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Conceptual and Procedural Instruction:
Mathematical Teaching Approaches and Strategies in an Urban Middle School

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A DISSERTATION

Presented to the Affiliated Faculty of the
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in Partial Fulfillment of Requirements
For the Degree of Education

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**CONCEPTUAL AND PROCEDURAL INSTRUCTION: MATHEMATICAL TEACHING
APPROACHES AND STRATEGIES IN AN URBAN MIDDLE SCHOOL**

Abstract

The purpose of this qualitative research study is to describe which methods and strategies can help to improve students' achievement in mathematics in under resourced urban middle schools. The significance of this study is to develop math instructional skills in urban schools that can help bridge the achievement gap between urban underperforming schools and suburban achieving schools. Urban mathematics educators are content-ready and state-certified, but they lack certain key techniques and strategies that will help teachers succeed and students learn effectively and efficiently.

Two questions were answered in this survey: in answer to the first question, the educators characterized conceptual and procedural math teaching methods, while in answer to the second question, the instructors answered questions on teaching strategies and pedagogies that help improve the quality of math instruction at the middle school level. Twelve math educators were asked eleven, semi structured, face-to-face questions. The conceptual framework supporting this research includes professional development schools, project-based learning, and transformational leadership.

The conclusions that were drawn after the study can be categorized into three parts: First, the educators who were surveyed believe that conceptual learning is characterized as teaching students to apply the math concepts and theories that they have learned. Secondly, procedural

learning is associated with the memorization of math facts and formulas. Lastly, certain practices ensure quality math instruction, including positive behavior intervention support, professional development, professional learning communities, response to intervention, teacher professional development schools, using curriculum maps and pacing guides, the use of technology in the classroom and using project-based learning methods.

University of New England

Doctor of Education
Educational Leadership

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DEDICATION

This dissertation is dedicated to my mother, Mrs. Clara Otemaa Danquah.

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My greatest appreciation is to God almighty through his son Jesus Christ. As his word says: I can do all things through Christ who strengthens me (Philippians 4:13). Without the help of God all this would not be possible . . . wow, combining family, work and school.

My mother has been my backbone, talking to her on the phone once or twice a month kept me determined and “moving on.” Thanks to my wife, Laventra, and son, Nigel, for supporting me and tolerating my “exclusion behaviors.”

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CHAPTER 1

INTRODUCTION

The Michigan Department of Education (MDE) requires all schools to pass the newly improved annual scorecard at an increasingly higher rate. Schools that fail to make the grade in three consecutive academic years or more are scrutinized and prepared for a possible state audit. A new grading system known as the color-coded system was introduced by the state in the 2012-2013 academic year, replacing the letter grades assigned to schools. Green represents a school with 85%–100% rating, lime a school with 70%–84%, yellow a school with 60%–69%, orange a school with 50%–59% and red a school below 50%. Schools in red are termed priority schools and are critically scrutinized by the state for several years; without the necessary reforms, the school could be shut down (MDE, 2013).

Middle school buildings in the study site contain Grades 6-8; in effect, this research will be based on mathematics instruction in Grade 6-8 middle schools. The terminologies *urban* and *inner city* are synonymous and will be used interchangeably throughout the document. Inner city middle schools are closed more frequently in comparison to their suburban colleagues in part because of low levels of math proficiency as determined by state-standardized test scores. Factors that lead to poor achievement and to subsequently mandated reforms include math and English Language Arts (ELA), state-mandated standardized test scores and the students' yearly attendance rates (MDE, 2013). Factors that lead to poor math achievement include the lack of differentiated math instruction in the classroom (Koeze, 2007), strengthening teacher student relationships (McCready, 2010), which can result in improved instruction by the educator, improved reading comprehension (Glenberg & Wilford, 2012) which can result in a better

understanding and comprehension of math story problems, the consistent practice of math facts (Rozalski, 2008), teaching students mathematics via project-based learning (PBL; Verma, Dickerson, & McKinney, 2012), creating a conducive and teachable learning environment (Quinn, 2010), teacher professional development catering towards the improvement of teacher skills (Roberts 2010), inculcating technology in instruction (Papa, 2011), and adopting the Response to Intervention (RTI) or multitiered system of instruction in teaching mathematics (Turse & Albrecht, 2015). Without the necessary changes in the approach used in teaching mathematics, low-income area schools will continue to experience students who perform below the state average in math, have low math achievements on state test scores, and have an increased, high school dropout rate and unemployment, leading to deviant behaviors and heightened crime and incarceration rates of the youth in inner cities. Community and school leaders have not addressed the mentioned factors adequately to strengthen math instruction in schools. Leaders must first have a vision of what academic success looks like before the changes will materialize. As indicated by Kotter (2012), “Vision plays a key role in producing useful change by helping to direct, align, and inspire actions on the part of large numbers of people” (p. 8). Math educators must rise to the occasion by adopting leadership styles, teaching techniques, and teaching methods and strategies that will reform the teaching of mathematics by balancing the conceptual procedure of teaching the subject with the procedural process. Christinson (2012) claimed, “Students are motivated to learn math by responding actively rather than merely listening, by having opportunity to interact with their peers, by being provided with situations that invite thought and by participating in activities” (p. 49). Students should be given the opportunity to learn math by relating the subject to life scenarios and situations and by applying math concepts to their daily lives.

The teaching of mathematics can be strengthened when educators adopt the teaching of mathematics using Math Practice One as the key teaching tool in the classroom. Math Practice One was adopted as the common core state standards to promote the teaching of mathematics conceptually and procedurally (Christinson, Cook, Lassiter, & Wiggs, 2012).

