available to practitioners to help them gain a deeper understanding of how to support impactful and sustainable instructional practices for teachers and will have a direct correlation on student achievement. This study can also benefit superintendents as they provide effective, content-driven professional development for teachers and administrators. Math coaches can use this information to access research-based strategies they can utilize as they collaborate with teachers and administrators who are helping prepare students become proficient in middle school mathematics. College education programs can access and use this research to prepare future educators as they embark on the task of delivering high-quality math instruction to increase student achievement.

Conceptual Framework/Assumptions

There are several assumptions associated with this study. One is that the respondents will exercise due diligence as they answer each question, recognizing the importance for the data to be valid and reliable.

Another assumption used in this study is that there is a variation with regards to equity and access for students who are African American, Hispanic and from low socio-economic backgrounds. Despite all the discourse about equal educational opportunities for all students, children of color and those living in poverty are often shortchanged and positioned to fail. Olson (2003) cited the Quality Counts 2003 which reported that schools that had a high percentage of students with low socio-economic backgrounds and who are minorities had the lowest probability of being exposed to high-quality instructors.

The Education Trust (2009) concluded that “the nationally the highest poverty and the minority districts receive fewer state and local funds per pupil than the lowest poverty and lowest minority districts” (Brimley, Vestegen & Garfield 2012, p. 52).

An additional assumption is that when school leaders focus on instruction, they will provide the necessary resources to positively impact student outcomes. This will include high-quality teachers, books, accommodations for the subgroups such as English as a New Language (ENLs) and Students with Disabilities(SWDs), technology, and additional academic supports.

Unfortunately, students don’t have a voice in determining who will teach them. They must accept whoever is assigned to be the person in charge of their academic futures. Some math teachers have low expectations for their students. This may be because some of those teachers are seldom considered to be true mathematicians in the sense of their pure mathematical knowledge and preparation (Assouline & Shoplik, 2011).

Delimitations

This research was conducted in New York City public high-needs middle schools. Data were collected from principals’ responses using Google Forms, an online survey. A specific timeline was provided regarding the return of the responses. The anticipated sample size was 100 New York City public high-needs middle school principals.

Limitations

One limitation of this study relates to the fact the instrument used was an electronic survey. If the participants wanted to share additional information with the researcher, they were unable to do so because the survey did not include such an accommodation for them.

Another limitation was that this study was restricted to the mathematics content in middle schools in New York City high-needs school districts. This restriction limits the results of this study from being generalized.

Definition of Key Terms and Words

Achievement: In this study, achievement refers to student outcomes on Common Core Mathematics State Exams.

Adequate Yearly Progress (AYP): A measurement used by the U.S. Department of Education to hold public schools and their districts accountable for academic performance on standardized exams.

Middle schools: In this study, middle schools refer exclusively to grades 6-8 in the various public-school configuration bands of K-8, 6-8, and 6-12.

Proficient level: In this study, proficient refers to New York State's four performance level, designations (from 1, the lowest to 4, the highest) to describe scale score ranges for the New York State Common Core Mathematics Tests.

The high-needs middle schools: In this study, high-needs middle schools refer to public middle schools with low proficiency percentages on mathematics state exams and poverty levels of over 70 % of students qualified for free lunch.

Organization of the Study

This dissertation is organized in five chapters. Chapter One is an overview of the study consisting of the background information of the problem. This chapter also outlines the purpose of the study, research questions, significance of the study, conceptual framework/assumptions, the delimitations, limitations, definitions of key terms and words and organization of the study.

Chapter Two presents the review of the literature that informs this study. Chapter Three explains the research methodology and specific procedures followed to conduct the research, including detailed information on the sampling criteria, instrumentation, data collection and analysis. Chapter Four provides the findings from the data analysis for this study. Chapter Five presents a summary of the findings, conclusions, and recommendations for future research.

Chapter Two: Literature Review

Introduction

Students' performance in mathematics has been a focal point of concern in the United States for decades. According to the Organization for Economic Cooperation and Development (OECD) and the Program for International Student Assessment (PISA) results for 2009, the average 15-year-old American student scored "statistically significantly below the OECD average" (OECD, 2010, p. 134). Additionally, in mathematics literacy, they scored lower than 24 other countries (OECD, 2010).

Neal (2006) observed that there had been no change during the last 50 years in the scholarly outcomes of American students despite a ten-times increment in financing per child, and billions of dollars contributed by the central government. The young scholars who are struggling academically are mainly from high-needs and minority subgroups (Balfanz and Byrnes, 2006). These students' racial and low-socioeconomic backgrounds are contributors to the achievement gap (Williams, 2003). Students who are from low-socioeconomic backgrounds have a high probability of not being ever exposed to high-quality teachers (Barnett 2004). Jung (2011) noticed a pattern with students who were challenged in high school; they were some of the same students who experienced challenges in middle school.

It is evident that a mathematical achievement gap exists at every grade, but it is more noticeable in middle school (Akos, Shoffner, & Ellis, 2007). Balfanz and Byrnes (2006) concur that many students who are below grade level in high–needs middle schools are seldom able to reach the appropriate standard. It, therefore, should not be a surprise that thousands of students in high-needs middle schools are disproportionately failing in mathematics. Whenever there is an achievement gap, the root-cause analysis should be done and the findings used to improve teaching and learning. Researchers (Stigler & Hiebert, 2009) acknowledged that there exists a "teaching gap" in the mathematics classrooms in American middle schools.

Congress created many initiatives to close the achievement gap. Unfortunately, these reforms had minimal effect, as the gap still exists today (Williams, Kirst, & Haertel, 2010). Congress passed the No Child Left Behind Act (NCLB) in 2001 (NCLB, 2002). This law was unprecedented and relentless in its demands for equity for all students. Lawmakers placed the onus on educators to ensure all students, regardless of their color, class, gender or race have access to a high-quality education. This federal act called for testing, accountability, and school improvement by requiring schools to measure and report the grade level proficiency of their student population, as well as subgroups. If schools did not meet the stipulated level of progress towards students' proficiency goals, the law ensured the school leaders were accountable for increasing levels of consequences (NCLB, 2002). Despite this federal mandate, statistics continued to display a gap in student achievement. Proponents of NCLB classified these efforts as another failed endeavor at raising student achievement (Dufour & Marzano, 2011; Klein, 2015).

Another attempt to address the academic disparity in the United States was the transition from NCBL to The Common Core Math Standards. Lawmakers developed these standards to close the achievement gap for students in every state as they prepare them to be successful in college and beyond. The national standards would help students to be successful in college and with future careers (New York Common Core Task Force, 2015). New York State operated on a faster timeline with the Common Core Standards than any other state in America. They rolled out the standards in 2011-12, and administrators scheduled the new Common Core Mathematics Tests for the 2012-2013 school year. In April 2013, New York students took the first Common

Core-aligned State exam. There was only a year mandated to implement this reform. The implementation of the Common Core Math Standards on an accelerated timeline presented New York State principals with additional challenges for which they were not adequately prepared to respond (New York Common Core Task Force, 2015). Despite this initiative being new, teachers' and principals' annual evaluations were tied to it (New York Common Core Task Force, 2015; Rentner &, 2014b).

Elmore (2000) argued the following:

> Accountability must be a reciprocal process. For every increment of performance, I demand from you, I have an equal responsibility to provide you with the capacity to meet that expectation. Likewise, for every investment you make in my skill and knowledge, I have a reciprocal responsibility to demonstrate some new increment in performance. This is the principle of "reciprocity of accountability for capacity. (p. 5)

New York principals were required to institute the Common Core State Standards but were not given the necessary professional development to conduct the task with fidelity and due diligence. Consequently, the administration of the Common Core State Test resulted in thousands of more students added to the list of already failing students. The New York Common Core Task Force (2015) acknowledged there were problems with the introduction and execution of the Common Core Standards:

> After careful review, the Common Core Task Force affirmed that New York must have rigorous, high quality education standards to improve the education of all our students and hold our schools and districts accountable for students' success. However, it is well-established that there were significant issues with the roll-out and implementation of the

> Common Core Standards causing parents, educators, and other stakeholders to lose trust in the system. (New York Common Core Task Force, 2015, p.7)

President Obama was another strong advocate for reforms to the American education system and championed Every Student Succeeds Act (ESSA 2015), which includes provisions that will help to ensure success for students and schools. Lawmakers wanted this Act to provide America's disadvantaged and high-need students equity by upholding critical protections for them. The Act incorporated the following: (a) Demands —unprecedented —that all students be educated to scholarly standards that will set them up to be successful at the school- level so they can be ready for their future career. (b) Disseminate data to all stakeholders through yearly state exams.

The 2016 Math Common Core Math State exams revealed, however, staggering 60,784 students failing despite the institution of the ESSA Act. The three legislative reforms, No Child Left Behind (NCLB), Common Core State Standard (CCLS), and Every Child Succeeds Act (ESSA 2015) were all responses from the educational stakeholders demanding more effective schools and trying to close the achievement gap. They did not meet their goal and in no way stopped the widespread failure of the American students. As such, there was then an urgent need to discover ways to transform this academic failure. It prompted finding ways to discover the strategies high-needs middle school principals use to impact student achievement in mathematics.

The literature review in this chapter will provide insights for the strategies that could influence student achievement in mathematics. The sub-sections of this chapter are (a) leadership, (b) data structures, (c) collaborative practices, (d) rigorous mathematics instruction, (e) assessment and (f) summary.

Leadership

The definition of leadership at the school level at times seems to be very blurry. Solicitations for school leadership and accountability are at an all-time high, and such demands are causing the definition of school leadership and the practice of leadership to be revolutionized (Fullan, 2001). Seikaly, Seremet, Ward, and Williamson (2009) defined effective principals as "strong educators, anchoring their work on central issues of learning and teaching and continuous school improvement" (p. 1). Leadership at the school level should focus on school improvement activities to increase and sustain student achievement. Grogan (2013) highlighted "if we have many improvement priorities we actually have none; so, we must choose a priority and stay relentlessly focused on it" (p. 221).

During the most recent decade, the job specifications of the school leader have changed drastically (Marsh & LeFever, 2004). Stein and Nelson (2003) claimed that an instructional leader capacity to perform places the administrator's critical characteristic in a new leadership construct, Leadership Content Knowledge, that is his or her mastery of content knowledge and comparable teaching methods is crucial to that position. One metric used to quantify achievement and effectiveness of teaching and learning is student academic outcomes (Imig & Imig, 2006). Data from test scores are used as the only criteria for evaluating the performance of school leaders (English & Steffy, 2005). Reeves (2003) advocated that,

> the five factors that will help to raise student achievement in mathematics in high-needs districts are: (a) focus on academic achievement, (b) clear curriculum choices, (c) frequent assessment of student progress and multiple opportunities for improvement, (d) an emphasis on nonfiction writing, and (e) collaborative scoring of student work. (p.3)

Waters and Marzano (2006) contended that when the focus is on instruction, student academic achievement is inevitable—establishing non-negotiable goals for student. Schools where students exceed academic expectations, have school leaders that consider instruction their area of focus. Conversely, schools that have a high number of students underperforming have principals that do not place instruction as a top priority. McEwan (2003) stated that a highly effective principal is one who is: (a) a communicator, (b) an educator, (c) an envisioner, (d) a facilitator, (e) a change master, (f) a culture builder, (g) an activator, (h) a producer, (i) a character builder, and (j) a contributor. A transformative principal can use the 10 traits to move a school to the next level to increase students' achievement.

Raising student performance can be an onerous task, and the additional accountability measures make it even more daunting. "An effective principal is thought to be a necessary precondition for an effective school" (Marzano 2005, p. 5). Seikaly, Seremet, Ward, and Williamson (2009) defined effective leaders as "strong educators, anchoring their work on central issues of learning and teaching and continuous school improvement" (p. 1). They created five performance indicators for effective leaders to improve student outcome. These performance indicators include,

> Promoting collaborative problem solving and open communication; collecting, analyzing, and using data to identify school needs; using data to identify and plan for needed changes in the instructional program; implementing and monitoring the school improvement plan; and using systems thinking to establish a clear focus on attaining student achievement goals. (Seikaly et al., 2009, p. 8)

These indicators may appear to be simple for principals but to be successful with these performance indicators can be challenging as the duties are ever evolving over the years.

Many school leaders may lack the content and confidence to supervise mathematics. According to Spillane (2005), math education-related leadership responsibilities seem to involve fewer school leaders. McEwan (2000) agreed when he wrote, “even well-educated school leaders get sweaty palms and heart palpitations when confronted with an algebra problem” (p. 1). Marks and Nance (2007) corroborated the inequality in education finding that schools in which a high number of the students were eligible for either reduced-priced or free lunch programs were frequently assigned principals who tend to have a history of low-performance rating.

Principal need to use instruction as a lever to increase student achievement. Walters and Marzano (2006) contended that for principals to increase student academic achievement, they must intentionally focus on instruction. Schools where students perform academically have instructional leaders. Cotton (2003) corroborated that principals who were well-informed about academics and focused on instruction had higher-achieving students than those who focused on the operational facet of the school.

The literature reaffirms that success in middle school is an indicator of whether students will be successful in high school, college, and beyond. The ideas that surfaced reveal that there is an apparent disproportionately low academic success rate when compared to other schools regarding the principals, teachers, and resources for students of color, Hispanics, and those who come from a low-socioeconomic background.

Solicitations for school leadership and accountability are at an all-time high, and such demands are causing the definition of school leadership and the practice of leadership to be revolutionized (Fullan, 2001). Waters and McNulty (2005) agreed there is a need for an effective principal in every school. Bennis and Nanus (2007) made a clear distinction between the behaviors of leaders and managers. “Managers are people who do things right, and leaders are people who do the right thing" (Bennis & Nanus, 2007, p. 20). The leader establishes the vision for an organization while the managers are the implementers. A leader's burning desire is to be a problem solver and "know-why ahead of know-how" (Bennis & Nanus, 2007, p. 38).

In *Why Leadership Matters: Putting Basic Skills at the Heart of Adult Learning*, Howard and Kings (2010) described their study of the characteristics that defined leaders as those who place underachievers at the center of the educational organization. They found in their study that,

> Effective leaders know that teaching and learning can always be better than it is and have the energy and drive to improve quality. They are farsighted professionals, not only able to create a vision but also the focus to realize it. They understand the advantages for the learners and the entire organization that will be reaped from sticking to their values. (Howard and King, 2010, p. 10)

Various researchers have examined and debated the extent of the principal's influence on student academic performance. There is a plethora of research confirming that principals have a substantial effect on student achievement (Blasé & Kirby, 2009; Cotton, 2003; Dufour & Marzano, 2011; Hallinger & Heck, 1998; Leithwood, Seashore, Anderson, & Wahlstrom, 2004; Robinson, Lloyd, & Rowe, 2008). Robinson et al. (2008) found that principals who were "more focused on teaching and learning, provided a stronger instructional resource for teachers, and tended to be more active participants in the leadership of teacher learning and development had greater student achievement in their schools" (pp. 657-658).

It is important to have a framework as school leaders attempt this task. Bolman and Deal (2008) defined a framework as the following:

> A mental model—a set of ideas and assumptions—that you carry in your head to help you understand and negotiate a particular 'territory.' A good frame makes it easier to

> know what you are up against and, ultimately, what you can do about it. Frames are vital because organizations don't come with computerized navigation systems to guide you turn-by-turn to your destination. (p. 11)

It then becomes the responsibility of the instructional leader and their school community to ensure all students, despite their color or economic status, will be exposed to a high-quality education.

The approach to solving this problem places the principal at the vortex of the work to be done. Marzano, Waters, and McNulty (2005) asserted that every school needs an effective principal. Crum and Sherman (2008) stated that outstanding principals have the following six attributes:

> (1) external awareness and engagement (2) a bias towards innovation and action; (3) personal qualities and relationships; (4) vision, expectations, and a culture of success; (5) teacher learning, responsibility, and trust; and (6) student support, common purpose, and collaboration. (p. 4)

In addition to these six attributes, principals must focus on instruction. Administrative behaviors, policies, practices, and other factors under the school's control were found to have the greatest impact on school effectiveness (p. 16). The National Association of Secondary School Principals (NASSP) stated that effective principals would adhere to ideas that will transform teaching and impact student academic performance.

The role the principal should assume in this process is one of a powerful instructional leader for the school community they serve. "Teachers often develop mathematical content knowledge independent of pedagogical knowledge. For teachers to only have content is not sufficient to teach mathematics, as content and pedagogy must be connected" (Prediger, 2010, p.

74). There is an evolving body of research that suggests that principals have an important effect on student achievement (Blasé & Kirby, 2009; Cotton, 2003; Dufour & Marzano, 2011; Hallinger & Heck, 1998; Leithwood et al., 2004; Robinson et al., 2008). Robinson et al. (2008) concurred that principals must create goals and identify the high-leverage approach required to accomplish this important work. Goldring (2007) explained that the principal has opportunities, both formally and informally, to communicate school goals to the school community. The research identified a clear link between communicating school goals and student achievement (Goldring et al., 2007; Leitner, 1994; Locke & Latham, 1990; Picucci, Brownson, Kahlert, & Sobel, 2002; Waters, 2005).

Data Structures

Katz (2005) affirmed that "educators need to develop an inquiry habit of mind, become data literate, and create a culture of inquiry" (p. 18). Kerr et al. (2006) agreed that principals who engage their staff with the data inquiry process to make informed decisions are leaders who will create a strong data-wise culture at their schools. Togneri and Anderson (2003) recognized three components reported in the research that are crucial to developing informed decision-making practices: cultivating a mindset of inquiry, objectivity about the data and building a culture of trust. Researchers concurred that providing opportunities for staff to use data can be a challenging but also rewarding activity that provides information to guide the school improvement process (Bernhardt, 2003; Boudett, Murnane, City & Moody, 2005; Datnow 2007; Holcomb, 2004; Love, 2002; Supovitz & Klein, 2003; Wayman & Stringfield, 2006; Young, 2006). Besser (2006) and the Leadership and Learning Center developed a process for collecting and analyzing student data to improve student outcome by identifying goals and creating instructional strategies to meet them. He further specified that three components are recorded in the research that are instrumental to creating a culture of data-driven decision: developing inquiry-based practices, objectivity about the data, and building trust. Researchers corroborated that building organizational capacity for data use is complex. Nevertheless, it is valuable to schools, as the information gleaned can be used to individualize instruction for students (Bernhardt, 2003; Boudett, Murnane, City & Moody, 2005; Datnow et al., 2007; Holcomb, 2004; Love, 2002; Supovitz & Klein, 2003; Wayman & Stringfield, 2006; Young, 2006).

Learning Points Associates (2006) highlighted that “Data can be defined as any information when taken together and analyzed that can be used to produce knowledge” (p. 1). One purpose for creating a culture of using data is that the information will inform the teaching and learning cycle to support school improvement (Johnson, 2002; Love, 2009). Kouzes and Posner (2002) stressed the importance of the educational leader of the school to “lead the way” in developing a school of effective data-users. School communities should develop a robust data-wise culture. This reactive process can be used to make thoughtful decisions about instruction to increase student achievement. The technological world influenced the data process by insisting important advancement with tools that support data collection and analysis. They range from sophisticated Statistical Package for the Social Science (SPSS) software to Excel and Google Sheets.

Creighton (2001) asserted that many decisions made by a large number of principals are done “by using intuition and shooting from the hip, rather than considering data collection and data analysis” (p. 52). Besser, Almeida, Anderson-Davis, Flash, Kim, and White (2008) highlight that the process of engaging in making decisions that are driven by data is a cyclical system used to assist school leaders and teachers in making more individualized decisions for increased student academic performance. Principals should use data tools to monitor the mathematical performance of students regularly. This practice will provide insights for interventions rather than waiting to perform a postmortem when it is too late.

Besser (2006) and the Leadership and Learning Center have developed a process for collecting and analyzing student data to improve student performance by identifying goals and instructional strategies. This collaborative process uses the lens of student achievement to identify the strengths and deficits areas of instruction. It is crucial that school leaders monitor the effect of teaching and learning regularly. According to (Noyce, Perda, & Traver 2003), schools must develop a data-driven culture. They suggest that when making decisions, schools should rely on this data. This study highlighted the importance of "an institutionalized willingness to use numbers systematically to uncover patterns and answer questions about policy, methods, and outcomes" (p. 52).

Data provide an objective approach to making decisions; and therefore, the subjectivity is replaced by evidence. Davis and Davis (2003) contended that a high number of principals rely on their feeling and not data to guide them in making decisions. The technological world makes data readily accessible for everyone. The calls for accountability cannot be done without the use of data as a valuable tool for school improvement. Earl and Katz (2005) corroborated that leaders and their school community should work "to develop an inquiry habit of mind, become data literate, and create a culture of inquiry" (p. 18). Kerr et al. (2006) claimed that principals who model using data in front of their staff are committed to the success of their students.

Looking closely at four successful school structures, Datnow et al. (2007) discovered five systemic practices found in all of the schools for creating data-driven decision-making leadership (a) creating a system of using data to refine practices, (b) establishing data-driven decision-making culture, (c) investing in an information management system, (d) creating the process to build school data-driven decision-making capacity, and (e) to improve academic performance by analyzing data and responding immediately . Although the schools they observed made extraordinary gains with information-driven decisions, frequently the investigator found that supporting a culture of working continuously to improve data practices requires regular investment in assets that might be challenging for a few schools to sustain. The investigator further found that investing in the resources and people is important to impact student achievement using data.

As indicated by Bernhardt (2004), the factor that sets schools apart in their change efforts is the utilization of one, regularly ignored component—data. Datnow (2007) reaffirmed that a basic part of the establishment of a culture of inquiry is the practices the school leaders used to keep and manage information-driven systems. School leaders should provide opportunities for teachers to learn how to effectively respond and use data, as they require them to analyze assessments. Data analysis is one way to monitor the progress of students and provide interventions for students before it is too late.

School leaders should use the information gleaned from the data to conduct data-chats with teachers to improve and sustain student outcomes. McIntyre (2005) defined three levels for schools that engage in data mining. In the first stage, schools only collect data to meet compliance. Information is stored, but never retrieved. In the second stage, schools begin to understand how they can benefit from data mining. Schools in this stage begin to use formative assessment to support instructional activities. Schools will use the information from the data to identify struggling students. McIntyre (2005) makes a key point when he stated that "data analysis that focuses on improving efficiency works mostly at the edges of the problem, and eventually the school will pull all of the slack out of the system" (p. 10). Schools in the second stage focus on the immediate needs of the students but have difficulties setting goals for the future. In the third stage schools can use data analysis techniques to support ongoing student achievement. Also in the third stage, schools look at the learning variance of every group not only those in the lowest third. The needs of every group are taken into consideration to provide targeted intervention. Schools should examine baseline data as they work with parents and students to set benchmark goals and most importantly keep track of how they are meeting the goals.

A data-wise culture can act as a conduit to move students along the learning continuum. A simple task such as assigning "exit slips" that require students to summarize their learning before the lesson ends is incredibly powerful. Instructors can use the information from the data collected to create flexible groups of students and inform instruction for the following day.

Principals should lead their staff to use data if they also have a strong background in making data decisions (Lashway, 2002). Maxwell (2004) reaffirmed that the schools that engage with data practices, collect data and analyze it, to make informed decisions. When they include "best practices," they are intentionally using data to monitor school functions, in particular those directly connected to student academic progress.

Although building a data-wise culture school can be challenging, teachers using data effectively will help to impact student achievement (Bernhardt, 2003; Boudett et al., 2005; Datnow et al., 2007; Holcomb, 2004; Love, 2002; Supovitz & Klein, 2003; Wayman & Stringfield, 2006; Young, 2006). To ensure educators effectively use data, their professional development cannot be a one-time deal but an ongoing process that is done in cycles. Creighton (2001) maintained that effective leadership includes using data and is the hallmark of effective schools. Building a data-wise culture includes scheduling time for teachers to collaborate and share best practices as they engage with the important work of educating our students. With the ever-increasing demands to increase student achievement, educators should integrate the data analysis model to improve their pedagogy.

The tenure statutory New York Education Law §§3014;3020 to 3020-a. developed by the New York State Department of Education (NYCDOE), required teachers as part of their tenure requirement to demonstrate successful use of data. The tenure process for a New York State teacher, according to Sanders (2008), is presently including “an evaluation of the extent to which the teacher successfully uses analysis of available student performance data and other relevant information when providing instruction” (p. 1).

In 2010, the former Chancellor of New York City Joel Klein acknowledged the importance of data to inform instruction. He subsequently created a Data Specialist position for all schools. The job description detailed in School Allocation Memorandum No. 45 FY 11 stated the following:

> All non-charter schools will be provided funding to support school-based Data Specialists. The data specialist is responsible for ensuring the ongoing accuracy of student and school data in the Department of Education (DOE) source systems, as well as understanding and sharing with school staff the importance of source system data as the building blocks for accountability tools such as the DOE Progress Report and New York State accountability metrics. (p. 1)

The *Quality Review* (QR) is an accountability process that helps in evaluating schools in New York City. The Principal’s Review of the Quality Review (2016-2017) explains that,

> The *Quality Review* is a process that evaluates how well schools are organized to support student learning and teacher practice. The quality of school practices is rated based on criteria outlined in the 10 Quality Indicators of the Quality Review Rubric. (p. 3)

Schools are ranked along the continuum from underdeveloped, developing, proficient, and well-developed. Data practices are outlined as an integral part of the process. Indicator 3.1 of the Principal's Review of the Quality Review (2016-2017) states the following: "Establish a coherent vision of school improvement that is reflected in a short list of focused, data-based goals that are tracked for progress and are understood and supported by the entire school community" (p. 6). The Principal's Review of the Quality Review (2016-2017) explicitly defines a well-developed data process:

> Goal-setting and effective action planning at the school level, including professional development planning, are informed by a comprehensive, data-driven needs assessment and ongoing data gathering and analysis that improve teacher practice across classrooms and close the achievement gap. (p. 6)

The principals should create a deep sense of collaboration among teachers as they use data structures to increase student achievement in mathematics.

Collaborative Practices

Effective school improvement practices cannot be accomplished by the principal alone despite how intelligent, charismatic or hardworking they are with this work. They must engage all stakeholders to contribute to this process. Rosenholtz (1989) argued that replacing the typical isolation of teachers with staff collaboration was an essential ingredient for realizing such a level of staff cohesiveness and could positively affect student achievement. Wenger (1998) defined communities of practice as, "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (p. 1). Common planning can be considered as that type of activity.

It is a common time for the team members of the school to meet formally to focus on ways to improve student achievement. Hord (2009) suggested that school leaders must be specific as they deliberately schedule the meeting times and places for teachers to meet. These meeting times should have "protocols" that guide the work and the interactions with each person (Gates & Watkins, 2010; Horn & Little, 2010; Mullen & Schunk, 2010; Richmond & Manokore, 2011; Strahan, 2003). Specifically, Gates and Watkins (2010), Horn and Little (2010), Richmond and Manokore (2011), Strahan (2003) have agreed that productive professional learning community meeting times should vary from 45 to 90 minutes and be weekly, bi-weekly, or monthly.

In a four-year study of a school collaboration initiative, Supovitz (2002) found that just because teams are meeting does not mean they are engaging in school improvement activities. There should be some accountability factored in where principals attend the meetings. Teachers should submit the agenda and minutes to the principals if they are unable to participate in the sessions. Teachers need to intentionally use this time to establish and monitor. The mechanism should be set up in such a way that team members allow each other to consider their practices and offer some recommendations. They would also develop a culture in which they feel accountable to each other for the increase in student achievement.

Even though there are numerous benefits to participating in learning communities, there are many principals who do not set time aside for teachers to talk with each other about the work, so they can adjust where they are needed (Schmoker, 2004). Principals should intentionally schedule appropriate time in their teachers' schedules for them to collaborate with the primary purpose of improving student academic performance. Through collaboration, creativity is encouraged, and levels of responsibility are moved from the individual to the professional learning community (PLC) team (Mitchell, 2007). Researchers (Stigler & Hiebert, 2009) have showed how in China teachers learn from their colleagues, carefully developing model lessons that guide students towards conceptual understanding and procedural agility. They went on to say that Chinese teachers improve their practice by creating a collegial and rigorous environment in which teachers can learn from each other's experience, evaluate precisely how students learn, and create lessons that are staples of the curriculum. These collaborations provide hope for American schools.

Principals should create a monitoring structure to ensure that these meetings are productive. This is done by having teachers submit their agendas and minutes electronically to principals, so they can stay informed and provide feedback. School leaders can also produce this interdependent learning feature by providing feedback and asking guiding questions (Levine & Marcus, 2007). These purposeful conversations should focus on meeting the needs of students, as teachers support each other in doing so (Strahan, 2003). In the studies reviewed (Gates & Watkins, 2010; Richmond & Manokore, 2011; Strahan, 2003), researchers found that these purposeful and supportive conversations cultivated an upward spiral of school improvement.

In New York City, Chancellor Carmen Farina with a vision for school improvement endorsed the Framework for Great Schools to guide the school improvement work in New York City schools. The framework has six elements: effective school leadership, collaborative teachers, rigorous instruction, a supportive environment, strong family-community ties, and trust. The collaborative teacher's element is described as follows:

> High-quality instruction is the strongest influence on student achievement. We will help teachers acquire skills and expertise by providing opportunities for them to develop, grow, and learn from peers and experts. Teachers must be committed to student success and driven to improve their schools. Strong teachers innovate and hone their practice through continuous learning and frequent professional development. (p. 2)

Administrators evaluate schools in New York City using this framework through the process of asking teachers, parents, and students to complete a survey about each element. The questions that pertain to collaboration look for evidence to determine if teachers are working together to improve instruction and their professional growth. The principal has no influence or connection with this process. The data collected from the schools are computed into a number, which is then factored in to determine the overall score for the School Quality Snapshots. This document provides a rating for each element. School, depending on their score, would then receive a rating of excellent, good, fair or poor for each element.

During math common planning times, teachers should focus on math instruction and collectively determine ways to move instruction to the next level by making it more rigorous.

Rigorous Mathematics Instruction

Concerns specifically with the perennial problem of poor academic achievement in middle school mathematics curriculum and instruction are not new and go back as far as the 1980s (Flanders, 1987; Steen, 1986). Secretary of Education Arne Duncan's remarks at the 2011 National Forum’s Annual School to Watch Conference focused national attention on middle schools. He declared, “middle grades present the last, best opportunity for educators to reach all students. It’s a time of great promise and great peril” (U. S. Department of Education, 2011). In the 1980s, after the National Commission on Excellence in Education published A Nation at

Risk, it was evident that education professors and educational practitioners should intensify their work of improving the education system because American schools taught math ineffectively.

In *Knowing and Teaching Elementary Mathematics*, Liping Ma described how in the United States, elementary and middle school teachers lack the understanding to articulate mathematics concepts clearly to their students. Teachers in the United States address confusions about how to solve problems by directing students quickly to the proper procedure. Stigler and Hiebert (1999) highlighted that Japanese teachers, on the other hand, do not offer solutions initially, they allow students to grapple with the concepts in their groups before providing any type of intervention. In addition, in American classrooms while "content is not totally absent, the level is less advanced and requires much less mathematical reasoning than in [Germany and Japan.]" (Stigler & Hiebert, 1999, p. 27).

Scholars and theorists have suggested that the future demands an improved education system with increased rigor and engagement in classrooms (Edwards, 1999; Friedman, 2007; Pink, 2006). These same researchers further stated that engagement without increased rigor would not lead to the level of achievement that students must have to meet the demands of the twenty-first century. The president of the National Council of Teachers of Mathematics (NCTM) Linda Gojak (2013) stated that rigor in mathematics involves all participants in the learning process. She further explained that teachers must integrate rigor as they plan lessons and assign tasks. This type of teaching requires students to "grapple" with concepts that may have multiple pathways and solutions.

Manthey (2005) developed a chart to compare the cognitive level of standards and the work he saw students doing in the classroom during informal observations or walkthroughs. He determined that together with checking alignment to standards, teachers must examine the tasks that students are being asked to complete and be able to respond to the following questions: (a) "What is the level of the task?" and (b) "Will the task engage the students enough to motivate them to complete the task?" Stein, Smith, Henningsen, and Silver (2000) found that using a high-quality task would not ensure that the students were using higher level thinking skills, but that lower level tasks ensure that there will not be higher level thinking. Teachers can use the Task Analysis Guide (See appendix C) to help them with the process of creating rigorous tasks.

A study by Matsumura, Slater, and Crosson (2008) focused on specific teaching behaviors associated with academically rigorous instruction and found that students needed a safe space where emotional intelligence supported academic rigor. Becoats (2009) acknowledged that students' success in mathematics is contingent on exposure to effective mathematics instructors who will provide high-quality and explorative lessons for them. Teachers now must be able to do more than providing one standardized method for completing a type of problem; they must also be capable of discussing and redirecting various student interpretations. Students, in turn, are now required to not only get to the correct answer but also to be able to explain their reasoning (Burns, Kanive, & DeGrande, 2012).

The Common Core Math Standards were designed with the goal of providing "essential, rigorous, clear and specific, coherent, and internationally benchmarked" standards to prepare students for college and careers in the 21st century (Common Core State Standards Initiative, n.d.). The increased level of rigor and depth of these standards represented a major change in expectations for students across most states. The Common Core Math Standards brought with them not only a shift in content across the grade levels but perhaps more significantly a shift in pedagogy (Rentner & Kober, 2014).

In a report examining math standards across the United States before the implementation of the Common Core Math Standards, Klein (2005) looked at individual states' math standards and judged them on mathematical content, mathematical reasoning, clarity, and negative qualities. In this report, only three states were given an "A," while 29 states received a "D" or "F" ranking (Klein, 2005). New York State was given an overall "C" ranking (Klein, 2005). Additionally, in the review of sample lessons from New York State's "Mathematics Resource Guide with Core Curriculum, 1999," Klein (2005) commented that "the sample classroom lessons are often little more than puzzles and are poor vehicles for teaching core principles of mathematics" (p. 87). With this analysis, the implementation of the Common Core Math Standards required a significant instructional change for schools across the United States including New York State.

Jitendra, Sczesniak Griffin, and Deatline-Buchman (2007) explained that the "story" problems that require students to apply their knowledge demand that students apply several different cognitive processes simultaneously. "Studies have raised concern about the fact that students who process slowly are less likely to contribute to the class discussion that is so critical in a constructivist classroom" (Baxter, Woodward, & Olson, 2005, p. 544).

Proficiency in math acts as a gateway to open opportunities for future careers in technology, science, and finance (Saffer, Burns, Kanive, & DeGrande, 2012; Mat Zin, 2009). Ensuring there are standards in a lesson does not guarantee that students will achieve performance levels in mathematics. The teacher is an integral part of the success (Sanders & Horn, 1998). In a 2013 survey of 20,157 teachers, 40% indicated they strongly agree, and 43% somewhat agreed that teachers have the highest level of influence on student achievement (Bill & Melinda Gates Foundation & Scholastic, 2013).