Math Practice One reflects recommendations that math should be taught conceptually and procedurally. Hudson and Miller (2007), found that acquiring conceptual math knowledge is “a connected web of information which in the linking relationships are as important as the pieces of discrete information that are linked” (p. 49). In other words, math concepts and theories should be related to the student’s life experiences to strengthen the understanding of the subject. Hudson and Miller (2007) also stated,

When the goal of mathematics instruction is to help students understand the meaning associated with the procedures they are learning or the concepts being taught, it is important to provide various modes of representation . . . in three dimensions (i.e. manipulative devices) and two dimensions (i.e. pictures). (p. 49)

In using these modes, educators aim to strengthen a student’s understanding of mathematical ideas and concepts. However, procedural knowledge is the capability to track a set of sequential steps to solve a mathematical problem (Hudson & Miller, 2007, p. 49). Procedures involve using formulas, steps, sequences, and order in solving math problems. A balance of both conceptual and procedural procedures will lead to a better understanding of mathematics; however, this research will focus only on how Math Practice One enhances the teaching of math conceptually and procedurally in a case study of one urban middle school in Michigan.

Statement of the Problem

Classroom teachers lack instructional strategies that will help urban students understand mathematical concepts and excel on math standardized tests. Their lack of training in how to use appropriate strategies results in schools that are unable to obtain average standards on the MDE annual report card, which has long-term effects such as possible school closures, and an increasing number of high school dropouts and delinquent juveniles in the community.

Purpose of the Study

The purpose of this qualitative research study is to describe which methods and strategies can help to improve achievement in mathematics in under resourced, urban middle schools. Math instruction can be improved by implementing the eight math practices associated with the national common core standards; however, this essay will focus on Math Practice One. The following learning strategies serve as methods and approaches to implementing and practicing Math Practice One in middle schools. The first method and approach is the PBL curriculum; the proponents of the constructivism learning theory suggest that people learn better by actively participating in the learning process (Verma, Dickerson, & McKinney, 2012). Students learn better when they are provided with opportunities to express their creativity or use their assets (Douglas, Burton, & Reese-Durham 2008). Using differentiated instruction (Koeze, 2007) and computer delivered instructional methods aid in boosting student comprehension of math facts (Burns et al., 2012). Other curriculum approaches include teaching reading in math which helps in solving story problems (Glenberg & Wilford, 2012), the consistent practice of math skills (Rozalski, 2008), creating a conducive classroom learning environment (Quinn, 2010), improving student behavior and parental involvement (Gu et al., 2011) and adopting the early childhood program in elementary schools (Jairells, 2009). In addition, encompassed in these

approaches are the using math academic coaches (Becky et al., 2013), conducting professional developments on math teaching pedagogies (Roberts, 2010), conducting data teams geared towards improving mathematics instruction (William, 2013), using RTI teams and systems (Turse & Albrecht, 2015), focusing on the Positive Behavior Intervention Support program (Lampron & Gonsulin, 2013), and emphasizing on special education strategies that will strengthen the RTI program (Shyyan, 2008).

Although most of the literature deliberates on the problems associated with low math achievement in schools, most of the researched materials do not dwell on the root cause of the problem. Most scholarly authors do not concentrate on the ways and means of responding to the academic needs of the child from the perspective of parental and community support. In this research, educators answered questions about how they characterize the teaching of mathematics procedurally and conceptually in an urban classroom. In addition, educators answered questions on what instructional methods, strategies, and practices could help boost and support quality math instruction in an urban middle school.

Research Questions

Although many factors contribute to the underperformance of mathematics among middle school students, in this study, the researcher focused on academic approaches to finding solutions to improving instruction in the context of implementing the Common Core's Math Practice One program. The main questions that will be answered by this study are as follows:

1. How do educators determine whether conceptual and procedural math teaching approaches are useful teaching strategies in an urban middle school?
 - i. How do educators characterize conceptual math teaching instruction?
 - ii. How do educators characterize procedural math teaching instruction?

2. What instructional strategies are beneficial for teaching mathematics to urban middle school students?

Conceptual Framework

Procedural and conceptual learning concepts are vital and essential tools to use in improving math instruction at the middle school level. Rittle-Johnson, Schneider, and Star, (2015) found that “conceptual knowledge is defined as knowledge of concepts, which are abstract for example, the National Research Council defined it as comprehension of mathematical concepts, operations, and relations” (p. 588). Rittle-Johnson et al. (2015) also indicated that “procedural knowledge is often defined as knowledge of a series of steps, or actions, done to accomplish a goal” (p. 588).

PBL improves the understanding of math concepts because students are involved in the creation of a product in relation to the topic learned. It is usually a hands-on activity meant to strengthen the understanding of basic math topics (Angelou, Capraro, & Yetkinar, 2008). Professional development schools (PDSs) create an opportunity for collaboration between educators with the aim of exploring classroom culture, collaboration agendas, and quality approaches for building a conceptual framework for teaching mathematics. The goal of the PDS is to strengthen teacher knowledge and skill at the school site, which will lead to a higher quality and effective teaching of the subject (Cozza, 2010).

Northouse (2013) drove this researcher’s study through the statement: “Although the transformational leader plays a pivotal role in precipitating change, followers and leaders are inextricably bound together in the transformation process” (p. 186). Northouse continued, adding, “Transformational leadership is concerned with improving the performance of followers and developing followers to their fullest potential” (p. 191). The quality of math instruction

improves considerably when school administrators, teachers, teacher assistants, and instructional coaches embark on leading students by exhibiting transformational leadership qualities.

Assumptions, Limitations, and Scope

The responses of 12 middle school mathematics educators in one middle school might not represent the opinions and views of most math educators in under resourced, urban middle schools in Michigan. Math educators, including math teachers, teacher assistants, instructional coaches, and school principals, are directly involved in teaching or supporting math instruction in middle schools. Although they do not represent all urban middle school teachers, their professional training and characteristics might reflect the views and opinions of many urban middle school teachers.

Significance and Rationale of the Study

According to Cahn (2014) “The prospect for human progress and flourishing hinge fundamentally on the care that those needing it receive, and the ethics of care stresses the moral force of the responsibility to respond to others in need of the dependent” (p. 145). If this statement remains true, a definite lack of connection exists between the poor and rich neighborhood schools regarding resources and opportunities. In considering the state of under resourced schools in inner cities, perpetuating injustice might be the best way to describe these school systems. Although funding per pupil drawn from federal, state, and local city funds in a typical urban school might surpass some suburban schools, state of the art amenities and facilities are yet lacking as compared to the performing schools in the suburbs. It must be mentioned that most of the per-pupil funding is geared towards educator salaries. The lack of well-equipped and quality teachers deprives urban city students of achieving at their highest level, hence the need to conduct research on how to improve math instruction.