For students to be successful on the Common Core Mathematics Exam they should have mastery of the standards. "Content knowledge is of particular interest with relation to Common Core State Standards (CCSS) mathematics implementation, as many teachers indicated that greater depth of knowledge is required by CCSS, which challenges, or possibly exceeds some teachers' level of content knowledge" (Cristol & Ramsey, 2014, p. 18). Teachers must do more as they unpack the standards for students. They must be able to model multiple representations and require students not only to focus on their answers but the thought process involved with finding a solution. A well-written lesson-plan (See Appendix D) will act as a catalyst to impact teaching and learning of mathematics

Rigorous instruction will help to impact student achievement in middle school mathematics. Students will be exposed to standards-based work to raise the level of their thinking as they develop a more profound conceptual understanding. In the Framework for Great School, the element of Rigorous instruction is defined as "A successful classroom requires a strong curriculum—aligned to the Common Core— that challenges students, scaffolds their experience, and is enlivened by teachers who are engaged with their craft" (New York City Department of Education, 2015, p. 1). The curriculum must meet students where they are and be able to individualize instruction. Rigorous instruction aligns content to the Common Core and apply strategies within and across grades. Again, the QR Rubric is used to evaluate New York City schools. Rigorous instruction is observed by the evaluator using the QR Rubric the expectations are the principals would "Ensure engaging, rigorous, and coherent curricula in all subjects, accessible for a variety of learners and aligned to Common Core Learning Standards and content standards" (p. 2).

Rigorous instruction will help to impact student achievement in middle school mathematics. They will be exposed to standards-based work to gain a deeper understanding of the concepts. Assessing whether they got the concept is essential to the learning process. Assessment informs the instructional cycle and provides a window into students thinking. Common assessments are an element of the process that provides a consistent method to analyze student performance. These assessments are directly aligned to the standards and are representative of collective expectations (Besser et al., 2006).

Assessments

Teaching and learning are both evaluated by assessments. The question that frequently surfaced is how often should the assessments be administered? Bambrick-Santoyo (2010) explained,

> While schools and teachers assess in some form all the time, the key assessments-the ones driving change in the school making dramatic gains in achievement –are interim assessment. Interim assessments need to happen at least quarterly, and should be given every six to eight weeks at the middle and high school levels. If assessments are administered less frequently, then weaknesses will go unrecognized until it is too late to correct them. If assessments are administered far more frequently, then teachers cannot do the depth of analysis without burning out. (p.13)

Wiggins (1990) and Frey and Allen (2012), authentic assessments require students to use prior knowledge in their education and measure their intellectual and reasoning skills (Svinicki, 2004). Wiggins (1990) stated,

> Authentic assessment requires students to be effective performers with acquired knowledge, present the student with the full array of tasks that mirror the priorities and

> challenges found in the best instructional activities, attend to whether the student can craft polished, thorough and justifiable answers, and achieve validity and reliability by emphasizing and standardizing the appropriate criteria for scoring such products. (p. 2)

Authentic assessments should be implemented in all subjects. One of the ideas that emerged when implementing is to keep the real-world connection in all disciplines (Frey & Allen, 2012). Students should see the connection of math to real life and not mere abstract concepts they will never use. In 2000, the NCTM (2000) outlined principles to support math instruction.

The six principles of mathematics were written to help teachers develop their lessons so that all students can have access to, "high-quality, engaging mathematics instruction" (NCTM, 2000, p. 3). One of the six principles addressed assessment. The assessment principle addressed "the use of authentic assessments which should reflect the mathematics that students should know and be able to do, to enhance mathematics learning, promote equity, be an open process, promote valid inference, and be a coherent process" (NCTM, 2000, p. 22). The process of creating authentic assessment can be sometimes problematic; one way to get it done is to use an observation checklist as the students complete the problems (Rowlands, 2006).

There are two major types of assessments namely summative and formative assessments. Summative assessments are at the end of the learning process and therefore tend to be evaluative by nature. Such an assessment sums up where the student is placed at the end regarding their understanding of the standards (Chappuis, 2009). Some examples of summative assessments are interim assessments, New York State tests, and finals. These types of tests provide information about students' achievement. As standards-based grading became the order of the day, formative assessment seemed to present a clearer picture of student learning. It also provides opportunities to remediate, unlike summative assessment, which is done at the end and there is no time to schedule targeted interventions. O'Connor (2002) definition of formative assessment is "Assessment designed to provide direction for improvement and or adjustment to a program for individual students or a whole class, that is, quizzes, initial drafts attempts, homework, and questions during instruction" (p. 109). Assessment for learning uses the information to support students to meet the standards. "Assessment for learning helps students close the gap between where they are and where the teacher wants them to be" (Stiggins & Chappuis, 2005, p. 19). Black, Harrison, Lee, Marshall, and William (2004) shared the following:

> From our review of the international research literature, we were convinced that enhanced formative assessment would produce gains in student achievement, even when measured in such narrow terms as scores on state-mandated tests. At the outset, we were clear that it was important to have some indication of the kinds of gains that could be achieved in real classrooms and over an extended period. (pp. 10-11)

The final stage of the assessment process was students being able to show what they comprehend and how they are able to apply that knowledge (Gardner & Moran, 2006). When mathematics is taught in a variety of ways, students then see the relevance and become more engaged. Assessments should also be constructed in a manner that reflects the value that is experienced in everyday life.

Summary

The literature review for this chapter confirms that leadership, data structures, collaborative practices, rigorous instruction and assessments can act as levers in mathematics to increase student outcome. There is a plethora of research that confirms principals have a substantial effect on student achievement (Blasé & Kirby, 2009; Cotton, 2003; Dufour & Marzano, 2011; Hallinger & Heck, 1998; Leithwood et al., 2004; Robinson et al., 2008).

Marnzano, Reeves, and Waters provided an evolving body of research to support that principals in their role as change agents can act as catalysts to change the statistics results from the CCS exams. To be successful with this endeavor, they emphatically highlighted that principals must stay focused on instruction.

There is a disparity regarding the mathematics performance of students of color, African American, Latinos and those from low socio-economic background. Lattimore (2005) investigated some of the reasons why these subgroups of students continue to fail mathematics. He discovered the fact that some African American are taught with the *Pedagogy of Mediocrity*; they are being taught in the way that requires rote memorization rather than conceptual understanding. He attributes students' failure to the type of instruction they receive from their teachers. Elmore, Marnzano, Reeves, and Waters, provided an evolving body of research to assist school leaders in their role as leaders of instruction who can transform the situation. They emphatically highlighted that principals must stay focused on instruction to impact student academic performance.

Addressed in the review are some levers that can be used to impact change, the use of data, collaboration among teachers, rigorous instruction, and assessments as backed by research as being effective approaches that positively influence student outcomes in middle school mathematics. Chapter Three focused on the methodology of the quantitative study. The instrument used was an electronic survey through *Google Forms*, which was emailed to participants. Data were collected and analyzed using SPSS version 24 software.

Chapter Three: Research Methodology

Introduction

Students' mathematics underperformance in the United States has been an ongoing topic of broad discussion for decades. American students tend to fall behind their counterparts in the industrialized world. Hanushek, Peterson, and Woessmann (2010) pointed out that in the United States many students are below the performance in mathematics compared to their counterparts in many of the world's leading industrialized nations.

The 2015 *Trends in International Mathematics and Science Study* (TIMSS) reported that educators, as well as policy makers, are concerned about the American middle and high school students' underperformance in mathematics. In Singapore, for example, 50% of students scored high enough to be considered advanced in math compared with just 14% of U.S. students who reached that benchmark. Many believe that a nation's long-term economic potential can be determined by secondary math achievement (Friedman, 2006; National Mathematics Advisory Panel, 2008). Success in middle school is an indicator of success in high school, college, and beyond.

The purpose of this quantitative research study is to discover the strategies principals in New York City public high-needs middle schools use to increase student achievement in mathematics. The sections in this chapter include research design, population and sample, instrumentation, data collection, data analysis, validity, reliability, and a summary.

Research Design

According to Cone and Foster (2006), the research design is determined by the purpose of a study. A quantitative method was chosen for this research study because it would help to compare and contrast the various strategies utilized to increase student achievement in mathematics. A correlational study of this nature “will measure the degree of relationship between variables or whether one variable predicts the other; usually, when experimenting is not possible” (Creswell, 2015, pp. 338-376). Math achievement of schools in this study is based on students’ performance as measured by the New York State Common Core Math Exams. The dependent variable in this study is student math achievement as indicated by Adequate Yearly Progress (AYP). The independent variables are various instructional strategies and practices implemented by the schools' principals. “Independent variables are those variables whose change affects the outcome of other variables under study (dependent variables). Dependent variables are those being affected by the change in the independent variables” (Alemu, 2016, p. 59).

This study is guided by the following research questions and hypotheses:

Research Question 1: To what extent does the principal ensure that teachers implement rigorous math instruction to increase student achievement?

H_a – Alternative Hypothesis 1: There is an association between the principal ensuring teachers implement rigorous math instruction and meeting Adequate Yearly Progress (AYP).

H_o – Null Hypothesis 1: There is no association between the principal ensuring that teachers implement rigorous math instruction and meeting Adequate Yearly Progress (AYP).

Research Question 2: To what extent do principals’ collaborative structures impact student achievement in mathematics?

H_a – Alternative Hypothesis 2: There is an association between principals’ collaborative structures in mathematics and meeting Adequate Yearly Progress (AYP).

H_o - Null Hypothesis 2: There is no association between principals' collaborative structures in mathematics and meeting Adequate Yearly Progress (AYP).

Research Question 3: Is there any relationship between a principal's uses of data structures to monitor students' progress in mathematics that significantly impact student achievement?

H_a – Alternative Hypothesis 3: There is an association between a principal's use of data structures to monitor students' progress in mathematics and meeting Adequate Yearly Progress (AYP).

H_o - Null Hypothesis 3: There is no association between a principal's use of data structures to monitor students' progress in mathematics and meeting Adequate Yearly Progress (AYP).

Research Question 4: Does the principal's background (content area expertise, experience) impact his/her strategies in improving mathematics achievement?

H_a – Alternative Hypothesis 4: There is an association between the principal's background (content area expertise, experience) impacting his/her strategies and meeting Adequate Yearly Progress (AYP).

H_o - Null Hypothesis 4: There is no association between the principal's background (content area expertise, experience) impacting his/her strategies and meeting Adequate Yearly Progress (AYP).

Research Question 5: To what extent does the principal's use of the assessment cycle influence students' performance in mathematics?

H_a – Alternative Hypothesis 5: There is an association between the principal's use of the assessment cycle and meeting Adequate Yearly Progress (AYP).

H_o – Null Hypothesis 5: There is no association between the principal's use of the assessment cycle and meeting Adequate Yearly Progress (AYP).

Population and Sample

For this study, the sample was New York City (NYC) high-needs middle school principals. The sample size was 100 school principals from a total of 284 high-needs middle schools in NYC. The schools chosen for this study are middle schools in NYC that are below the city average, which is 36.4 % for mathematics as per the New York State Common Core Exam results. The sampling method was a two-stage sampling where first the researcher "purposefully" selected only those school leaders with failing mathematics scores. The next step was to then randomly select 100 of those principals from that pool of failing schools and invite them to participate in the survey process. Principals were chosen exclusively from Brooklyn, Manhattan, Queens, Bronx, and Staten Island.

Instrumentation

The data collection tool used for this study was an electronic survey instrument developed by the researcher. Creswell (2011) explains, using a survey "provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population" (p. 145). The questions were closed-ended with two sections. Section one is comprised of 11 items pertaining to demographic data that included the number of years of the principals' experience, their content background, the number of students eligible for free lunch, and the academic standing of their school. Section two had 34 Likert scale type questions, in which respondents denoted their answers with responses from seven choices of options ranging from 1 = never, 2 = less than once a month, 3 = once a month, 4 = 2-3 times a month, 5 = once a week, 6 = 2-3 time a week, and 7 = daily.

Data Collection

The data collection process began by identifying the selected New York City middle schools that underperformed in the Common Core Mathematics State Exams. The researcher received IRB approval from the Sage Colleges and the New York City Department of Education (NYCDOE) before the recruitment process of the principals commenced. Letters of informed consent and survey questions were emailed to participating principals along with the explanation of the purpose of the research and the protection of their anonymity. The principals were also informed that they had the choice of whether they wanted to participate, and the option to withdraw at any stage of the process.

Principals who met the selection criteria received an electronic Google Form survey from the researcher. The first 11 questions pertained to their demographic and educational experiences. The other 34 questions provided information about the instructional strategies they used to influence student achievement in mathematics. They were required to select from choices one to seven on the Likert scale for their responses. Participants needed approximately 30 minutes to complete all questions.

The data was collected through online surveys using Google Forms. The survey was coded not to collect identifying information of individuals and their respective schools. Participants received the link electronically. Follow-up reminders were emailed to maximize return rates. Data was stored in a password-protected computer accessible only by the student researcher. Flash drives, when not in use, were placed in a locked cabinet with only the student researcher having access to retrieve them.

Data Analysis Techniques

This section describes the analysis of the five research questions. Forty-five survey items were used to answer the five research questions. Data were analyzed in the aggregate, further ensuring anonymity. The first step in this process was to organize the data for analysis. "Data analysis is the process that helps to make sense of raw data; it involves extracting what is relevant. The data analysis helps the researcher to answer the research questions" (Alemu, 2016, p. 66). The responses to the surveys were analyzed. Statistical Package for Social Sciences software (SPSS), version 24, was the software program used for the data analysis process. Questions 1-11 were analyzed using descriptive statistics. Chi-square and Spearman's rho correlation were used for analyzing question 12-45. The survey was administered once, and the participants' responses were measured for the reliability of the consistency using Cronbach's alpha.

The respondents' answers for section two items were measured using the 7-point Likert scale ranging from never, less than once a month, once a month, two-to-three times a month, once a week, two-to-three times a week, to daily. Regarding frequency, choice Number 1 was the least and choice Number 7 was the most.

For Research Question 1, a series of chi-square cross tables and Spearman's rho correlation were used to determine if there was a significant statistical association between the instructional strategies and meeting Adequate Yearly Progress (AYP). Measure of association using Pearson based on Chi-square and Cramer V for Spearman's rho correlation were used to find out whether the relationship between the two variables was significant and the effect size or the strength of the relationship. In inferential statistics, there is the null hypothesis (H_o) that predicts there is no relationship and the alternative hypothesis (H_a) which claims there is a relationship between the two variables. In many cases, the test criterion is set to .05. If the *p*-value<.05, then the null hypothesis (H_o) must be rejected, and the alternative hypothesis (H_a) is accepted. The two-tailed testing was used to calculate for non-direction.

For Research Question 2, a series of Chi-square (χ^2) cross tables and Spearman's rho correlation were used to determine if there was a significant relationship. Cramer's V based on Chi-square (χ^2) was used were used to find out whether the relationship between the two variables was significant and the effect size or the strength of the relationship. In inferential statistics, there is the null hypothesis (H_o) that predicts no relationship. The alternative hypothesis (H_a) claims there is a relationship. In many cases, the test criterion is set to .05. If the *p*-value $<$ .05, then the null hypothesis must be rejected and the alternative hypothesis is accepted. Two-tailed testing is used to calculate for non-direction.

For Research Question 3, a series of Chi-square (χ^2) cross tables and Spearman's rho correlation were used to determine if there was a significant statistical association between the instructional strategies and meeting AYP. Measure of association using Cramer's V based on Chi-square (χ^2 were used to find out whether the relationship between the two variables was significant and the effect size or the strength of the relationship. In inferential statistics, there is the null hypothesis (H_o) that predicts no relationship. The alternative hypothesis (H_a) claims there is a relationship. In many cases, the test criterion is set to .05. If the *p*-value < .05, then the null hypothesis must be rejected and the alternative hypothesis is accepted. Two-tailed testing is used to calculate for non-direction.

To analyze Research Question 4, a series of Chi-square (χ^2) cross tables and Spearman's rho Correlation were used to determine if there was a significant statistical association between the instructional strategies and meeting AYP. Measure of association using Cramer's V based on

Chi-square (χ^2) was used to determine whether there was a statistical relationship between the two variables, and if so, the strength of the relationship. In inferential statistics, there is the null hypothesis (H_o) that predicts no relationship. The alternative hypothesis (H_a) claims there is a relationship. In many cases, the test criterion is set to .05. If the p-value < .05, then the null hypothesis must be rejected and the alternative hypothesis is accepted. Two-tailed testing is used to calculate for non-direction.

To analyze research question five, a series of Chi-square (χ^2) cross tables and Spearman's rho correlation were used to determine if there was a significant statistical association between the instructional strategies and meeting AYP. Measure of association using Cramer's V based on Chi-square (χ^2) were used to find out whether the relationship between the two variables was significant and the effect size or the strength of the relationship. In inferential statistics, there is the null hypothesis (H_o) that predicts no relationship. The alternative hypothesis (H_a) claims there is a relationship. In many cases, the test criterion is set to .05. If the p-value < .05, then the null hypothesis must be rejected and the alternative hypothesis is accepted. Two-tailed testing was used to calculate for non-direction.

Validity and Reliability

Cronbach's alpha was used to assess the reliability or internal consistency of the survey items. According to Pallant (2013) the internal correlation of the items could be described using Cronbach's alpha It should ideally be above 0.7 (DeVellis, 2012; George & Mallery, 2003). The Cronbach's alpha coefficients for the survey items of each of the research questions all fall above the acceptable 0.7 range, which indicated that all the items within the research questions consistently measured the same construct.

The validity of the sample was established by having the respondents first answer demographic questions to establish that they were a principal of a middle level building with the configuration of Grades 5-8, Grades 6-8, or Grades 7-8. To further ensure validity, most of the questions were based on strategies implemented in the math classroom.

Summary

In Chapter three, the methodology of collection and analysis of data for this study was described. It included the research design, population, sample, data-collection process, instrumentation, and data analysis for the study of strategies principals in New York City public high-needs middle schools use to increase student achievement in mathematics. In Chapter four, the findings of the data analysis will be presented.

Chapter Four: Findings

Introduction

Computer technology, engineering, medicine and science are considered the gateway careers of the 21st century and demand a high level of competency in mathematics. However, as the Program for International Student Assessment (PISA) documented, American students lag in mathematics behind their peers in other developed countries. Low student achievement is more predominant in schools with students from low-socioeconomic backgrounds. The fact that every year thousands of students failing in mathematics is of concern. Academic underperformance especially in middle school mathematics can restrict students' access to higher education and future career opportunities. This systemic problem must be addressed immediately with a deep sense of urgency.

Chapter Four presents the results of the data analysis for this study. The research design utilized quantitative methodology. This chapter is organized into two sections. The first section provides basic demographic data. The second section provides analysis of the data for each research question. The following five research questions guided this study:

1. To what extent does the principal ensure teachers implement rigorous math instruction to increase student achievement?
2. To what extent do principals' collaborative structures impact student achievement in mathematics?
3. Is there any relationship between a principal's use of data structures to monitor student progress in mathematics and student achievement?
4. Does the principal's background (content area expertise, experience) impact his/her strategies in improving mathematics achievement?

5. To what extent does the principal's use of the assessment cycles influence student performance in mathematics?

Out of a sample of 100 participants, 73 individuals answered the question items on the survey, with a 73% rate of return. The data collected were used for the analysis process, which was conducted on two levels. The first level of analysis entailed using descriptive statistics to create a holistic view of the sample demographic characteristics, creating a profile of the school leaders by examining the frequencies and percentages of responses of the survey items. The second level of analysis was relational using Spearman's rho correlation coefficient and Pearson Chi-square to examine and analyze any association that may exist between the independent and dependent variables, mathematical strategies principals use, and student achievement as outlined in the five research questions. In the Chi-square test, a *p*-value being smaller than .05 was used as a standard for the relationship being significant. If the *p*-value is smaller than 0.05, the null-hypothesis (H_o: the variables have no association) is rejected. If the *p*-value is greater than or equal to 0.05, the alternative hypothesis (H_a: there is an association between the variables) is rejected.

Background of Participants

There were 73 respondents for this sample. The demographics profile survey identified 11 items that indicated key principal characteristics designed to collect data on the participants and to capture a profile of them: years of experience as a principal, content background, gender, ethnicity, school classification, student population, accountability status of school, eligibility for free or reduced lunch, Math Lead Teachers, highly qualified teachers as per the Basic Education

Data System (BEDS) survey, and meeting Annual Yearly Progress (AYP). Tables 1 through 10 highlight findings in these areas.

Table 1

Principals' Years of Experience

		Frequency	Percent	Cumulative Percent
Valid	Less than five years	24	32.9	32.9
	5-10 years	31	42.5	75.3
	10 years and more	18	24.7	100.0
	Total	73	100.0	

As shown in Table 1, most of the principals had varied years of experience. Most of them, 31 (43%), had five to 10 years of experience. The smallest number years of experience were the principals 18 (25%) of them with10 years and more of experience. There were no principals with 20 years or more experience.

There were varied content backgrounds of the principals. As displayed in Figure 1, 32 (44%) of them had English Language Arts as their content background, 18 (25%) mathematics, 6 (8%) social studies, and 5 (7%) science. It is evident looking at the data from (Figure 1), that 75% of middle school leaders did not have a mathematics content background. Twelve (16%) of the principals had expertise in content different from the ones mentioned in Figure 1.

As shown in Table 2, 50 (68%) female and 23 (32%) male principals participated in the study. The ethnic makeup of the participating principals' group, as shown in Table 3, consisted of 40 (55%) African Americans, 21 (29%) Caucasians, one (1%) Asian, seven (9%) Hispanic/Latino, and four (6%) of the principals reported their ethnicity as other.

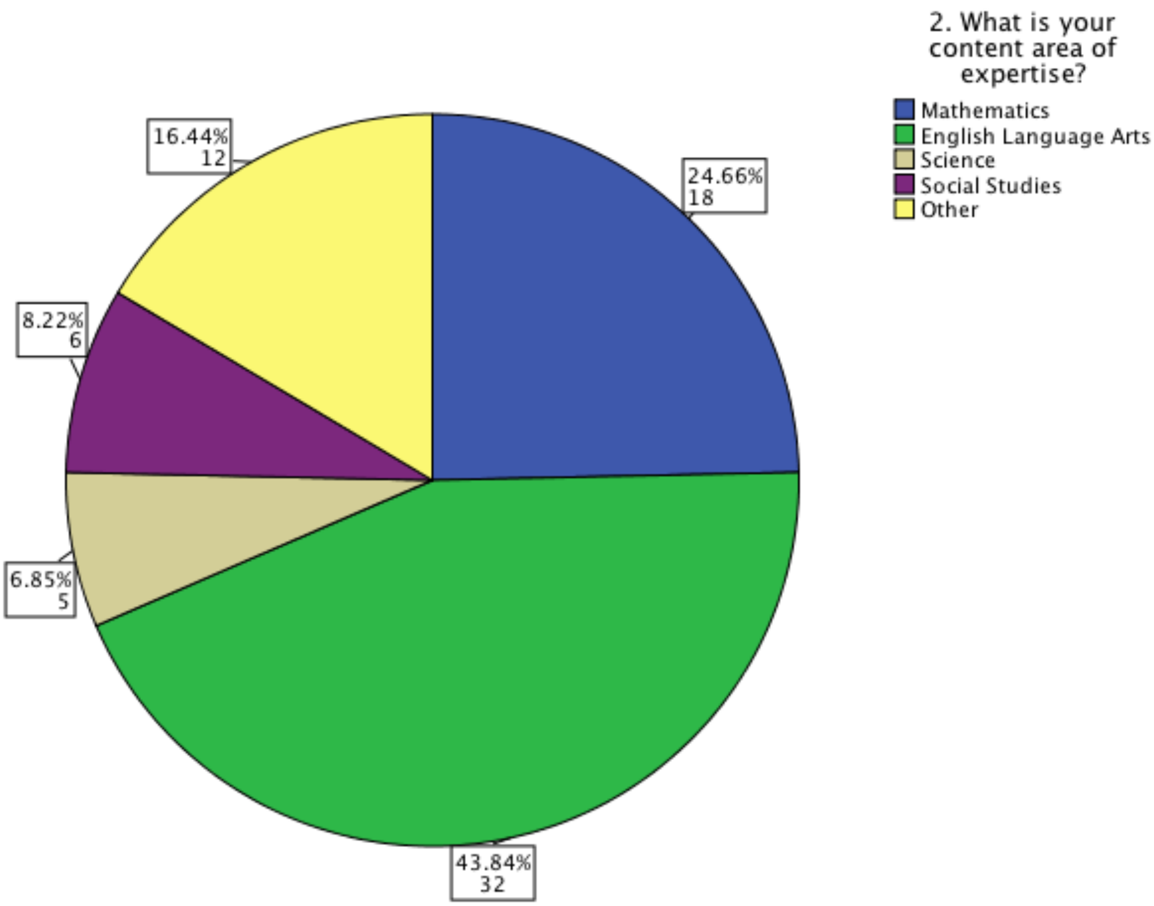

Figure 1. *Content expertise of principals.*

Table 2

Gender of Principals

		Frequency	Percent	Cumulative Percent
Valid	Male	23	31.5	31.5
	Female	50	68.5	100.0
	Total	73	100.0	

Table 3

Ethnicity of Principals

		Frequency	Percent	Cumulative Percent
Valid	African American	40	54.8	54.8
	Asian	1	1.4	56.2
	Caucasian	21	28.8	84.9
	Hispanic/Latino	7	9.6	94.5
	Other	4	5.5	100.0
	Total	73	100.0	

Table 4

Classification of School

		Frequency	Percent	Cumulative Percent
Valid	Regular Public	66	90.4	90.4
	Charter	1	1.4	91.8
	Magnet	3	4.1	95.9
	Other	3	4.1	100.0
	Total	73	100.0	

Table 5

Approximate Student Population

		Frequency	Percent	Cumulative Percent
Valid	Less than 200	14	19.2	19.2
	200-300	18	24.7	43.8
	301-500	17	23.3	67.1
	over 500	24	32.9	100.0
	Total	73	100.0	

Table 4 shows that 66 (91%) of the participants work in regular public schools, one (1%) in charter schools, three (4%) in magnet schools, and three (4%) selected other school. As shown in Table 5, the size of the schools varied from small to large. Fourteen (19.2%) had less than 200 students, 18 (24.7%) had 200-300 students, 17 (23.3%) had 301-500 students, and 24 (32.9%) had over 500 students.

As shown in Table 6, the schools of the participating principals also varied by accountability status. There are 22 (30.1%) Focus, 10 (13.7%) Priority, 39 (53.4%) in good standing, and 2 (2.7%) other. As shown in Table 7, those eligible for free or reduced lunch include one (1.4%) of student in the less than 25% band, one (1.4%) in the 26-50 band, 10 (13.7 %) in the 51-75 band, and 61 (83.6%) in the 76 and over band. As shown in Table 8, schools who had Math Lead Teachers were 37 (50.7%) of the schools, while 36 (49.3%) had none. As shown in Table 9, the Basic Educational Data System (BEDS) survey revealed data 43 (58.9%) of the schools had less than 25 percent of their teachers qualified to teach mathematics.

Table 6

Accountability Status

		Frequency	Percent	Cumulative Percent
Valid	Focus	22	30.1	30.1
	Priority	10	13.7	43.8
	Good Standing	39	53.4	97.3
	Other	2	2.7	100.0
	Total	73	100.0	

Table 7

Percent of Students Eligible for Free Lunch

		Frequency	Percent	Cumulative Percent
Valid	Less than 25 percent	1	1.4	1.4
	26- 50 percent	1	1.4	2.7
	51-75 percent	10	13.7	16.4
	76 and over	61	83.6	100.0
	Total	73	100.0	

Table 8

Math Lead Teacher

		Frequency	Percent	Cumulative Percent
Valid	Yes	37	50.7	50.7
	No	36	49.3	100.0
	Total	73	100.0	

Table 9

Percent of Teachers Qualified to Teach Math

		Frequency	Percent	Cumulative Percent
Valid	Less than 25 percent	43	58.9	58.9
	26- 50 percent	11	15.1	74.0
	51-75 percent	10	13.7	87.7
	76 and over	9	12.3	100.0
	Total	73	100.0	

Table 10

2016 Annual Yearly Progress (AYP)

Met AYP		Frequency	Percent	Cumulative Percent
Valid	Yes	29	39.7	39.7
	No	44	60.3	100.0
	Total	73	100.0	

Table 10, shows the schools that met Adequate Yearly Progress (AYP) as 29 (39.7%) and 44 (60.3%) did not meet. The majority of schools that participated in this study did not meet AYP for math in 2016.

In conclusion, the demographic data revealed that most of the principals in the sample fall in the range of having five and more years of experience. They were mostly African

American 40 (54.8 %) leading schools that did not meet AYP 40 (60%). Interestingly, they had diverse content background; however, most them had English Language Arts, 32 (43.84%), as their content background. Therefore, many of the sample schools have principals without a math background. Most schools were small "priority" and "focus" designated, with 61 (83.6%) students qualifying for free lunch, and 43 (58.9%) had less than 25 percent of teachers not qualified to teach math. A large percentage (60%) of the schools did not meet AYP.

Below is the presentation of research findings for each research question. The responses from the survey were analyzed using Statistical Package for Social Science (SPSS) version 24.

Research Question One

To what extent does the principal ensure teachers implement rigorous math instruction to increase student achievement?

This research question asked the extent to which the principal ensure teachers implement rigorous math instruction to increase student achievement in middle school math. The number of respondents was 73. The nine survey questions associated with research question one are 9, 12, 13, 14, 15, 16, 17, 18 and 19. Eight questions from the nine were measured using the 7-point Likert scale, including never, less than once a month, once a month, two to three times a month, once a week, two to three times a week, and daily.

The scale of the eight items had a low level of internal consistency of 0.617 as indicated by Cronbach's alpha. After dropping Question 14, the Cronbach's alpha value was increased to 0.755, suggesting that Question 14 was the reason for the poor overall quality. Therefore, in subsequent analysis, Question 14 was excluded.

Table 11

Chi-Square Analysis of Math Lead Teachers and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
13. Does your school have Math Lead Teachers to support teachers with content?	Yes	19	18	37
	No	10	26	36
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.241	.040
	Cramer's V	.241	.040
N of Valid Cases		73	

The data from the responses were analyzed using Chi-square test. Based on Table 11, there was a test for the statistical significance of the difference. This statistical analysis resulted in a *p*-value of .04. Because *p*-value is smaller than .05, the null hypothesis (H_o) is rejected which states there is no association between the two variables. Therefore, the alternative hypothesis (H_a) is accepted that there is an association between support from Math Lead Teachers and student achievement. Because the Cramer's V value is 0.24, which is between 0.2 and 0.3, the association is considered moderately strong.

Of the 37 schools that had Math Lead Teachers, 19 (51%) met AYP. On the other end of the spectrum, among the 36 schools without Math Lead Teachers, there was only 10 (28%) that met AYP. The numbers of schools having Math Lead Teachers and meeting AYP more than doubled when compared with those who did not have Math Lead Teachers.

The Spearman rho statistical analysis was obtained (Table 12). The correlation coefficient between the practice of teachers using Engage NY to supplement their math curriculum and meeting (AYP) was obtained, r = .13, and p=.28. Because the p-value is greater than 0.05, this means that we accept the null hypothesis (H_o) that there is no correlation between the practice of teachers using Engage NY to supplement their math curriculum and meeting (AYP).

According to Table 13, there is no association between the practice of teachers providing opportunities for student-led discussions about mathematical concepts and meeting AYP. To test for the statistical significance of the difference, the data from the responses were analyzed using the Chi-square test. The relation between these variables is not significant, χ^2 (2, N = 73) =.24, $p > .05$. This statistical analysis resulted a p-value of .67. Because $p > .05$, the null hypothesis (H_o), is accepted which states there is no association between the two variables.

Table 12

Using Engage NY and Meeting AYP

			11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?	14. Teachers use Engage NY to supplement their math curriculum?
Spearman's rho	11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?	Correlation Coefficient	1.000	.13
		Sig. (2-tailed)		
		N	73	73
	14. Teachers use Engage NY to supplement their math curriculum?	Correlation Coefficient	.129	1.000
		Sig. (2-tailed)	.276	.
		N	73	73

Table 13

Student-led Discussions about Mathematics and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
15. Teachers provide opportunities for student-led discussions about mathematical concepts?	Never	0	2	2
	Less than once a month	1	2	3
	Once a month	1	2	3
	Two to three times a month	1	4	5
	Once a week	4	7	11
	Two to three times a week	14	13	27
	Daily	8	14	22
	Total	29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.235	.670
	Cramer's V	.235	.670
N of Valid Cases		73	

Table 14
Teachers Highlight Multiple Representation and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
16. Teachers model lesson highlighting multiple representations in mathematics?	Never	3	2	5
	Less than once a month	2	4	6
	Less than once a month	3	7	10
	Two to three times a month	11	15	26
	Once a week	10	16	26
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.141	.836
	Cramer's V	.141	.836
N of Valid Cases		73	

The data in Table 14, were used to test for the statistical significance of the difference, the data from the responses were analyzed using Chi-square test. This statistical analysis resulted in χ^2 (2, N = 73) =.14, $p >$ .05, Pearson Chi-Square is .84. Because $p > .05$, the null hypothesis (H_o) is accepted which states there is no association between the practice of teachers modeling lesson highlighting multiple representations in mathematics and meeting AYP.

The data shown in Table 15, were used to test for the statistical significance of the difference, the data from the responses were analyzed using the Chi-square test, χ^2 (2, N = 73) =.42, p is less than .05. This statistical analysis resulted in a p-value of .01. Because p is smaller

Table 14

Solving Math Problems that are Similar to the Ones on State Test and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
17. Students are given opportunities to solve math problems that are Common Core aligned and are similar to the ones on the Mathematics Common Core State Exams?	Never	4	0	4
	Less than once a month	2	2	4
	Once a month	0	5	5
	Less than once a week	12	11	23
	Once a week	11	26	37
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.415	.014
	Cramer's V	.415	.014
N of Valid Cases		73	

than.05, the null hypothesis (H_o) which states there is no association between the two variables is rejected. Therefore, the alternative hypothesis (H_a) is accepted that there is an association between the practice of providing opportunities for students to solve math problems that are Common Core aligned and similar to the ones on the Mathematics Common Core State Exams and meeting AYP. Because the Cramer's V value is 0.42, which is greater than 0.3, the association is considered strong.

Of those schools implementing the strategy less than once a week, 12 (52 %) out of 23 of them met AYP. When the tests were given once a week, 11 (30%) out of 37 schools met AYP.

As shown in Table 16, there is a marginal significance between the strategy of teachers providing opportunities for students to "grapple" with math concepts and meeting AYP. A Chi-square test of association was performed to examine the relation between providing opportunities for students to “grapple” with math concepts and meeting AYP. The relation between the two variables is marginally significant, χ^2 (2, N = 73) =.41, p = .05. There is an association between the practice of providing opportunities for students to "grapple" with math concepts and meeting AYP. The statistical analysis resulted in a p-value of .05. Because p = .05, which is close to the significance level of .05, the null hypothesis (H_o) is rejected that states there is no association between the strategy and meeting AYP. The researcher accepts the alternative hypothesis (H_a), there is a marginal association between teachers provide opportunities for students to "grapple" with math concepts and meeting AYP.