Definitions

The eight math practices, associated with the common core state standards will be defined; however, this research will focus on how teachers can use only the first practice in improving math instruction, in effect, the first practice will be defined in detail, while the other seven practices will be briefly explained. It is worth knowing that all eight practices are interconnected, and all promote and ensure the quality of math instruction from the procedural and conceptual perspectives of math instruction. It is also important to distinguish between the math practice standards and curriculum standards. The curriculum standards are the defined topics to be taught at the various grade levels. For example, the Curriculum Standard 7.G.3 is defined as follows: Seventh grade geometry three, two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

However, the math practice standards are simply concepts, ideas, and strategies used in teaching the curriculum standard. For example, Practice Standard 1 is as follows: Make sense of the problem and persevere in solving them is a strategy, concept and idea used in attaining the objectives of the Curriculum Standard 7. G.3.

Make sense of the problem and persevere in solving it. This means solving math problems should include a dialogue, conversation, thinking and reasoning between students without basing the conversation on solely finding the answer to a problem, but on the process involved in solving the problem. This simply means that one can solve a problem without giving up, through elaborate deliberations, persistence, and determination on the part of the student, as Christinson, 2012, stated,

Students analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt Students consider analogous problems, and try special cases and simpler forms of the original problem to gain insight into its solution. (p. 51)

Tools that can be used in achieving the aims and objectives of math practice one are technology, multiple intelligence techniques, audiovisuals, quality pacing guides and curriculum, having a cordial relationship with students through efficient classroom management, and practicing PBL methods. Other strategies and methods that can be used in promoting Practice Standard 1 are using the Positive Behavior Intervention Support (PBIS) system and conducting weekly professional learning community events that ensure teacher collaboration and communications. In addition, professional development for teachers that supports them in learning strategies that will improve implementation of Math Practice One is essential, and data teams must be developed to track students' progress and identify areas of weakness that can be taught and retaught in the classroom. The RTI tool can also be used to promote Math Practice One.

Reason abstractly and quantitatively. This means students will be able to apply math concepts in their day-to-day lives, in other words, students can think of numbers in many ways. It is the ability to decontextualize abstract math problems and relate them to a real-life scenario.

Construct viable arguments and critique the reasoning of others. This is the ability to move beyond computation to the interpretation and analysis of information, meaning math students should be able to explain their thinking and try to understand others.

Model with mathematics. This shows students ability to use physical objects, drawings, and physical gestures to represent situations or the pupil can show their work in several ways. This enhances the learning needs of students who learn math best through visuals.

Use appropriate tools strategically. This is when students can use math tools in attaining solutions and explain why the tool was chosen as a means to an end. It includes using of all tools such as computers, software, a compass and a wide range of mathematical tools. This process can involve students familiarizing themselves with their own math data; in effect, they become conversant with their areas of strength and weakness and focus on improving in the areas of weakness.

Attend to precision. This is when a fluent math student uses math vocabulary and provides precise and concise answers on measurements and computations. In this scenario, students can work carefully and check their work for accuracy. This can be achieved through the consistent practice of math facts, the study of math at an early age and training teachers through professional development to adopt research proven pedagogical skills.

Look for and make use of structure. This is when the pupil can determine patterns and use the mathematical knowledge one has acquired in solving new problems. This method requires consistent practice in acquiring the skill of using patterns and structure in solving other problems.

Look for and express regularity in repeated reasoning. This is an instance when proficient math students can develop short cuts in solving problems by using rules and patterns. This requires higher order thinking skills where math skills developed will be applied in finding solutions in the real world. PBL will be used in this instance to a large scale (Christinson et al., 2012).

Multiple intelligence is a theory that taps into the various modalities of intelligence of a human rather than seeing intelligence as a solitary general capability. Brainpower can be exhibited through the following eight criteria: musical, verbal, visual, logical, kinesthetic, interpersonal, and intrapersonal relationships and naturalistic ways (Gardener, 1993).

Differentiated instruction might be considered a response to theories about multiple intelligences, and is an educational philosophy that influences approaches for teachers to instruct students at their level of comprehension or learning styles, usually in the same classroom setting (Douglas, Burton, & Reese-Durham, 2008). For instance, in a class of 20 students, there might be three math comprehension levels. Five students might be proficient at an 80th percentile, 12 students at a 50th-79th percentile while three students will be below the 50th percentile. All three levels will be instructed and given assignments at their significant levels.

The RTI system is a system whereby students are identified through screening as having learning or behavior challenges (Turse & Albrecht, 2015). Students are designated by “tiers” or degrees of ability. Tier I consist of all students instructed by the general education teacher. Tier II students are usually students who perform a grade below grade level, while Tier III students are 2 or more years below grade level. Tier IV students are usually those with special educational needs. Institutions categorize the tiers to suit the needs of their students; in effect, the defined tiers or categories can differ between schools and districts.

Professional learning communities (PLCs). These are professional bodies that meet regularly for individuals to share ideas and learn from each other and about modern trends and innovations in the profession. In the Kindergarten-Grade 12 (K-12) educator profession, there are generally both vertical PLCs that are made up of meetings between educators who teach different

grades and different subjects, and horizontal PLCs that are made up of educators who teach the same grade level.

Conclusion

In this study, the researcher focused on finding solutions to low math achievement from the perspective of what educators can do academically to boost students' math academic performance. Although an emphasis is placed on the eight math practices and their implementation in the classroom, the authors in the literature emphasized what educators could do to enrich the implementation of Math Practice One in the classroom. Most scholarly materials do not study the ways and means of reaching the individual child's academic needs at home. State education departments tend to put the entire blame of student academic underperformance on the educator. However, the circumstances of the student outside the school premises could possibly disrupt the students' academic capabilities and potential, thus, resulting in low academic achievement. Chapter 2 will reiterate and elaborate on the literature in which the authors found solutions to the underperformance of mathematics in urban middle schools.

CHAPTER 2

REVIEW OF THE LITERATURE

The literature review focuses on solutions to supporting and improving math achievement in under resourced inner city middle schools. The research described here focuses on key solutions to this plight from the perspective of the school leaders, middle school math teachers, teacher assistants, and instructional coaches. The chapter is categorized into three major sections: Math learning, school leadership roles, and teacher training.

It has become imperative in inner-city public middle schools in the state of Michigan to improve math instruction for students. Outcomes of preparing students for math would include higher math achievement, leading to science and engineering careers in the future; helping schools obtain state average standards on the Michigan annual report card, and in the long run, decreasing the number of high school drop-outs and increasing the number of students who pursue tertiary education. The major objective of this research is to provide educators with ideas and possible solutions that can be used in preventing the continuous low achievement in math among under resourced middle schools. Although most research and literature conducted on improving math instruction focuses on what educators are doing wrong and what educators, parents and students ought to do, there is less emphasis on the socioeconomic status and family issues students encounter, circumstances that negatively affect and limit students' academic growth and success.

The research presented includes studies by acclaimed scholars in the field of education. A clear majority of articles, books, and dissertations were derived from the University of New England library resource website, particularly from the ERIC database. Most of the peer

reviewed materials were derived through snowballing search; using key terms such as school improvement, professional development, data driven instruction, classroom management, RTI, the PBIS system improving mathematics instruction in middle schools and the eight math practices from the Common Core State Standards. I agree with all the mentioned views of the various authors enumerated below, the view of all authors are geared towards promoting K-12 education in general and or math education specifically. The research presented in this review addresses initiatives that can be taken by school principals, teachers, teacher assistants, and instructional coaches in improving the teaching of mathematics in under resourced inner city schools which will eventually lead to improved student achievement. Many research participants support the practical learning of math in support of Math Practice Standard One, a concept developed by the United States' Department of Education (DOE) and published by Christinson et al. (2012): *Make sense of problems and persevere in solving them*. The other seven standards are closely related to Standard One, and they are as follows: Reason abstractly and quantitatively, construct viable arguments and critique the reasoning of others, model with mathematics, use appropriate tools strategically, attend to precision, look for and make use of structure and look for and express regularity in repeated reasoning.

Math Learning

While teachers are expected to be highly qualified in the subject or grade they teach, they may not be fully prepared. One is required to have at least 20 college credit hours (minor) in the subject taught to be a certified teacher in the state of Michigan. The teacher is mandated to take the course: teaching in the content area (pedagogy) and pass a state test in basic skills and the content taught to be a certified middle school teacher in Michigan. Self-contained middle school teachers (K-8) in addition to the basic skills test, are required to pass an elementary proficiency

test to teach a self-contained middle school class (MDE, 2013). Teachers' assistants are expected to have at least 60 college credits to qualify as a teacher assistant while school administrators are expected to have a master's degree and an administration certificate issued by the state of Michigan to become a school leader. The mentioned educator preparations and guidelines outlined by the state indicates that educators are content ready to instruct students academically, but are they fully prepared for all the other challenges that are associated with the profession? The review will focus on methods that can be used in improving math instruction in the classroom such as the prolific use of technology, multiple intelligence techniques, curriculum pacing guides, differentiated instruction, classroom management, reading in math, practicing math skills, PBL and creating a conducive classroom atmosphere for teaching.

Procedural and Conceptual Learning

According to Ngu and Phan (2016), conceptual and procedural knowledge represents essential components of mathematical proficiency and are defined as such: "conceptual knowledge is a principle that governs a domain, and procedural knowledge is a step-by-step sequence of actions to obtain a solution (p. 63). Rittle-Johnson, Schneider, and Star, (2015), found that "conceptual knowledge is defined as knowledge of concepts, which are abstract for example, the National Research Council defined it as comprehension of mathematical concepts, operations, and relations." They also indicate that "Procedural knowledge is often defined as knowledge of a series of steps, or actions, done to accomplish a goal" (p. 588).

The mentioned definitions support the idea and concept of the eight math practices and in particular, Math Practice One, which states: solving math problems should include a dialogue, conversation, thinking and reasoning between students (in effect, promoting conceptual learning

methods) without basing the conversation on solely finding the answer to a problem (promoting procedural learning) but also the process involved.

The Eight Math Practices

The United States' Department of Education in conjunction with the National Council of Teachers of Mathematics developed eight math practice standards meant to promote the teaching of mathematics conceptually and procedurally. The practices are embedded in the Common Core State Standards (i.e., math curriculum standards) and are as follows: (a) make sense of problems and persevere in solving them, (b) reason abstractly and quantitatively, (c) construct viable arguments and critique the reasoning of others, (d) model with mathematics, (e) use appropriate tools strategically, (f) attend to precision, (g) look for and make use of structure, and (h) look for and express regularity in repeated reasoning (Christinson et al., 2012).

The eight math practices have been adopted by thousands of school districts across the United States. Christinson's (2012) *Navigating the Mathematics Common Core State Standards* is being distributed to math educators in school districts with the goal of improving math instruction by promoting procedural and conceptual learning in the classroom.

Technology

As indicated by Papa, teachers can use various forms of technology for instructional purposes. Technology provides an open access to communication that brings students extensive models of teaching that enriches standards, broadens the problem-solving problem process and creates further possibilities for interactive learning (Papa, 2011, p. 190–191). Technology for instruction is evident in various forms in the school system. It ranges from laptops and desktops computers, iPad, and smart boards. Teachers who fail to use the mentioned devices will have their instruction termed obsolete. There are other ways of fusing technology in the curriculum

such as playing math games online, completing and submitting assignments online and creating communication tools online to enhance the teaching of mathematics.

Burns and others (2012) support research that found that, after students were involved in a computer-based intervention program, they developed the following skills: conceptual understanding of the subject, procedural competency, and the ability to represent and formulate math problems mentally and to develop reasoning skills. Lastly, the program was designed to enable students to apply mathematical concepts practically, hands-on and to their day-to-day lives. A total of 216 Grade 3 and 4 students (in preparation towards middle school) participated in the program, the students worked on the software at least three times a week for an 8–15-week duration. At the end of the course, students who participated in the workshop improved their math skills as compared to students who did not, and the intervention program was deemed very effective.