The schools who met AYP implementing the strategy there were 15(43%) of the 35 schools’ teachers who implemented the strategy daily, five (83%) of the six schools who implemented it three times a week, and five (22%) of the 23 schools that implemented it once a week. Schools where the teachers implemented this strategy more frequently (two or more times

Table 16

Students Grabbling with Math and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
18. Teachers provide opportunities for students to "grapple" with math concepts?	Never	0	1	1
	Less than once a month	1	0	1
	Once a month	3	2	5
	Two to three times a month	0	2	2
	Once a week	5	1	6
	Two to three times a week	5	18	23
	Daily	15	20	35
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.415	.014
	Cramer's V	.415	.014
N of Valid Cases		73	

a week) had better results meeting AYP. Most teachers need to develop a culture in their math classrooms that allows students to "grapple" with the concepts rather than providing them with answers. This is an opportunity for the students to dig deep into the concepts and develop their own understanding. Teachers must develop the mindset that learning takes place when students "grapple" with mathematics concepts. This practice lends itself to the philosophy stating that active learning in the interactive classroom improves student outcome in mathematics.

Table 15

Students Posing Questions to Each Other and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
19. Teachers allow students in the mathematics classroom to create questions to pose to their peers?	Never	1	5	6
	Less than once a month	2	4	6
	Once a month	5	5	10
	Two to three times a month	5	5	10
	Once a week	7	8	15
	Two to three times a week	6	11	17
	Daily	3	6	9
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.200	.820
	Cramer's V	.200	.820
N of Valid Cases		73	

As shown in Table 17, a Chi-square test of association was performed to determine the difference of the significance. The relation between the teachers allowing students in the mathematics classroom to create questions to pose to their peers and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.20, p > .05. There is no association between the practice of teachers allowing students in the mathematics classroom to create questions to pose to their peers and meeting AYP. The statistical analysis resulted in a p-value of .82. Because p > .05, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a) is rejected, that states there is an association between the practice of teachers providing opportunities for students to create questions and pose to each other and meeting AYP.

Research Question Two

To what extent do principals' collaborative structures impact student achievement in mathematics?

This research question asked the extent to which principals' collaborative structures impact student achievement in mathematics. The research question was addressed using eight survey questions: 20, 21, 22, 23, 24, 25, 35, and 36. The eight questions were measured using the 7-point Likert scale including never, less than once a month, once a month, two to three times a month, once a week, two to three times a week, and daily. The scale of these eight questions had a high level of internal consistency as determined by Cronbach's alpha of .71. The Cronbach alpha for this study indicates that the answers are of sufficiently high quality that all items consistently measure the same construct of describing how collaborative structures affect student achievement.

According to Table 18, a Chi-square test of association was performed to examine the relationship between the principals attending common planning meeting and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.26, $p > .05$. The statistical analysis resulted in a p-value of .54. Because $p > .05$, the null hypothesis (H_o) is accepted, which states there is no association between the two variables.

Table 18

Principal Attending Common Planning Meetings and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
20. Principal attends math common planning meeting and actively participates?	Never	2	0	2
	Less than once a month	4	9	13
	Once a month	6	8	14
	Two to three times a month	6	9	15
	Once a week	9	12	21
	Two to three times a week	1	5	6
	Daily	1	1	2
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.263	.539
	Cramer's V	.263	.539
N of Valid Cases		73	

Table 19

Teachers Meet to Collaboratively Plan Lessons and Meting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
21. Mathematics teachers meet to collaboratively plan and model lessons?	Never	1	1	2
	Less than once a month	2	4	6
	Once a month	4	3	7
	Two to three times a month	13	20	33
	Once a week	6	14	20
	Two to three times a week	3	2	5
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.193	.742
	Cramer's V	.193	.742
N of Valid Cases		73	

Table 19 presents a Chi-square test of association that examines the relationship between mathematics teachers meeting to collaboratively plan and model lessons and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.19, $p > .05$. There is no association between the practice of mathematics teachers meeting to collaboratively plan and model lessons and meeting AYP. The statistical analysis resulted in a p-value of .74. Because $p > .05$, the null hypothesis (H_o) is accepted which states there is no association between the two variables. The alternative hypothesis (H_a) is rejected which states that there is an association between the practice of mathematics teachers meeting to collaboratively plan and model lessons and meeting AYP.

The highest number of schools that implemented the strategy was 33. Out of them thirteen (39%) met AYP that implemented the strategy two to three times a month. Six (30 %) of 20 schools implemented it once a week, and four (57%) of seven schools that used the strategy once a month met AYP.

Table 20

Teachers Analyzing Student Work and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
22. Mathematics teachers collaboratively analyze student work samples to determine the needs of students and inform their instruction?	Never	0	1	1
	Less than once a month	1	0	1
	Once a month	5	6	11
	Two to three times a month	8	13	21
	Once a week	11	16	27
	Two to three times a week	4	7	11
	Daily	0	1	1
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.205	.800
	Cramer's V	.205	.800
N of Valid Cases		73	

As shown in Table 20, a Chi-square test of association was performed to examine the relation between math teachers collaboratively analyzing student work samples to determine the needs of students to inform their instruction and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.21, $p > .05$. There is no association between the practice of math teachers collaboratively analyzing student work samples to determine the needs of students to inform their instruction and meeting AYP. The statistical analysis resulted in a p-value of .80. Because $p > .05$, the null hypothesis (H_o) is accepted, which states there is no association between the two variables. The alternative hypothesis (H_a) is rejected, which states that there is an association between the practice of math teachers collaboratively analyzing student work samples to determine the needs of students to inform their instruction and meeting AYP.

As shown in Table 21, a Chi-square test of association was performed to examine the relation between mathematics teachers taking the assessment themselves before administering it and discussing implications for teaching to determine the needs of students to inform their instruction and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) = .24, $p > .05$. There is no association between the practice of mathematics teachers taking the assessment themselves before administering it, and discussing implications for teaching to determine the needs of students to inform their instruction and meeting AYP. The statistical analysis resulted in a p-value of .63. Because $p > .05$, the null hypothesis (H_o) is accepted, which states there is no association between the two variables. The alternative hypothesis (H_a) is rejected, which states that there is an association between the practice of math teachers collaboratively analyzing student work samples to determine the needs of students to inform their instruction and meeting AYP. As shown in Table 22, a Chi-square test of association was performed to examine the relation between the practice of mathematics teachers conducting inter-visitation with each other and offering feedback during common planning meetings and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.26, p >.05. There is no association between the practice of mathematics teachers conducting inter-visitation with each other and offering feedback during common planning meetings and meeting AYP. The statistical analysis resulted in a p-value of .53. Because $p > .05$, the null hypothesis (H_o), which states there is no association between the two variables, is accepted. The alternative hypothesis (H_a) is rejected, which states that there is an association between the practice of mathematics teachers conducting inter-visitation with each other and offering feedback during common planning meetings and meeting AYP.

Table 16

Mathematics Teacher Taking the Assessment Themselves and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
Mathematics teacher take the assessment themselves before administering it and discuss implications for teaching?	Never	8	14	22
	Less than once a month	4	10	14
	Once a month	8	9	17
	Two to three times a month	4	3	7
	Once a week	3	5	8
	Two to three times a week	0	2	2
	Daily	2	1	3
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.244	.630
	Cramer's V	.244	.630
N of Valid Cases		73	

Table 17

Inter-Visitation and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
Mathematics teachers conduct inter-visitation with each other and offer feedback during common planning meetings?	Never	1	4	5
	Less than once a month	12	16	28
	Once a month	8	6	14
	Two to three times a month	6	10	16
	Once a week	2	5	7
	Two to three times a week	0	1	1
	Daily	0	2	2
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.264	.534
	Cramer's V	.264	.534
N of Valid Cases		73	

Table 18

Teachers Practice Solving Math Problems and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
Teachers practice solving math application problems during common planning before teaching them to students?	Never	2	8	10
	Less than once a month	8	14	22
	Once a month	9	6	15
	Two to three times a month	3	2	5
	Once a week	5	8	13
	Two to three times a week	2	3	5
	Daily	0	3	3
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.313	.307
	Cramer's V	.313	.307
N of Valid Cases		73	

As shown in Table 23, a Chi-square test of association was performed to examine the relation between the practice of the practice of teachers solving math application problems during common planning before teaching them to students and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.31, p > .05. There is no association between the practice of teachers solving math application problems during common planning before teaching them to students and meeting AYP. The statistical analysis resulted in a p-value of .31. Because p > .05, the null hypothesis (H_o) is accepted which states there is no association between the two variables. The alternative hypothesis (H_a) is rejected which states that there is an association between the practice of teachers solving math application problems during common planning before teaching them to students and meeting AYP.

As shown in Table 24, a Chi-square test of association was performed to examine the relation between the principal scheduling math professional development for teachers both at home school and outside of the building and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.25, p > .05. There is no association between the principal scheduling math professional development for teachers both at their home school and outside of the building and meeting AYP. The statistical analysis resulted in a p-value of .58. Because p > .05, the null hypothesis (H_o) is accepted which states there is no association between the two variables, the alternative hypothesis (H_a) is rejected that states there is an association between the practice of the principal scheduling math professional development for teachers both at their home school and outside of the building and meeting AYP.

Table 19

Professional Development and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
35. Principal schedules math professional development for teachers both at home school and outside of the building?	Never	1	0	1
	Less than once a month	6	5	11
	Once a month	10	15	25
	Two to three times a month	10	18	28
	Once a week	2	3	5
	Two to three times a week	0	2	2
	Daily	0	1	1
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.254	.584
	Cramer's V	.254	.584
N of Valid Cases		73	

Table 20

Teachers Leading Professional Development and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
36. Principal builds leadership by providing opportunities for teachers to lead math professional development sessions?	Never	0	1	1
	Less than once a month	5	9	14
	Once a month	15	12	27
	Two to three times a month	7	12	19
	Once a week	2	5	7
	Two to three times a week	0	3	3
	Daily	0	2	2
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.316	.294
	Cramer's V	.316	.294
N of Valid Cases		73	

As shown in Table 25, a Chi-square test of association was performed to examine the relation between the principal building leadership, by providing opportunities for teachers to lead math professional development sessions and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.31, p > .05. There is no association between the principal building leadership, by providing opportunities for teachers to lead math professional development sessions and meeting AYP. The statistical analysis resulted in a *p*-value of .29. Because $p > .05$, the null hypothesis (H_o) is accepted which states there is no association between the two variables. The alternative hypothesis (H_a) is rejected, which states that there is an association between principal building leadership, by providing opportunities for teachers to lead math professional development sessions and meeting AYP.

Research Question Three

Is there any there any relationship between a principal's use of data structures to monitor students' progress in mathematics and students' achievement?

This research question asked if there was any relationship between a principal's use of data structures to monitor students' progress in mathematics and students' achievement. The number of respondents was 73. The survey responses associated with this research question are 26, 27, 28, 29, 30, 31, 32, 33 and 34. The nine survey questions were measured using the 7-point Likert scale including never, less than once a month, once a month, two to three times a month, once a week, two to three times a week, and daily.

The scale of the nine items had a high level of internal consistency as indicated by Cronbach's alpha of 0.75. The Cronbach's alpha for this research question indicates that all nine items consistently measure the same construct of describing to what extent principals' use of data structure increase student achievement in mathematics.

As shown in Table 26, a Chi-square test of association was performed to examine the relation between principal scheduling math data chats with teachers after assessments to find alternative ways to reteach concepts and meeting AYP. The relation between the two variables is not significant χ^2 $(2, N = 73) = .34$, $p > .05$. The statistical analysis resulted in a *p*-value of .14. Because $p > .05$, the null hypothesis (H_o) is accepted which states there is no association between the two variables. The alternative hypothesis (H_a) is rejected which states that there is an association between the principal scheduling math data chats with teachers after assessments to find alternative ways to reteach concepts and meet AYP.

Table 21

Principal Scheduling Data Chats and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
26. Principal schedules math data chats with teachers after assessments to find alternative ways to reteach concepts?	Never	7	5	12
	Less than once a month	8	19	27
	Once a month	6	14	20
	Two to three times a month	4	5	9
	Once a week	3	0	3
	Two to three times a week	1	1	2
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.339	.136
	Cramer's V	.339	.136
N of Valid Cases		73	

A Chi-square test of association was performed to examine the relation between teachers creating misconception template and meeting AYP (see Table 27). The relation between the two variables is not significant, χ^2 (2, N = 73) =.19, p > .05. There is no association between teachers creating misconception template and meeting AYP. The statistical analysis resulted in a p-value of .85. Because p > .05, the null hypothesis (H_o) is accepted, which states there is no association between the two variables. The alternative hypothesis (H_a) is rejected which states that there is an association between the teachers creating misconception template and meeting AYP.

Table 22

Using Misconception Template and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
27. Principal requires teachers to create math misconception templates to analyze strength and weaknesses of students?	Never	15	16	31
	Less than once a month	5	9	14
	Once a month	5	7	12
	Two to three times a month	1	3	4
	Once a week	1	4	5
	Two to three times a week	1	3	4
	Daily	1	2	3
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.191	.849
	Cramer's V	.191	.849
N of Valid Cases		73	

As shown in Table 28, a Chi-square test of association was performed to examine the relation between teachers tracking students' mathematics data to provide intervention and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.12, $p > .05$. There is no association between teachers tracking students' mathematics data to provide intervention and meeting AYP. The statistical analysis resulted in a p-value of .98. Because $p > .05$, the null hypothesis (H_o) is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected which states that there is an association between the teachers tracking students' mathematics data to provide intervention and meeting AYP.

Table 23

Tracking Students' Data and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016? Yes	No	Total
Teachers track students' mathematics data to provide intervention?	Never	1	1	2
	Less than once a month	1	2	3
	Once a month	4	9	13
	Two to three times a month	8	12	20
	Once a week	5	6	11
	Two to three times a week	4	4	8
	Daily	6	10	16
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.123	.981
	Cramer's V	.123	.981
N of Valid Cases		73	

As shown in Table 29, a Chi-square test of association was performed to examine the relation between teachers using math data to create flexible groups and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.25, p > .05. There is no association between teachers using math data to create flexible groups and meeting AYP. The statistical analysis resulted in a p-value of .57. Because p > .05, the null hypothesis (Ho), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected which states there is an association between the two variables.

Table 24

Flexible Grouping and meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
29. Teachers use math data to create flexible groups?	Never	2	1	3
	Less than once a month	1	3	4
	Once a month	3	4	7
	Two to three times a month	3	7	10
	Once a week	2	9	11
	Two to three times a week	6	6	12
	Daily	12	14	26
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.257	.569
	Cramer's V	.257	.569
N of Valid Cases		73	

As shown in Table 30, a Chi-square test of association was performed to examine the relation between teachers collecting data from exit slips to gauge instruction to create groups and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) = .26, $p > .05$. There is no association between teachers collecting data from exit slips to gauge instruction to create groups and meeting AYP. The statistical analysis resulted in a *p*-value of .54. Because $p > .05$, the null hypothesis (H_o) is accepted which states there is no association between the two variables. The alternative hypothesis (H_a) is rejected which states that there is an association between teachers collecting data from exit slips to gauge instruction to create groups and meeting AYP.

Table 25

Exit Slips and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
30. Teachers collect data from exit slips to gauge instruction and create groups?	Never	2	1	3
	Less than once a month	0	1	1
	Once a month	0	1	1
	Two to three times a month	1	3	4
	Once a week	4	5	9
	Two to three times a week	14	14	28
	Daily	8	19	27
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.263	.536
	Cramer's V	.263	.536
N of Valid Cases		73	

Table 26

Using Data from State Exams and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016? Yes	No	Total
31. Teachers use the data from State Exams to track the Common Core Learning Standards that are deficits for students at grade and individual level?	Never	2	0	2
	Less than once a month	8	10	18
	Once a month	6	10	16
	Two to three times a month	5	9	14
	Once a week	4	6	10
	Two to three times a week	3	3	6
	Daily	1	6	7
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.274	.483
	Cramer's V	.274	.483
N of Valid Cases		73	

As shown in Table 31, a Chi-square test of association was performed to examine the relation between teachers using the data from state exams to track the Common Core Learning Standards that are deficits for students at grade and individual level and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.27, p > .05. There is no association between teachers using the data from state exams to track the Common Core Learning Standards that are deficits for students at grade and individual level and meeting AYP. The statistical analysis resulted in a p-value of .48. Because $p > .05$, the null hypothesis (H_o), which states there is no association between the two variables is accepted. The alternative hypothesis (H_a), is rejected that states there is an association between teachers using the data from State Exams to track the Common Core Learning Standards that are deficits for students at grade and individual level and meeting AYP.

Table 27

Implementation of Feedback and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
32. Teachers bring work to math data meetings to show evidence of implementation of feedback and progress of students?	Never	2	1	3
	Less than once a month	2	6	8
	Once a month	8	11	19
	Two to three times a month	6	12	18
	Once a week	6	11	17
	Less than once a week	5	2	7
	Daily	0	1	1
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.280	.455
	Cramer's V	.280	.455
N of Valid Cases		73	

As shown in Table 32, a Chi-square test of association was performed to examine the relation between teachers bringing work to math data meetings to show evidence of implementation of feedback and progress of students and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N=73) =.28, p >.05. There is no association between teachers bringing work to math data meetings to show evidence of implementation of feedback and progress of students and meeting AYP. The statistical analysis resulted in a p-value of .46. Because $p > .05$, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected that states there is an association between teachers bringing work to math data meetings to show evidence of implementation of feedback and progress of students and meeting AYP.