The online tutoring program known as 4MALITY, an online tutoring software designed to support enquiry learning and problem solving in elementary and secondary schools, is a resourceful and progressive approach to student academic success. The system is made to teach students problem solving and test taking strategies and skills with emphasis on the Massachusetts Comprehension Assessment System (MCAS). A study of the effectiveness of the software addressed the following questions: Do students show growth in performance from pretest to the posttest? What strategies and methods will teachers have to use in combining the mentioned online program with the traditional classroom teaching methods? In other words, how will the program align and fit into the usual classroom teaching method? The system delivers instruction in four different ways: the first part explains story problem questions regarding the language used, the second portrays computational operations, while the third and fourth parts teaches

students strategies used in solving math story problems and test taking skills respectively (Maloy, et al 2010).

This method of studying story problems can be associated with unwrapping the meaning of key verbs and nouns in story problems. Students taught math story problems from the perspective of understanding the practical meaning of the problem are bound to understand and know the mathematical operation expected to be used in solving the problem. The results of the study indicated that 70% of students improved their test scores from pretest to posttest, and students could apply the math concepts learned to their day-to-day lives (Maloy, et al 2010).

Kebritchi and others (2009) wrote about a survey conducted among K–12 educators on the deficiencies of educational websites in relation to instruction. Students learn effectively when they are engaged and having fun, using such quality games will serve as means of possibly achieving high academic standards in math. The results also showed that games hardly align directly with the state and national curriculum; secondly, teachers needed training on how to adequately access and use these games. Solutions to the mentioned problems included designing game websites that are easy to access, manipulate, and browse through, and the website needed include multimedia components. Findings indicated continuous training should be designed and made available to users both online and face-to-face. Technical training should be made available continuously showing educators how to align and relate the game to the curriculum and student level of study. Software should be accommodating of several browsers and versions, and ongoing trainings should be made available for school districts all over the country (Kebritchi et al., 2009). This mode of instruction can increase student interest in mathematics, students interested in technology but deficient in math skills can gain interest in math eventually if multimedia technological components are used as a means of instruction.

When students are involved with using technology in the classroom, they may develop an interest in the subject being taught. Obviously technology will not necessarily produce a prolific math student, however it can serve as incentive in securing the interest of the child in math when it is used as a medium of instruction.

Multiple Intelligence

Douglas, Burton, and Reese-Durham (2008) citing Hoerr (2002) defined direct instruction as a “rigorously developed, highly scripted method for teaching that is fast-paced and provides constant interaction between students and the teacher” (p. 182). This form of instruction is good for re-teaching math lessons but not for introducing new topics. Rather, multiple intelligence approaches to teaching is one solution to creating a better understanding of math topics. Multiple intelligence includes all forms of learning thereby capturing the various learning styles of students: Kinesthetic, tactile and audio-visuals and using hands-on activities.

Hoerr (2002, as cited in Douglas, Burton, and Reese-Durham, 2008) claimed, Direct Instruction purports that learning is taught and directed by the teacher and can be compared to a banking process, where teachers are simply depositing information into students as opposed to multiple intelligence methods where students are provided with opportunities to express their creativity or use their assets. (p. 182)

It is essential to tap into various learning styles in a math class. Students learn differently, in effect using visuals in teaching all the time may not favor the kinesthetic and tactile learner. It is therefore imperative that educators adopt a blend of teaching styles and techniques that will suit the needs of all students.

Math Curriculum and Pacing Guides

Math is a subject that requires teaching sequentially from one topic to the next, and failure to derive a pacing guide that sequentially paces the topics and teaches them strategically can be detrimental to students. One should avoid long-term intervals between the teachings of topics and should ensure that preceding topics are prerequisites to future topics taught. It is imperative that educators create units about the content of the various standards with each unit having a preand posttest and having math topics that blend into each other without breaks to better strengthen student's understanding of the topics (Boylan, 2011).

Boylan (2012) found that math courses should be taken continuously and developmentally, in effect, there should not be long breaks between taking courses, and one should avoid skipping basic math courses before taking advanced math courses. Per Boylan, in mathematics, if one does not use the skill; one loses it. If long intervals are left between taking progressive math courses, it results in skill deficiencies. This method is essential and critically important in ensuring the mastery of mathematics skills, students should take fundamental math courses before progressing to more advanced courses. In addition, students should not wait for a long period between taking math courses.

To develop a teaching plan that requires focus, rigor, and effective impartation of skills, the educators will need a good curriculum and an efficient pacing guide. The pacing guide creates a sense of direction and purpose for the educator, and it enables skills to be taught sequentially and progressively in a timely manner.

Differentiated Instruction

Differentiated instruction is a system of structuring learning that places students in groups where they are taught at their level, skill and competence in an academic subject area. Kim

(2010), investigates the fact that two-thirds of urban or inner-city boys in schools are deficient in mathematics, part of which can be attributed to student deviant behavior in the classroom setting. Per the author, research was conducted on a group of seventh grade students that yielded certain interesting results. The students were placed in small group settings where instruction was individualized, results indicated that individualized study provided such students ample time to understand mathematical concepts, in effect, their test scores soared. In school districts with students with high numbers of deviant behaviors that are known to affect student academic performance, “one on one” tutoring improved student academic proficiency (Kim, 2010).

Koeze (2007), citing Tomlinson (2001), indicated “differentiated instruction calls on a teacher to realize that classrooms must be places where teachers pursue the understanding of teaching and learning and to recall daily that no practice is truly best practice unless it works for the individual learner” (p. 17). In effect, learning must be tailored to the individual student’s need. Students learn differently, for example, there are students who learn effectively by listening (audio), watching (visual), movement (kinesthetic) and tactile (touch or feel) or by using a combination of the mentioned learning styles. It is imperative that educators can categorize students in groups or through providing divergent learning stations that best suits the student style of learning.

An essential aspect of differentiating instruction is providing students with access to their progress in the form of data, this will help students take ownership of the learning process, boost their self-confidence while they monitor their own progress. When students have access to their data, they are empowered; it helps them learn to interpret charts and develop action plans to bridge their knowledge gaps. For instance, students might see that, when they spent more time on math problems after school, they finally mastered a challenging concept or that their

performance tended to improve after they watched a video on a math concept. Seeing that information visually in charts helps students make informed decisions about developing their study skills (Khan & Slavitt, 2013).

Classroom Management and the Student-Teacher Relationship

Classroom management is an essential part of providing quality math instruction. In a well-managed classroom, students have and obey certain outlined rules and regulations and are aware of the consequences when the rules are violated. It is imperative that educators develop a rapport with all students, building relationships with students' increases learning among students. If a child trusts an adult there is greater likelihood that he or she will be willing to learn from that adult.

McCready (2010) wrote about research on student behavior conducted in four inner city schools in Toronto, Ontario, Canada. Educators were asked the following questions: What type of behavior and classroom management situations are the most challenging? Explain why? Which actions or consequences help students improve their behavior? Do students from different backgrounds such as ethnicity, race, and gender have different needs, and if so, how do educators build trusting relationships with students? Examples of challenging student conduct included yelling, swearing, lack of communication skills and physical aggression with peers. Other behaviors included defiance, stubbornness, and severe academic disengagement. The mentioned behaviors hinder teaching the most because students are disrupted and lose concentration in the process of instruction, irrespective of student's race, ethnicity, or gender. Through the mentioned findings, educators collectively deduced solutions such as training students on how to develop leadership skills, learning about the cultures of other students, educators developed empathy towards students and engage students in conversations with the aim of building a rapport with

the pupil. It is important that students share their life experiences with their peers and teachers while teachers in turn teach students how to develop polite etiquette and communication skills (McCready, 2010).

Classroom management techniques are critical factors used in ensuring quality math instruction in an urban middle school. Without rules and regulations and the implementation of an effective reward system, educators cannot teach efficiently. It is therefore necessary that educators develop a reward system that will motivate students to be of good behavior and focus on academic achievement.

Reading in Mathematics

Mathematics test scores cannot be improved without improving reading skills. If a student cannot comprehend English language then he or she will not be able to solve math story problems irrespective of a student's level of competency in math (Glenberg & Wilford, 2012). Glenberg and Wilford (2012) conducted a research study using a concept known as Inherent Hypothesis: reading by putting words and phrases together as well as an embodied mental model created from the readings, can make a remarkable difference in student reading capabilities, and this competency can be transferred to mathematics. While reading a story problem, students can map the problem on paper or mentally use words and phrases in the story problem to map the solution to the problem. This method can be used in improving students' math proficiency (Glenberg & Wilford, 2012). Without adequate reading comprehension skills, it is impossible to solve math story problems. Educators must ensure that students are equipped with reading comprehension skills that can lead to improved math achievement.

Consistent Practice

Rozalski (2008) believed the constant practicing of math skills makes one perfect. The author lists five major practices that educators can use to ensure students practice repeatedly to strengthen one's understanding of the skill. The first is improving student listening skills, per Rosalski, math proficiency can be achieved by having students indulge in playing academic games, creating listening centers in the classroom as well as listening to audio books; also, identifying story sequences and recalling the order of stories through audio devices is yet another technique that will help students comprehend story problems. Sharpening the note taking skills of the student is an additional important practice that will eventually have positive effects on students' math academic achievement. It is ideal to teach students how to identify the main idea of a story or concept. It is not necessary to write all notes dictated during a lecture or class. Rozalski, however, argues that students who take notes in class and read their notes have better grades than students who do not write things down and or read their notes. Yet another skill that needs to be developed is student thinking and analysis skills: teachers should assist the pupil in mastering think aloud methods and strategies as well as developing critical thinking skills by reading aloud story problems in groups and analyzing the vocabulary and math operations used in solving the problem. The fourth practice is the ability to develop memory skills: the learner must develop mnemonics and acronym recording techniques. The last practice is reading directions; the learner should master reading directions before beginning an assignment, during multiple choice exams the student should read all possible answers before committing to choosing one, similar and absurd options should be eliminated in the process (Rozalski, 2008).

At the middle school stage, it is necessary and important to review previously taught math skills in the classroom. Math skills can be easily forgotten if not revisited quite often, so

teachers must ensure that past topics taught are reiterated during warm up assignments to reinforce the skill. Per Van Der Heyden, a research was conducted in the southwestern region of the United States in inner-city schools using the multitiered system known as RTI. The major objective of the study was to determine how students retained math and reading skills over a period and to be able to predict how the pupil can retain and understand related content in the future. On a weekly basis, students were tested on skills studied during that week and reviewed assignments on past skills, in effect, reinforcing and practicing previously taught skills. In math, the pupil had to practice basic computational skills four days in a week for the entire academic year, and students were expected to master one skill in a week. At the end of the academic year, students showed remarkable improvement in mathematics skills (Van DerHeyden, 2009).

Summative and formative assessments practiced in class will increase the probability of students improving their math test competencies, teacher designed assessments as well as curriculum designed tests should be practiced in class often. William writes about one of Edward Haertel's ideas on how testing can possibly improve the educational process in a school. The author suggests that high-stakes, well-structured and constructed tests are of immense value to both students and teachers. Frequent classroom testing raises students' achievement and improves student retention and memory skills, formative assignments motivate students and gives them confidence in preparation towards summative assignments. Through math formative and summative assessments, teachers can confirm the weaknesses and strengths of students, which leads to the delivery of quality instruction on the part of the educator, teachers can derive an area of concentration and focus when testing is used as a form of assessment, weak standards are usually targeted, taught and re-taught depending on student scores. Testing has led to the proliferation of data teams in schools across the United States. Data teams specifically collect

test data, analyze scores, and determine the measures needed to be taken by the institution to improve student academic achievement and performance (William, 2013).

As students practice math skills continuously and consistently, they become very skillful and prolific mathematicians. It is important to have students solve “test-like” questions in class to familiarize students with vocabulary used on standardized test.

Project-Based Learning

Teachers must engage students in PBL if they hope to see improvements in math scores. Middle and elementary school math PBL is an instructional method that uses multiple teaching styles, concepts and strategies in teaching students. Students are usually assigned projects that encourage them to submit and or present assignments to their instructor in the form of a skit or theatrical show, musical, research paper, multimedia presentations, documentaries, interviews, collaborations, writings and video documentaries. This approach allows the student to engage in hands-on activities and assist them in applying mathematical concepts in the real world; this no doubt strengthens the student’s understanding of basic math concepts and theories (Verma, Dickerson, & McKinney 2012).