Table 28

Collection of Lesson Plans and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
33. Principals collect lesson plans to provide instructional feedback to teachers?	Never	3	2	5
	Less than once a month	9	14	23
	Once a month	6	14	20
	Two to three times a month	9	6	15
	Once a week	1	5	6
	Two to three times a week	1	1	2
	Daily	0	2	2
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.309	.324
	Cramer's V	.309	.324
2N of Valid Cases		73	

As shown in Table 33, a Chi-square test of association was performed to examine the relation between principals collecting lesson plans to provide instructional feedback to teachers and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.31, p > .05. There is no association between principals collecting lesson plans to provide instructional feedback to teachers and meeting AYP.

The statistical analysis resulted in a p-value of .32. Because $p > .05$, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected that states there is an association between principals collecting lesson plans to provide instructional feedback to teachers and meeting AYP.

As shown in Table 34, a Chi-square test of association was performed to examine the relation between the principal recognizing teachers for increasing student achievement in mathematics and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.27, p > .05. There is no association between the principal recognizing teachers for increasing student achievement in mathematics and meeting AYP. The statistical analysis resulted in a *p*-value of .49. Because *p* > .05, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected that states there is an association between the principal recognizing teachers for increasing student achievement in mathematics and meeting AYP.

Table 29

Teacher Recognition for Math and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
34. Principal recognizes teachers for increasing student achievement in mathematics?	Never	1	2	3
	Less than once a month	16	24	40
	Once a month	6	11	17
	Two to three times a month	3	2	5
	Once a week	1	5	6
	Two to three times a week	1	0	1
	Daily	1	0	1
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.272	.492
	Cramer's V	.272	.492
N of Valid Cases		73	

Research Question Four

Does the principal's background (content area expertise, experience) impacts his/her strategies in improving mathematics achievement?

This research question asked whether the principal's background (content area expertise, experience) impacts his/her strategies in improving mathematics achievement. The number of respondents was 73. The survey responses associated with this research question are 1, 2, 3, 4 and 37. The five survey questions were measured using the 7-point Likert scale including never, less than once a month, once a month, two to three times a month, once a week, two to three times a week, and daily. Data structures are created to monitor and inform instruction.

As shown in Table 35, a Chi-square test of association was performed to examine the relation between a principal's number of years of experience and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.14, p > .05. There is no association between the total number of years of experience as a Principal and meeting AYP.

The statistical analysis resulted in a p-value of .47. Because $p > .05$, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected that states there is an association between principals' years of experience and meeting AYP.

Table 30

Principals' Number of Years of Experience and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
1. Total number of years of experience as a Principal?	less than three years	10	14	24
	five years and more	14	17	31
	ten years and more	5	13	18
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.14	.47
	Cramer's V	.14	.47
N of Valid Cases		73	

The data in Table 36, were analyzed using a Chi-square test of association which was performed to examine the relation the principal's content area of expertise and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.30, p > .05. There is no association between the principal's content area of expertise and meeting AYP.

The statistical analysis resulted in a p-value of .17. Because $p > .05$, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected that states there is an association between the principal's content area of expertise and meeting AYP.

As shown in Table 37, a Chi-square test of association was performed to examine the relation between the gender of the principal and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.07, p > .05. There is no association between the total number of years of experience as a principal and meeting AYP.

The statistical analysis resulted in a *p*-value of .56. Because $p > .05$, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected that states there is an association between the principal's gender and meeting AYP.

Table 36

Principals' Content Area of Expertise and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
2. What is your content area of expertise?	Mathematics	5	13	18
	English Language Arts	10	22	32
	Science	3	2	5
	Social Studies	4	2	6
	Other	7	5	12
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.30	.17
	Cramer's V	.30	.17
N of Valid Cases		73	

Table 37

Gender of Principals and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
What is your gender?	male	8	15	23
	female	21	29	50
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.07	.56
	Cramer's V	.07	.56
N of Valid Cases		73	

As shown in Table 38, a Chi-square test of association was performed to examine the relation between the ethnicity of the principal and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.17, p > .05. There is no association between the ethnicity of the principal and meeting AYP.

The statistical analysis resulted in a p-value of .72. Because $p > .05$, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected that states there is an association between the principal's ethnicity and meeting AYP.

As shown in Table 39, a chi-square test of association was performed to examine the relation between the principal using their own background knowledge in math to coach Math Lead Teachers and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) = .18, p > .05. There is no association between the principal using their own background knowledge in math to coach Math Lead Teachers and meeting AYP.

The statistical analysis resulted in a *p*-value of .90. Because $p > .05$, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected that states there is an association between the principal using their own background knowledge in math to coach math lead teachers and meeting AYP.

Table 31

Ethnicity of Principals

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
4. What is your Ethnicity?	African American	16	24	40
	Asian	1	0	1
	Caucasian	8	13	21
	Hispanic/Latino	2	5	7
	Other	2	2	4
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.17	.72
	Cramer's V	.17	.72
N of Valid Cases		73	

Table 32

Principal's Use of Background knowledge and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
37. Principal uses their own background knowledge in math to coach math lead teachers?	Never	7	9	16
	Less than once a month	5	13	18
	Once a month	5	8	13
	Two to three times a month	4	6	10
	Once a week	3	4	7
	Two to three times a week	3	2	5
	Daily	2	2	4
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.18	.90
	Cramer's V	.18	.90
N of Valid Cases		73	

Research Question Five

To what extent does the principal's use of the assessment cycle influence student performance in mathematics?

This research question asked whether the principal's use of the assessment cycle had any influence on student achievement in middle school mathematics. The number of respondents was 73. The survey responses associated with this research question are 38, 39, 40, 41, 42, 43, 44, and 45. The eight survey questions measured responses using the 7-point Likert scale including never, less than once a month, once a month, two to three times a month, once a week, two to three times a week, and daily. It is important to determine if learning is taking place by being intentional in creating cycles of assessments. This is an instrument to inform teaching and learning.

The scale of the nine items had a high level of internal consistency as indicated by alpha (α) Cronbach of 0.84. The Cronbach's alpha for this research question indicates that all eight items consistently measure the same construct of describing to what extent the principal use the assessment cycle to increase student achievement in mathematics.

As shown in Table 40, a Chi-square test of association was performed to examine the relation between the teacher administering weekly mini-assessments to check for understanding and track students' progress and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.25, $p > .05$. There is no association between the teacher administering weekly mini-assessments to check for understanding and tracking students' progress and meeting AYP. The statistical analysis resulted in a *p*-value of .63. Because $p > .05$, the null hypothesis (H_o), which states there is no association between the two variables, is accepted. The alternative hypothesis (H_a), which states that there is an association between the teacher tracking students' progress by administering weekly mini-assessments to check for understanding and meeting AYP, is rejected.

Table 33

Administering Weekly Assessments and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
38. Teacher administers weekly mini-assessments to check for understanding and track students' progress?	Never	2	2	4
	Less than once a month	1	1	2
	Once a month	3	2	5
	Two to three times a month	6	15	21
	Once a week	10	17	27
	Two to three times a week	6	4	10
	Daily	1	3	4
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.245	.626
	Cramer's V	.245	.626
N of Valid Cases		73	

As shown in Table 41, a Chi-square test of association was performed to examine the relation between the teacher using station activities after math assessments to reteach according to students' needs and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.22*,* p > .05. There is no association between the between the teacher using station activities after math assessments to reteach according to students' needs and meeting AYP. The statistical analysis resulted in a p-value of .73. Because p > .05, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected that states there is an association between the between the teacher using station activities after math assessments to reteach according to students' needs and meeting AYP.

Table 34

Using Station Activities After Math Assessments and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		yes	No	Total
39. Teacher's use station activities after math assessments to reteach according to students' needs?	Never	4	6	10
	Less than once a month	4	7	11
	Once a month	5	2	7
	Two to three times a month	6	9	15
	Once a week	5	11	16
	Two to three times a week	3	6	9
	Daily	2	3	5
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.223	.727
	Cramer's V	.223	.727
N of Valid Cases		73	

As shown in Table 42, there is a marginal association between the practice of teachers creating lesson plans to respond to math deficits on exams and meeting AYP. Pearson Chi-square is .05, which is close to the threshold significance level of .05. Therefore, the H_o is marginally rejected, and the association between the strategy and meeting AYP is accepted.

Table 35

Creating Lesson Plans to Respond to Deficit Area

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
40. Teachers create lesson plans to respond to math deficits on exams?	Never	0	1	1
	Less than once a month	1	5	6
	Once a month	7	3	10
	Two to three times a month	9	6	15
	Once a week	4	6	10
	Two to three times a week	3	15	18
	Daily	5	8	13
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.412	.054
	Cramer's V	.412	.054
N of Valid Cases		73	

As shown in Table 43, a Chi-square test of association was performed to examine the relation between the teachers identifying distractors on math assessments and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.23, $p > .05$. There is no association between the between the teachers identifying distractors on math assessment and meeting AYP. The statistical analysis resulted in a p-value of .68. Because $p > .05$, the null hypothesis (H_o) is accepted which states there is an association between the two variables. The alternative hypothesis (H_a), is rejected that states there is an association between the teachers identifying distractors on math assessment and meeting AYP

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Table 36

Identifying Distractors and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
41. Teachers identify distractors on math assessments to identify misconceptions?	Never	2	2	4
	Less than once a month	4	5	9
	Once a month	4	10	14
	Two to three times a month	9	9	18
	Once a week	5	11	16
	Two to three times a week	1	4	5
	Daily	4	3	7
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.233	.682
	Cramer's V	.233	.682
N of Valid Cases		73	

As shown in Table 44, a Chi-square test of association was performed to examine the relation between the practice of teachers tracking movement of students from test to test and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) = .30, p > .05. There is no association between the between the practice of teachers tracking movement of students from test to test and meeting AYP. The statistical analysis resulted in a p-value of .37. Because p > .05, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a) is rejected which states that there is an association between the practice of teachers tracking movement of students from test to test and meeting AYP.

Table 37

Tracking Student Data from Test to Retest and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?	
		Yes	No
42. Mathematics teachers track student movement from test to retest and find ways to support students that demonstrated no progress?	Never	2	1
	Less than once a month	4	3
	Once a month	3	15
	Two to three times a month	7	7
	Once a week	4	6
	Two to three times a week	7	9
	Daily	2	3
Total		29	44

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.299	.368
	Cramer's V	.299	.368
N of Valid Cases		73	

As shown in Table 45, a Chi-square test of association was performed to examine the relation between the practice of the teachers grouping student according to their deficits on exams and meeting AYP and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) = .12, p > .05. there is no association between the practice of the teachers grouping student according to their deficits on exams and meeting AYP. The p-value is .98, which is >.05. Therefore, the H_o, is accepted which states that there is no association between the strategy and meeting AYP.

Table 45

Grouping Students According to Deficit Area and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016? Yes	No	Total
43. All exam questions integrate the math standards and students are grouped according to their deficit area?	Never	3	3	6
	Less than once a month	3	6	9
	Once a month	5	9	14
	Two to three times a month	6	10	16
	Once a week	4	5	9
	Two to three times a week	4	4	8
	Daily	4	7	11
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.119	.984
	Cramer's V	.119	.984
N of Valid Cases		73	

As shown in Table 46, a Chi-square test of association was performed to examine the relation between the practice of after interim assessments in math, individual goals are created for students, and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) = .22, p > .05. There is no association between after interim assessments in math are analyzed, individual goals are created for students and meeting AYP. The statistical analysis resulted in a p-value of .76. Because p > .05, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected which states that there is an association between the practice of after Interim Assessments in math are analyzed, individual goals are created for students, and meeting AYP.

Table 38

Analysis of Assessments and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016? Yes	No	Total
After Interim Assessments in math are analyzed, individual goals are created for students?	Never	4	3	7
	Less than once a month	7	10	17
	Once a month	8	17	25
	Two to three times a month	5	6	11
	Once a week	3	6	9
	Two to three times a week	0	1	1
	Daily	2	1	3
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.216	.758
	Cramer's V	.216	.758
N of Valid Cases		73	

As shown in Table 47, a Chi-square test of association was performed to examine the relation between the teachers scheduling opportunities to discuss math interim assessment results both vertically and horizontally and meeting AYP. The relation between the two variables is not significant, χ^2 (2, N = 73) =.28, the p-value is > .05. There is no association between the practice of the teachers scheduling opportunities to discuss math interim assessment results both vertically and horizontally and meeting AYP. The statistical analysis resulted in a p-value of .44. Because $p > .05$, the null hypothesis (H_o), is accepted which states there is no association between the two variables. The alternative hypothesis (H_a), is rejected that states there is an association between the teachers scheduling opportunities to discuss math interim assessment results both vertically and horizontally and meeting AYP.

Table 39

Opportunities to Discuss Math and Meeting AYP

		11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?		
		Yes	No	Total
45. Teachers get opportunities to discuss math interim assessment results both vertically and horizontally?	Never	2	1	3
	Two to three times a week	5	7	12
	Once a month	5	16	21
	Two to three times a month	8	9	17
	Once a week	8	10	18
	Two to three times a week	0	1	1
	Daily	1	0	1
Total		29	44	73

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.284	.437
	Cramer's V	.284	.437
N of Valid Cases		73	

Summary

The first research question addressed to what extent the principal ensures teachers implement rigorous math instruction to increase student achievement. Survey questions 12, 13, 14, 15, 16, 17, 18 and 19 were constructed to provide answers to research question 1. Question 12, the strategy of having Math Lead Teachers to support other teachers and meeting AYP, resulted in the relation between the two variables being significant, χ^2 (2, N = 73) =.24, p < 05.

This statistical analysis resulted in a *p*-value of .04. Because of $p < 05$, the relationship was significant. Cramer's V was .24, signifying a moderately strong effect on student achievement when using Math Lead Teachers. There is a strong association between the practice of providing opportunities for students to solve math problems that are Common Core aligned and like the ones on the Mathematics Common Core State Exams and meeting AYP. The Chi-square results: χ^2 (2, $N = 73$) =.41*,* $p < .05$, $p = .01$; therefore, the relationship is significant.

Providing opportunities for students to grapple with math concepts and meeting AYP yielded a marginally significant association: χ^2 (2, $N = 73$) =.41, $p = .05$. Because the *p*-value is on the threshold of .05, the relationship is marginal. Question 12, 17, and 18 showed a marginal association between implementing the practices and meeting AYP.

Research Question 2: To what extent do principals' collaborative structures impact student achievement in mathematics? The survey questions connected to this research question are 20, 21, 22, 23, 24, 25, 35 and 36. There was no significant relationship. All the *p*-values for each question resulted in $p >.05$.

Research Question 3: Is there a relationship between a principal's use of data structures to monitor students' progress in mathematics and meeting AYP? The survey questions 26, 27, 28, 29, 30, 31, 32, 33 and 34 were associated with research question three. The analysis revealed all cases of $p >. 05$, confirming no association.

Research Question 4: Does the principal's background (content area expertise, experience) impact his/her strategies in improving mathematics achievement? The survey questions associated with research question four are 1, 2, 3, 4, and 37. There was no significant relationship. All the *p*-values for each question resulted in $p >.05$.

Research Question 5: To what extent does the principal's use of the assessment cycle influence student performance in mathematics? The survey questions associated with this research question five are 38, 39, 40, 41, 42, 43, 44, and 45. After the statistical analysis of Chi-square was performed only question 40 showed an association between the independent and dependent variables. There is a marginal relationship between the practice of teachers creating lesson plans to respond to math deficits on exams and meeting AYP. Pearson Chi-square is .054, which is close to the threshold significance level of .05.

Chapter four provided the data analysis findings for each research question. Chapter 5 will give some interpretations of these findings as they relate to the current literature. Additionally, Chapter 5 will provide a discussion of the practical implications of these findings. Finally, Chapter 5 will provide a discussion of the limitations of the study and provide specific recommendations for further research.

Chapter Five: Summary of Findings, Conclusions, and Recommendations

Introduction

In 2016, the New York State Education Department reported that out of a total of 889, 276 middle school students that took the Common Core State Mathematics Exam, only 346,710 (39%) of them demonstrated proficiency. Furthermore, of the total number of students tested, the ethnic subgroup data showed the success rate for Hispanics/Latino was 24.3% and African Americans 20%, representing the lowest levels of academic success. The statistics revealed that 44.3% (339, 949) students belonging to these two subgroups are challenged with meeting academic standards. The lack of academic performance excludes them from being eligible to apply for lucrative job offers in the global market that demand competence in science, technology, and mathematics to be sufficiently qualified for such promising futures. These poor results required a review of the approaches that were utilized to ensure that all students could be more successful in middle school mathematics. Determined to discover ways to close the achievement gap, prompted the researcher to engage in a quantitative study entitled, *The Strategies Principals in New York City Public High-Needs Middle Schools Use to Impact Student Achievement in Mathematics.*

This study examined the instructional practices utilized by principals to increase student achievement in mathematics. The findings can be used to support superintendents, principals, and teachers as they work relentlessly to improve middle school students' achievement in mathematics.

Summary of Findings

The summary of findings for this study is organized by each research question presented below.

Research question one findings. The first research question addressed the extent to which principals ensure teachers implement rigorous math instruction to increase student achievement. The participants' responses to survey questions 9, 12, 13, 14, 15, 16, 17, 18, and 19 were analyzed to answer the first research question. After the statistical analysis was conducted on all the responses, the data were used to determine the findings and conclusions for this study. The results from questions 9, 17, and 18 confirmed an association between rigorous math instruction and meeting Adequate Yearly Progress (AYP).