According to Holmes and Hwang (2016), PBL is defined as students working collaboratively to design solutions for authentic and meaningful questions and problems in the real world Additionally, these projects involve students in problem-solving, decision-making, and investigative activities; give students the opportunity to work relatively autonomously over extended periods of time; and culminate in realistic products or presentations. (p. 449)

Holmes and Hwang conducted a research on the impact of PBL on the secondary school mathematics learner, the results proved that students did not necessarily develop standards

content proficiency but rather developed constructive critical and mathematical thinking skills, understanding that mathematics is a way of explaining the concrete world around them. The research proved that with time, PBL students became proficient in mathematical concepts and procedures and were able to apply math procedures in real life. Holmes and Hwang's research further proved that PBL promotes collaboration between students and therefore develops student collaborative and interactive skills. Holmes and Hwang (2016) found that "PBL has been widely recognized as an active, collaborative and integrative learning approach that engages learners while centering on practical-oriented education" (p. 451).

Karaçalli and Korur (2014) found that "project-based learning methods applied in the experimental group, students constructed their own knowledge and learned by themselves throughout the process" (p. 232). They believed that "This situation is sustained by the results showing that there were statistically significant effects of the PBL method on academic achievement and retention of knowledge" (p. 232). Zhou realized that project base learning promoted creativity skills on the part of the student; students developed a product in relation to the person, process, place, and product (Zhou, 2012). Maida (2011) made a unique statement about PBL: "Project-based learning, which builds on John Dewey's work a century ago on experiential, hands-on, student-directed learning, clearly fits within the trend toward practice-based and experiential learning" (p. 763).

Verma, Dickerson, and McKinney (2012) indicated that

Project-Based Learning has a proven record as a teaching tool. The constructivism learning theory suggests that people learn better by actively participating in the learning process. In order to involve students in the participatory learning process, the interaction

among students and between students and the instructor in a classroom becomes very critical. (p. 26)

Verma, Dickerson, and McKinney cite the benefits of PBL through Edgar Dale's cone of learning in Table 2.1.

Project-based Learning does not only improve the interactive skills of the students but also enables the student develop critical, analytical, and problem solving skills. This concept promotes conceptual learning to a great extent.

The Cone of Learning

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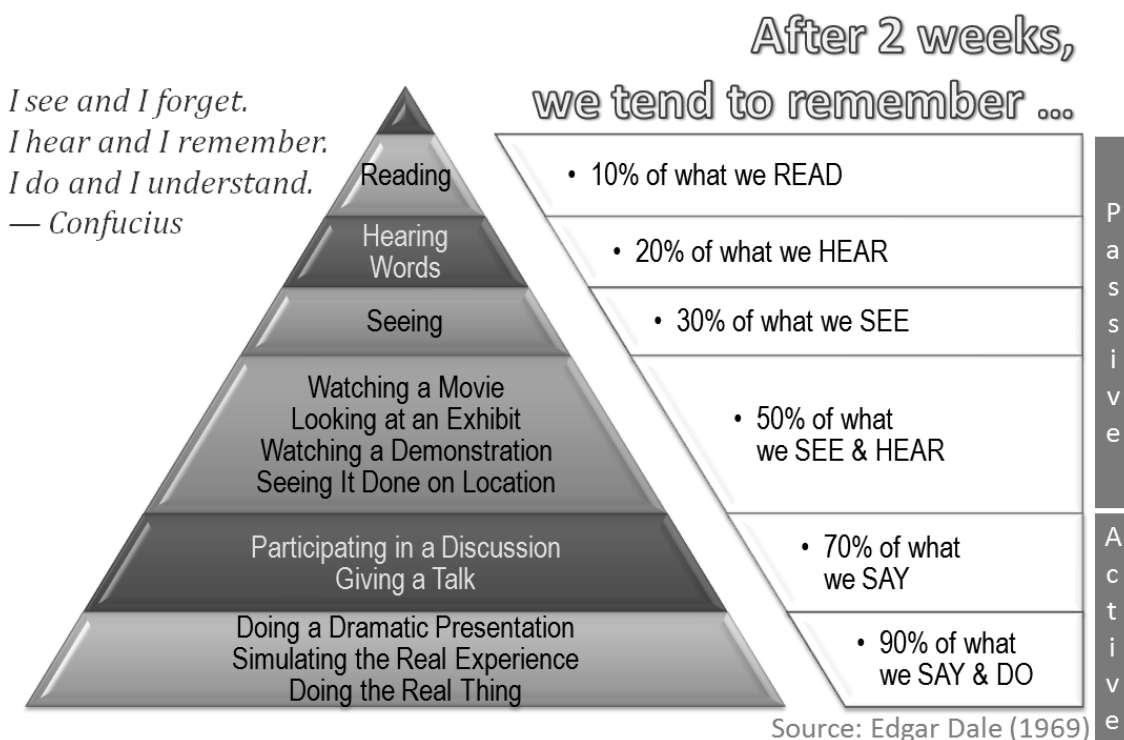


Figure 2.1. The Cone of Learning. From Edgar Dale.

Five Steps to Creating a Conducive Teaching Environment

Quinn (2010) recommended five easy steps or five key practices schools and districts can implement to improve achievement in mathematics. First, school boards should focus on student achievement by developing district goals, student performance objectives and develop strategic

plans. Developing a strategic plan gives the organization a sense of direction and purpose. Secondly, school leaders should focus on leading the instruction team by creating a vision, analyzing data, ensuring plans are implemented, and monitoring results. This will ensure that educators are on task and ready to deliver. Thirdly, a district should develop a quality assessment similar to state tests used in assessing students. The fourth factor requires schools to develop a site improvement plan focused on district data and the analysis of state data. Lastly, teachers should focus on meeting state objectives by focusing on state's curriculum and targeting students who need remediation plans. This resource emphasizes producing a quality educator capable of boosting the quality of instruction. Through data analysis, educators will be able to develop measurable and achievable goals, which can be accomplished by students (Quinn, 2010).