The statistical analysis based on the responses for item 9 showed an association between the Math Lead Teachers supporting other teachers with content and meeting AYP to be significant, $\chi^2(2, N = 73) = .24, p < 05$. This statistical analysis resulted with a p-value of .04. Because $p < .05$, the association was significant. Cramer's V was .24, signifying a moderately strong effect on student achievement.

The analysis also revealed that of the 37 schools that had Math Lead Teachers, 19 (51%) of them met AYP, when compared with the other 36 schools that did not have Math Lead Teachers, only 10 (28%) met AYP.

The study also revealed that there is a strong association between the practice of providing opportunities for students to solve math problems that are Common Core aligned and similar to the ones on the Mathematics Common Core State exams (item 17) and meeting AYP. The Chi-square results: χ^2 $(2, N = 73) = .41, p<.05$. The statistical analysis resulted with a p-value of .01, Cramer's V = .41; Because the p-value is < .05, the association is significant and there is a strong effect on student achievement.

The other significant finding of research question one is that providing opportunities for students to grapple with math concepts (item 18) and meeting AYP yielded a marginally significant association: χ^2 (2, N = 73) = .41, p = .05. Because the p-value is on the threshold of .05, the relationship is marginal.

Research question two findings. Research question two investigated the relationship between principals' collaborative structure and student achievement in mathematics. The survey questions connected to research question two were 20, 21, 22, 23, 24, 25, 35, and 36. After conducting an analysis, the results showed no significant relationship between a principal creating collaborative structures in mathematics and meeting AYP. Every statistical analysis revealed all the p-values for each question resulted greater than .05**.**

Research question three findings. Research question three asked if there was any relationship between a principal's use of data structures to monitor students' progress in mathematics and the students' achievement. The survey questions 26, 27, 28, 29, 30, 31, 32, 33, and 34 were associated with research question three. The analysis revealed that in all cases the p-value was greater than .05, confirming no association between the independent and dependent variables. There was no association between the principals' use of data structure to monitor students' progress and meeting AYP.

Research question four findings. Research question four investigated the relationship between the principal's background (content area expertise, experience) and his/her strategies to improve mathematics achievement. The survey questions associated with research question four were 1, 2, 3, 4, and 37. The analysis revealed that in all cases the p-value was greater than .05, confirming no association between the independent and dependent variables. There was no significant relationship between the between the principal's background (content area expertise, experience) and his/her strategies to improve mathematics achievement and meeting AYP.

Research question five findings. Research question five investigated to what extent does the principal's use of the assessment cycle influence student performance in mathematics. The survey questions associated with research question five were 38, 39, 40, 41, 42, 43, 44, and 45. After performing the statistical analysis of Chi-square for the responses to all the questions, only (item 40), teachers creating lesson plans to respond to math deficits on exams, yielded an association with student achievement. There is a marginal relationship between the practice of teachers creating lesson plans to respond to math deficits on exams and meeting AYP. Pearson Chi-square is .054, which is close to the threshold significance level of .05.

Conclusions

Research question one conclusion one

The findings of research question one is that principals of schools that are instructional improve student achievement. They utilized Math Lead Teachers to support their school communities with math content-focused activities yielded a moderately strong association on student achievement. Because the results showed a moderately strong association with student achievement, the researcher concluded that this practice can be embedded in the instructional design of every school. For students to be successful with the Common Core Exam, the instruction they receive daily in their classes should be rigorous. Becoats (2009) acknowledged that for students to be successful in mathematics they must be exposed to qualified teachers who provide them with robust tasks that are embedded with cognitive demands.

Rigorous lessons that are high quality and Common Core aligned impact student achievement. Teachers can do more than provide one standardized method for completing a type of problem; they could also be capable of discussing and redirecting various student interpretations. Students in turn are now required to not only get to the correct answer but also to be able to explain their reasoning for choosing that specific solution path (Burns, Kanive, & DeGrande, 2012).

For many principals and teachers, this paradigm shifts of providing rigorous instruction turned out to be more challenging than what educators could ever envisioned. The new reform required a higher level of content and pedagogical competency than other educational legislative reforms they previously were required to implement. New York operated on a faster timeline with the Common Core Standards than any other state in America. The New York State Education Department (NYSED) rolled out the standards in 2011-12, and the new Common Core Mathematics Tests was scheduled for the 2012-2013 school year. In April 2013, New York students took the first Common Core-aligned state tests. The Common Core State Standards implemented in New York in 2010, however, were qualitatively different. They were universal and demanding a higher level of rigor and conceptual understanding than previous exams. They also demanded a major shift in instruction and pedagogy (Conley, 2014).

According to the demands of this reform, most teachers found the conceptual understanding of mathematics and the pedagogical skills to teach the subject effectively quite challenging (Ball, Hill, & Bass; 2005; Ma, 1999). Most school communities, found the job of implementing this new initiative to be complicated. Principals recognized that they could not address this momentous task alone because they felt inadequately prepared to institute the changes (Lambert, 2002). Meeting the numerous demands placed upon school leaders in the effort to increase student achievement can be a daunting task. A principal should then harness strength from the teachers to build leadership capacity within the school's community (O'Donnell & White, 2005). The work of the Math Lead Teachers supporting other teachers with content would act as a catalyst to improve student achievement. Cornett and Knight (2008) concurred that instructional coaching directly affects student achievement as teachers increase their knowledge about teaching and learning.

The role of the school leader transitioned from being administrative to becoming an agent of change (Fullan, 2005). Shellard (2003) corroborates that the role of the principal has become increasingly complex and pressure-backed. With the lack of math performance at their schools, the burden falls on the principal to make it happen or be held accountable.

Elmore (2002) suggests that accountability is a reciprocal process. If you need someone to perform a task effectively, you must invest time in training them. Once provided with the necessary training, individual then can become capable of completing the task at hand effectively and only then can they be held accountable. For students to be successful with the Common Core State Mathematics Exams, rigorous instruction should be implemented daily. With the support of Math Lead Teachers, the assignments for students should be standards-based and require students to be critical thinkers. The fact that the there was a rushed time line and one year to implement the standards did not make it any easier for the school communities to implement this reform. There is an evolving body of research in addition to the statistical analysis of this study that supports the idea that allowing teachers to support their colleagues instructionally will influence student achievement.

The Math Lead Teachers can also receive content-focused coaching. Principals who support Math Lead Teachers instructionally would also benefit from this two-pronged process. The principal would have the opportunity to bond with the teacher leaders and in so doing continue to build trust, which is a critical element required to do this work effectively. Principals can monitor the quality and level of support the Math Teacher Leaders offer to their colleagues.

The support should be differentiated to accommodate the learning variances of the teachers. There should also be a system created to monitor the impact of the support the teachers receive on an ongoing basis. This should be conducted in such a way that the Math Lead Teachers do not feel micromanaged and become resentful. The Math Teacher Leaders should be experts on the standards and be able to ensure that follow-up is done with teachers to observe implementation and that Common Core Learning Standards (CCLS) are scripted in their lesson plans and integrated in the students' work assignments. They will help teachers to transition from superficial teaching, such as merely mentioning concepts, and move toward digging deep into the standards as they teach for conceptual understanding.

On the chalkboard, the standards should be highlighted for each class and the learning targets aligned to the standards to detail explicitly the steps or instructional moves students need to make to achieve the standards. They will work with the math team to select "power standards," the ones that are grade- appropriate, heavily tested and need to be mastered for the next grade level. A calendar of the days in the year and the amount of time spent on each standard is needed so that each "power standards" can be addressed before the academic year and test are over. The Math Lead Teachers' duties should include creating exemplars to provide teachers with artifacts to guide their work. The selection of teachers for inter-visitation would serve to continuously build capacity at the school-level and impact student achievement.

Research question one conclusion two

In this study, 23 out of the 73 schools (40%) that had students' assignments that were Common Core-aligned met AYP, versus the students who did not meet AYP, 44 out of 73 schools or (60%). The data confirmed that students succeed when teachers provided Common Core-aligned work and instruction for them.

Sometimes assignments for students often look and sound rigorous; but closer examination of the tasks reveal they are not standards-based and do not require students to think critically. Students' success depends on the quality of the instruction they receive from day-to-day teaching. The results of this study corroborate that Common Core aligned assignments will improve student achievement. Additionally, students' work must be identical to the test's format and the level of the questions should be able to push students' thinking to the next level.

Teachers whose data show they are impacting student achievement may consider becoming "standards experts" at their schools. The skills demanded for students to be successful can only be achieved   thorough teachers' profound understanding of the standards and integrating them into the work that is assigned to students. The Math Lead Teachers can work with their team members to create a lesson plan checklist to ensure the lesson has all the elements to be considered Common Core aligned. They should also create a separate checklist to ensure that the assignments created for students are Common Core aligned and academically robust.

Research question one conclusion three

In this study, allowing students to grapple with math concepts yielded a marginal association with student achievement. Liping Ma (1999) explained *in Knowing and Teaching Elementary Mathematics* how elementary and middle school teachers in the United States lack the understanding to articulate mathematics concepts clearly to their students. Teachers in the United States, address confusions about how to solve problems by directing students quickly to the proper procedure. Stigler and Hiebert (1999) showed that Japanese teachers, on the other hand, do not present solutions initially, allowing students to work in groups for longer periods of time, searching for the solutions without teacher intervention. In addition, in American classrooms while “content is not totally absent, the level is less advanced and requires much less mathematical reasoning than in [Germany and Japan.]” (Stigler & Hiebert, 1999, p. 27).

The Common Core Learning Standards have eight standards called Mathematical Practices (MP). They describe the skills teachers can develop in their students. Factored in *Mathematical Practice 1* (MP1) is a strategy that supports the idea of allowing student to “grapple” with math when it advocates that students should be given opportunities to “persevere.” The culture established in the math classroom should reflect perseverance. Rather than becoming frustrated with complex problems and giving up, they should engage their peers in discussions about solving them. Teachers can establish a culture that process is more important than answers by asking students to share their processes rather than their answers.

Students need to develop their own understanding of the concepts before direct instruction takes place. After whole class teaching is finished, students who did not initially answer their questions correctly would need to write in their journals about their new thinking, clearly stating their former misunderstandings. There should be a culture established that supports the idea that mistakes are learning sites. The teacher’s role is to act as a facilitator to encourage students to create their own understanding. During that time, they will circulate to each learning group asking probing questions to help students make their thinking visible and in so doing deepen their understanding of the concepts.

Research question two conclusion. The results of the questions associated with research question number two conclude that there was no relationship between teachers' collaborative practices and meeting AYP. However, research studies (DiPaola & Hoy, 2005; DuFour, DuFour, Eaker, & Many, 2006; Johnson & Johnson, 1979; McNelly, 2002) confirmed that there exists a relationship between collegiality, professionalism, and student achievement that is statistically significant. Rosenholtz (1989) corroborated that replacing the typical isolation of teachers with staff collaboration was an essential ingredient for realizing student achievement. Collaborative activities are common times for the team members of the school to meet formally to focus on school improvement activities. Hord (2009) suggested that school leaders must be specific as they deliberately schedule the meeting times and places for teachers to meet. These meeting times should have "protocols" that guide the work and the interactions with each person (Gates & Watkins, 2010; Horn & Little, 2010; Mullen & Schunk, 2010; Richmond & Manokore, 2011; Strahan, 2003). Specifically, Gates and Watkins (2010), Horn and Little (2010), Richmond and Manokore (2011). Strachan (2003) agreed that productive professional learning community meeting times should vary from 45 to 90 minutes and be scheduled weekly, bi-weekly, or monthly.

The data in this study did not reveal any correlation between teacher collaboration and student achievement. This outcome is perhaps due to the fact that the time set aside for teachers to work collaboratively during common planning is not monitored carefully by the administrators. Supovitz (2002) found that just because teams are meeting does not mean they are engaging in school-improvement activities.

The agenda should be created before the meeting and in collaboration with the principal. The work artifact should be constructed at the end of every session and be stated on every agenda. The beginning of every meeting should begin with a review of the progress of the action items outlined in the previous meeting.

Research question three conclusion. The findings of research question three is that there was no relationship between a principal's use of data structures to monitor students' progress in mathematics and student's achievement. The researcher concluded the practice of a principal's use of data structures to monitor students' progress in mathematics has no association with student achievement. However, Katz (2005) argued that "educators need to develop an inquiry habit of mind, become data literate, and create a culture of inquiry" (p. 18). Kerr (2006) concurred that principals who conduct inquiry using data effectively to make informed decisions are intelligent, and guide the work on how to establish a data culture to impact student achievement. Togneri and Anderson (2003) recognized three components reported in the findings that are crucial to developing informed decision-making practices: cultivating a mindset of inquiry, an objective stance about the data and building a culture of trust. Researchers concurred that providing opportunities for staff to use data can be a challenging but also rewarding activity that provides information to guide the school improvement process (Bernhardt, 2003; Boudett, Murnane, City & Moody, 2005; Datnow 2007; Holcomb, 2004; Love, 2002; Supovitz & Klein, 2003; Wayman & Stringfield, 2006; Young, 2006). Besser (2006) and the Leadership and Learning Center have developed a process for collecting and analyzing student data to improve student performance by identifying goals and instructional strategies.

The literature overwhelmingly supports the viewpoint that school leaders need to engage in creating data structures to monitor students' progress, yet the analysis of the survey responses rejected any association between the two variables.

Research question four conclusion. The principal's academic background, in research question four, in this study does not influence student achievement. The researcher concludes that when looking through the lens of observing math lessons, if the principal does not have some background in the content, it is then difficult to lead math instruction and offer actionable feedback. Teachers need content support, and the principal should make decisions to provide instructional support for both teachers and themselves, even if it requires hiring an outside math consultant to offer content-focused coaching. Jenkins (2009) affirms that instructional leadership is critical in the realization of effective schools.

The literature substantiates that the principal's academic background has a strong correlation to student achievement. They should be leaders of instruction and held accountable for the success of their students. Some of them should be offered targeted content -focused professional development so they can be better prepared to effectively increase student achievement in mathematics. Marzano and Waters (2006) reaffirm that for principals to increase students' academic achievement, they must intentionally focus on instruction. Schools where students perform well academically have leaders who are considered to be instructional leaders. Cotton (2003) discovered that principals who were knowledgeable and focused on instruction had higher-achieving students than those who focused on the operational facet of the school.

Research question five conclusion. According to this study, the relationship between teachers creating lesson plans to respond to students' deficits and meeting AYP in research question five was marginally significant. Bambrick-Santoyo (2012) reminds us that "assessment is useless until it affects instruction" (p.4). The researcher concludes that some strategies to increase student achievement with this practice would ensure that the time after an assessment be considered just as important as the time before the exam. Responding to the deficits is two-pronged; it helps to inform instruction and acts as a window into the students' thinking. (See Appendices E and F).

Principals need to schedule time to meet with teachers to talk about their data. One way to begin the error analysis work according to Bambrick-Santoyo (2012) is that teachers first learn the fundamentals of the data analysis process. After that they can begin looking closely at the distractors to determine the students' misconceptions.

Recommendations

Based on the findings of this study, the following recommendations have been made for policy and practice.

Recommendation one for policy

Middle school principals should hire Math Lead Teachers to improve student achievement in mathematics. Teaching mathematics in middle school can be quite onerous for some principals and teachers. Stein and Nelson (2003) purported that principals need content area expertise when acting as instructional leaders. Math Lead Teachers can help with this situation by working to increase the math content level at their school. The analysis of this study, showed a moderately strong correlation between having Math Lead Teachers to support other teachers with content and student achievement.

The principals should be thoughtful and intentional as they assign Math Lead Teachers their duties at the school. It is imperative that they be placed strategically to have the most influence on student achievement. They should lead common planning sessions when teachers come together to work on school improvement activities. The principals should schedule time to allow the Math Lead Teachers and the math team to plan, model, practice and review lessons. This collaborative model will increase the math expertise of everyone, teachers will no longer feel isolated, they will now have “thought partners” to support them as they teach middle school math. This learning experience will allow teachers to recognize the usefulness of these support structures because of the positive impact it will have on teaching and learning.

In this study, research question one the extent to which principals ensure teachers implement rigorous math instruction to increase student achievement results showed a moderately strong association between the both variables. When students were given assignments that are Common Core aligned and on the level of the Common Core state exams, there was a strong relationship with meeting AYP. Math Lead Teachers should work with teachers in common planning to ensure their work is aligned to the standards. This would mean teachers spending time to focus on the standards. Once a week, common planning should be spent with teachers unpacking the standards. The assignments should be at the level of the Common Core State Test. Checklists should be created to determine if assignments are Common Core aligned and at the level of the test.

After assessments are administered, it is important that there is a response to the deficit areas. Researchers (DuFour, DuFour, Eaker, & Many, 2006) concur that what sets schools apart is their response to data. They further went on to say the focus should not be on the teacher with low performance indicators but on creating a culture where the success of others is shared and can be replicated.

There should be a deliberate pause to reflect and determine ways for all students to move to the level of mastery. The mindset should not be to “cover” the curriculum but ensuring that concepts are fully understood before moving forward. Principals should factor in accountability, by creating a system to determine if there is implementation to address topics that were identified as students’ deficits areas by the teachers. Bambrick-Santoyo (2010) corroborates,

> All suggested changes should be clearly marked with a date and a time for implementation; if a plan is made without specific and well-defined time for action then it will probably be neglected due to the perpetual demands competing for a teacher's time. (p.73)

Collecting samples of students' work demonstrating their new understanding of the concepts can be one-way principals can become learning partners for the school community and monitor the progress of the work. Creating misconception templates would allow teachers to reflect on their teaching practices. This practice would generate discussions about increasing students' achievement and ways to improve their craft. They will then analyze the distractors to determine the misconceptions of the students; in doing so they will recognize which of the distractors students gravitated towards as they selected an answer. The next step is to ensure teachers script a responsive lesson showing how to teach the same concepts using an alternative approach. The refined lesson plans should be emailed to the principal as evidence of the collaborative and responsive work that is taking place at the school.

The Math Lead Teachers should be assigned at least two teaching periods per day and the remaining time spent working with parents, teachers, and administrators developing high-quality math instruction at their schools. They should also be able to select teachers from every grade to become future Math Lead Teachers for the following two years to build capacity at the school. Time spent training this new cadre of Math Lead Teachers will add value to the school community. Every month the Math Lead Teachers should be required to provide school leaders with evidence of the impact of their work as it relates to increasing student achievement.

Recommendation two for policy

Principal's recruitment programs need to create a policy that future principal candidates should have a background in mathematics. Some principals claimed they did not have the adequate subject-specific content knowledge (Stewart, 2006; Supovitz & Poglinco). One of the most important requisite to be an effective instructional leader is that the principal has a profound knowledge of the content (Stein & Nelson, 2003). Without this knowledge, they would be unable to effectively lead math, observe teachers to provide actionable feedback and provide content-focused coaching for teachers. They would, therefore, be unable to increase student achievement in middle school mathematics.

Additionally, the Science Technology Engineering and Mathematics (STEM) initiatives being mandated for all middle schools increase the demand for principals to have a strong math background. Their teachers would be looking for leadership from them so students can be successful in the sciences.

Principal interns can become part of the pipeline that feeds into the future principals' pool. This action will increase the percentage of principals with math content background, so they can serve in schools that desperately need leaders who know how to improve student performance in mathematics.

In this study, the data revealed of the 73 respondents, 32 (44%) had English Language Arts as their content background compared to 18 (25%) having math. Evidently, most of school leaders have English Language Arts as their content area of expertise. When principals have to lead the math instruction at their schools, if they do not have the content background this task can be quite overwhelming. McEwan (2000) concurred "even well-educated school leaders get sweaty palms and heart palpitations when confronted with an algebra problem" (p. 1). After observing the present trend of school leaders and their content background, a critical need surfaced to maintain a balance between the principals who had English Language Arts and Math as their content area of expertise. Increasing the recruitment of math teachers who will transition to the principals' pipeline for middle schools can serve to change the present direction, so that there is an increase of principals with math content as their area of expertise.

Recommendations for Practice

The following three recommendations are provided to improve instructional practices and student achievement:

Recommendation one for practice. Superintendents should recruit a math content specialist who will provide ongoing math content-focused professional development support for principals and teachers. Research studies (Dipola & Hoy, 2005; DuFour, DuFour, Eaker, & Many, 2006; Johnson & Johnson, 1979; and McNelly, 2002) confirmed that there is indeed a statistical relation between professionalism, collegiality, and student achievement which is significant. The content-focused professional development they offer should be individualized to target the teaching and learning deficits at their schools.

The Superintendent should monitor the work that is being done looking at data to see the growth in student achievement. Funds should be allocated in every school's budget to incur the expense of hiring Math Lead Teachers. This money should have restrictions so it cannot be used for any other purpose but to retain the services of Math Lead Teachers.

Recommendation two for practice. Principals should intentionally schedule "misconception time" after each assessment for teachers to collaborate. This time, inserted in their schedules would allow teachers to formally meet at a common time, to analyze student errors and write responsive lesson plans. Schools should apply for at least five half-days per year for students to be dismissed early and teachers staying behind to work on school improvement activities. These days should be scheduled in the school's calendar so it is intentional and used solely to improve teaching and learning.

Recommendation for Further Study

The findings from this study should serve as a spawn to trigger further research on the link between effective principal's emotional intelligence leadership in middle school mathematics and student achievement. The main finding of Kenney (2008) is that school leaders with subject-specific content backgrounds in (Science, Math, English Language, and History) have a lower impact on student academic outcome on state assessments than principals qualified in the emotional intelligence fields, for example, Elementary Education, Physical Education, Health and Guidance.

Principals' ability to lead is contingent on the level of interaction they have with their staff. Trust is an essential element of effective leadership (Bryk & Schneider, 2003). Principal should engage their communities with school improvement activities in mathematics. This assignment would include working extensively with people who may not be confident with the math content themselves. The tipping point is adding value to this situation by providing the necessary individualized supports that tap in to how adults learn so they can improve student achievement in mathematics.

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APPENDIX A:

RECRUITMENT LETTER

January 27, 2017

Dear Principal,

You are being asked to participate in a research study conducted by Patricia King, a doctoral candidate at The Sage Colleges. The purpose of this study is to discover strategies middle school principals in high-needs schools implement to impact student achievement in mathematics. This study will contribute to the field of education by providing more opportunities for thousands of students to meet performance level in mathematics.

This survey comprises a series of questions related to Strategies Principals in New York City Public High-Needs Middle Schools Use to Increase Student Achievement in Mathematics. Participation in this study will require about 30 minutes.

I do not perceive any major risks from your involvement in this study. A minimal risk of emotional discomfort will be uneasiness in answering some questions related to low student achievement. This survey is completely voluntary. You are free to discontinue the study at any time without any repercussion.

Potential benefit from participation in this study is contributing to efforts in improving how schools serve those in low socio-economic areas to meet performance levels in mathematics.

Individual responses are obtained and recorded anonymously. All data will be stored in a secure location accessible only to the student researcher. The researcher retains the right to use and publish non-identifiable data. The survey monkey will be coded not to collect identifying information about individuals and their respective schools. Also, data will be reported in aggregate. Data will be stored in Password protected computer accessible only by the student researcher. Flash drive, when not in use will be stored in a locked cabinet accessible only by the student researcher. All data will be destroyed after three years.

By completing this survey, you are consenting to participate in the study. This study has been approved by the IRBs of The Sage Colleges and NYC DOE.

If you have questions or concerns during the time of your participation in this study, or after its completion or you would like to receive a copy of the final aggregate results of this study, please contact:

Thank you in advance for completing this survey!

Patricia King

Education Leadership

Sage College

Kingp@sage.edu

LINK

APPENDIX B:

PRINCIPAL'S SURVEY

1. Total number years of experience as a Principal?

a. Less than three years

b. Five years and less

c. Ten years and more

d. 20 years and more

2. What is your content area of expertise?

a. Mathematics

b. English Language Arts

c. Science

d. Social Studies

e. Other

3. What is your gender?

a. Male

b. Female

4. What is your Ethnicity?

a. African American

b. Asian

c. Caucasian

d. Hispanic/Latino

e. Other

5. How do you classify your school?

a. Regular Public

b. Charter

c. Magnet

d. Other

6. What is your approximate student population?

a. Less than 200

b. 200-300

c. 301-500

d. over 500

7. What is the accountability status of your school for student achievement?

a. Focus

b. Priority

c. Good Standing

d. Other

8. What percent of your student population is eligible for free and reduced lunch?

a. Less than 25 percent

b. 26- 50 percent

c. 51-75 percent

d. 76 and over

9. Do your school have Math Lead Teachers to support teachers with content?

a. Yes

b. No

10. What percent of your teachers are highly qualified to teach mathematics as reflected on the Basic Educational Data System (BEDS)?

a. Less than 25 percent

b. 26- 50 percent

c. 51-75 percent

d. 76 and over

11. Did your school make Adequate Yearly Progress (AYP) in mathematics in the year 2016?

a. Yes

b. No

Direction: Respond to indicate how often the following practices occur at your school.

12. Mathematics teachers expose students to assignments that are Common Core aligned?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

13. Teachers assign work that require students to use critical thinking to solve math problems?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month

5. Once a week
6. Two to three times a week
7. Daily

14. Teachers use Engage NY to supplement their math curriculum?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

15. Teachers provide opportunities for student-led discussion about mathematical concepts?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

16. Teachers model lessons highlighting multiple representation in mathematics?

1. Never
2. Less than once a month
3. Once a month

4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

17. Students are given opportunities to solve math problems that are Common Core aligned and are similar to the ones on the Mathematics Common Core State Exams?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

18. Teachers provide opportunities for student to “grapple” with math concepts?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. once a week
6. Two to three times a week
7. Daily

19. Teachers allow students in the mathematics classroom to create questions to pose to their peers?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

20. Principal attends math common planning meeting and actively participates?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

21. Mathematics teachers meet to collaboratively plan and model lessons?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

22. Mathematics teachers collaboratively analyze student work samples to determine needs of students and inform their instruction?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

23. Mathematics teachers take the assessment themselves before administering it and discuss implications for teaching?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

24. Mathematics Teachers conduct inter-visitation with each other and offer feedback during common planning meetings?

1. Never
2. Less than once a month
3. Once a month

4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

25. Teachers practice solving math application problems during common planning before teaching them to students?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

26. Principal schedules math data chats with teachers after assessments to find alternative ways to reteach concepts?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

27. Principal requires teachers to create math misconception templates to analyze strength and weaknesses of students?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

28. Teachers track students' mathematics data to provide intervention?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

29. Teachers use math data to create flexible groups.

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week

6. Two to three times a week

7. Daily

30. Teachers collect data from exit slips to gauge instruction and create groups?

1. Never

2. Less than once a month

3. Once a month

4. Two to three times a month

5. Once a week

6. Two to three times a week

7. Daily

31.Teachers use the data from State Exams to track the Common Core Learning Standards that are deficits for students at grade and individual level?

1. Never

2. Less than once a month

3. Once a month

4. Two to three times a month

5. Once a week

6. Two to three times a week

7. Daily

32. Teachers brings work to math data meetings to show evidence of implementation of feedback and progress of students?

1. Never

2. Less than once a month

3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

33. Principals collect lesson plans to provide instructional feedback to teachers?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

34. Principal recognize teachers for increasing student achievement in mathematics?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

35. Principal schedules math professional development for teachers both at home school and outside of the building?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

36. Principal builds leadership by providing opportunities for teachers to lead math professional development sessions?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

37. Principal uses their own background knowledge in math to coach math lead teachers?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week

7. Daily

38. Teachers administer math weekly mini- assessments to check for understanding and track students' progress?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

39. Teachers use station activities after math assessments to reteach according to students' needs?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

40. Teachers create lesson plans to respond to math deficits on exams?

1. Never
2. Less than once a month
3. Once a month

4. Two to three times a month

5. Once a week

6. Two to three times a week

    7. Daily

41. Teachers identify distractors on math assessment to identify misconceptions?

1. Never

2. Less than once a month

3. Once a month

4. Two to three times a month

5. Once a week

6. Two to three times a week

    7. Daily

42. Mathematics teachers track student movement from test to retest and find ways to support students that demonstrated no progress?

1. Never

2. Less than once a month

3. Once a month

4. Two to three times a month

5. Once a week

6. Two to three times a week

7. Daily

43 All exam questions integrate the math standards and students are grouped according to their deficits?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

44. After Interim Assessments in math are analyzed, individual goals are created for students?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week
7. Daily

45. Teachers get opportunities to discuss math interim assessments results both vertically and horizontally?

1. Never
2. Less than once a month
3. Once a month
4. Two to three times a month
5. Once a week
6. Two to three times a week

7. Daily

APPENDIX C:

TASK ANALYSIS GUIDE

FIGURE 1.2 The characteristics of mathematical tasks at each of the four levels of cognitive demand (Stein & Smith, 1998).

THE TASK ANALYSIS GUIDE
Memorization Task

- Involve reproducing previously learned facts, rules, formulae, or definitions to memory.
- Cannot be solved using procedures because a procedure does not exist or because the6 time frame in which the task is being completed is too short to use procedure.
- Are not ambiguous-such tasks involved exact reproduction of previously seen material and what is to be reproduced is clearly and directly stated.
- Have no connection to the concepts or meaning that underlie the facts, rules, formulae, or definitions being learned or reproduced.

Procedures without Connections Tasks

- Are algorithmic. Use of the procedure is either specifically called for or its use is evident based on prior instruction, experience, or placement of the task.
- Require limited cognition demand for successful completion. There is little ambiguity about what needs to be done and how to do it.
- Have no connection to the concepts or meaning that underlie the procedure being used.
- Are focused on producing correct answers rather than developing mathematical understanding.
- Require no explanations, or explanations that focus solely on describing the procedure that was used.

Procedures with Connections Tasks

- Focus students' attention on the use of procedures for the purpose of developing deeper levels of understanding of mathematical concepts and ideas.
- Suggest pathways to follow (explicitly or implicitly) that are broad general procedures that have close connections to underlying conceptual ideas as opposed to narrow algorithms that are opaque with respect to underlying concepts.

  Usually are represented in multiple ways (e.g., visual diagrams, manipulatives, symbols, problem situations). Require some degree of cognitive effort. Although general procedures may be followed, they cannot be followed mindlessly. Students need to engage with the conceptual ideas that underlie the procedures in order to successfully complete the task and develop understanding

Doing Mathematics Tasks

- Require complex and no algorithmic thinking (i.e., there is not a predictable, well-rehearsed approach or pathway explicitly7 suggested by the task, task instructions, or worked-out example).
- Require students to explore and understand the nature of mathematical concepts, processes, or relationships.
- Demand self-monitoring or self-regulation of one's own cognitive processes.
- Require students to access relevant knowledge and experiences and make appropriate use of them in working through her task.
- Require students to analyze the task and actively examine task constraints that may limit possible solution strategies and solutions.
- Require considerable cognitive effort and may involve some level of anxiety for the student due to unpredictable nature of the solution process required.

Stein, Mary Kay; Smith, Margaret; Henningsen, Marjorie; Silver, Edward. (2009). *Implementing Standard-based Mathematics Instruction*. New York, NY: Teachers College Press

APPENDIX D :

LESSON PLAN RUBRIC

MIDDLE SCHOOL 267

Lesson Plan Rubric

Lesson Component	HI	MED	LOW	NONE	Comments
CCLS Standards addressed in the lesson plan reflect the curriculum of the current unit					
Learning Objective and **Teaching Point:** aligned to the CCLS and use an economy of language					
Learning Target are **aligned** to **CCLS**, **TP**, **LO**. __ *3 points* __ *<u>If</u>* these 3 points are executed by students, *<u>then</u>* the LO will be attained.					
QUESTIONS: relevant (promote discussion) and scripted, moving from DoK 1-2 to DoK 3-4					

TIME ALLOCATIONS follow "Workshop Model" (see handout)					
MODELING: Evidence of Explicit Modeling					
TRACKING: Evidence of **Tracking** Student Learning/Assessment					
ACCOMMODATIONS & Possible Misconceptions: Includes detailed modifications for diverse learners, special needs students, learning styles, English Language Learners and other anticipated problems you may encounter and how to solve them.					
ASSESSMENT Includes both summative and formative assessments. The behaviors assessed exactly match the behaviors described in the objectives and description of the lesson. (Scoring guides or rubrics are provided if appropriate).					
Interdisciplinary Connections					
SMALL GROUPS Evidence of small groups					

Name of Teacher whose lesson plan is being reviewed:
____

Reviewer: ______________________________

Date: ____________________________________

-

APPENDIX E:

MISCONCPETION FORM

Misconception Reflection Form

Name: ____________________ Question # _______ Class: ______

Question(s) you struggled with… *Name the concept* *What was your misconception?*	**How would your approach be different…?** *What skills would you use?*	**My new thinking…** *I previously thought … but now I know …*

APPENDIX F:

MATH INTERIM ASSESSMENT #2 MISCONCEPTION TEMPLATE

CCSS	Ques-tion#	Question Retest	Percent Incorrect	Percent In correct Retest	Most Incorrect option choice	Most Incorrect Choice Retest	Misconceptions	Misconception Retest	How to reteach	How to reteach Retest	Lowest 10 Students' name	Lowest 10 Retest
6.NS.4	6	10	75%	69%	C	B	A reading issue, students did not realize this question as a LCM question.	A wordy question. Students are not recognizing it as a LCM question.	Pin point key words which suggest that LCM must be applied to solve this kind of wordy problem. Key words have to be underlined and then write LCM immediately.	Stress LCM and not GCF. Have students practice.	Kayla	Migel, Darnell, Jaden, Rahmeek, Kenturah
6.NS.4	9	15	100%	69%	D	B	Concept of the Variable	The students did not fully understand what the question was asking them. Students just started to multiply without understanding the task.	Read and dissect this problem in a model, showing step by step.	Have students practice after the model. Draw a picture representation of the problem. Have students write out the steps to referrence.	Darnel	
6.NS.4	10	17	83%	62%	C	A	Did not add in the June 2	Another, wordy problem. Also a multi-step problem.	Dissect line by line and underline all important information. Look for key terms and concepts to determine the solution for the problem.	Practice, practice for mastery and fluency and conceptual understanding.	Miguel	
6.NS.4	11	19	75%	69%	D	B	Multiply all numbers	Students are not comfortable with the multi-step problems yet. They get confused.	Using Proportion	Show students how to use the given information to set up a proportion. Practice setting up proportions from similar word problems.	Kathy	
6.RP.2	14	20	75%	100%	A,B,C	A, B	Did not understand the UR	The table trick them. They just assumed without reading deeply what the question was asking them; but it skipped from 8 to 12... leaving out 10 and it webbed them in.	Using Proportion	Tell the students that it is imperative that they read carefully and use their cube to help them pin point all necessary information in the question. Practice using a same table and scenario with different numbers.	Nashali	
6.RP.3B	15		75%		A		12 x 3 + 5 = 40				Ana	
6.RP.3C	18		92%		A		Guess- DID NOT TEACH				Brandon	
6.RP.2	19		83%		C		Divided 180/10				Eric	