To attain proficient math instruction, there has to be an “all hands on deck” approach. The school board should be involved in student achievement objectives, and school leaders need a realistic and feasible vision. An assessment should be created and implemented within the school district that mimics the annual state test. The entire institution will have to focus on data as a means of tracking students' academic progress and remediation processes.

School Leadership Roles

School leaders must focus on initiatives that will expedite improvement of the quality of mathematics instruction. School-based leaders must consider ways to engage families in their reform efforts. Three key initiatives that leaders can take are as follows: Encourage the introduction of early childhood education in elementary schools, ensure stringent student disciplinary measures and encourage parental involvement.

Student Behavior and Parental Involvement

Educators who involve parents in the child's academic process usually experience positive changes in the student's academic performance. According to Gu et al. (2011), "In all these relationships, student absenteeism, classroom disturbance, and skipping class had very high negative correlation with teachers' expectations for student achievement" (p. 25). Gu et al. (2011) found that, "generally, teachers' high expectation on student performance and parental involvement in school activities play important roles in reducing student problem behaviors in schools" (p. 31). Mc Creedy (2010) found that 50 teachers interviewed indicated that student deviant behaviors were as follows: "Physical behaviors (temper tantrums, kicking, pushing, hitting, running away), verbal behaviors (screaming, yelling, swearing, lying), academic disengagement (time management, setting priorities) and miscellaneous non-compliance (opposition, social conflicts, stubbornness)" (p. 117). The mentioned behaviors can be attributed to factors found in the following study:

According to Morrissey, Hutchison, and Winsler (2014),

Family income during childhood has substantial impacts on academic achievement

The achievement gap between children living in low-income families and those in more well-off families begins before kindergarten, and widens with age One possible mechanism underlying relations between family income and student achievement is school attendance. Children who miss class fail to benefit from teacher-led lessons, peer interactions, and other activities designed to foster learning. Absences from school during the elementary school years are an important indicator of later academic success. (p. 741)

Elias and Leverett (2011) claimed, "Poor children experience cumulative exposure to multiple environmental risks that lead to a higher rate of physical and psychological morbidity

than is experienced by other groups of children” (p. 30). Elias and Leverett (2011), identified the following factors: “Among these risks are an increased pace of life; greater economic demands on parents; alterations in family composition and stability; breakdown of neighborhoods and extended families; weakening of community institutions” (p. 30).

Campbell and Brigman (2005) found one solution to the mentioned student deviant behaviors to be a “structured Approach to Group Counseling, group counseling is one of the key solution to the mentioned deviant behaviors.” They added, “While there is consensus on the overall effectiveness of group counseling with children, more specific research is needed to support the claim that group counseling can positively impact student achievement and behavior” (p. 68). Campbell further indicated, “The purpose of the group counseling program was to increase student school success skills and achievement in reading and math” (p. 69).

Parental involvement in their student’s academic progress usually yields positive results. Such students usually show academic and behavioral progress rapidly. Educators will have to contact parents about student’s progress not only when academic grades are declining but also when academic grades are improving.

Early Childhood Education

Administrators must make bold decisions to ensure improved math instruction, in other words, administrators must make drastic and radical changes by changing personnel and the processes and procedures of the organization. These decisions may not be popular and can be risky but such initiatives must be taken if math instruction should be improved. One such decision should be the introduction of early literacy in buildings through preschools equipped with certified Great Start Readiness Program (GSRP) teachers. Jairrels (2009) focused on the finding that early literacy skills on the part of the student can help in strengthening the child’s

academic performance. The author compares children of other races who received an education at an early age to African Americans who did not receive formal education at an early age. Findings showed that the African Americans who were not proficient academically at an older age as compared to other races did not receive early childhood education. Per the author, one solution to improved academic progress at the elementary level and beyond lies in early childhood education (Jairrels, 2009).

Teacher Training

To ensure math instruction is at its best, there are certain actions, procedures and processes that teachers will need access to and be knowledgeable about. They include using math coaches, knowledge of special education procedures and resources, and the essence of having professional development sessions and forming data teams. Others resources are the prolific use of the RTI or multitiered systems of categorizing learners and being conversant with the PBIS system.

Mathematics Academic Coaches

The lack of classroom coaches is another problem depriving schools of quality classroom instruction. Classroom coaches usually steer teachers in the right direction by ensuring the state curriculum is taught, professional developments are held to improve teacher instructional skills and data is used in directing instruction. According to Becky et al., an 11-year study was conducted on partnerships effort to improve the teaching of K–12 mathematics in Rapid City, South Dakota, called Promoting Reflective Enquiry in Mathematics Education (PRIME). This study began in 2002 and was completed in 2013; some of the reforms introduced included the hiring of teacher classroom coaches in math and the training of administrators on how to support teachers using a logic model to improve teacher knowledge of the content they taught. The

research proved through the statistics yielded that school with instructional coaches obtained higher test scores than schools without (Becky et al., 2013). Classroom coaches ensure teachers are teaching the state curriculum using the correct resources and are knowledgeable of the viable teaching strategies, pedagogies, and resources available.

Math coaches are a resourceful tool to math teachers in a middle school. Coaches provide educators with pedagogical and teaching strategies and resources that can possibly improve the teaching skills of a math teacher.

Special Education

Teachers ought to be aware that the aim of Tier IV is to transition the special education student into the general education population. Shyyan asserts that the prime objective of having a class of students with learning disabilities is to transition them to the general education classroom. Shyyan's findings indicate a research was conducted in two phases; phase one was based on thirty teachers from five schools, two of the schools in an urban area and three from a suburban area. Forty-three percent of educators were from general education classrooms, 23% from special education and 20% from schools with English as a second language (ESL) student, the other 14% included teachers from other fields of study such as music and art. In stage two, 42 teachers were surveyed from eight schools, six suburban and 2 urban schools, 40% from ESL schools, 24% special education and 36% general education. The results showed several approaches that could be used in improving instruction; these included using visuals in the classroom to strengthen students' vocabulary enrichment skills. Rich and pertinent vocabulary must be introduced in a math class periodically to keep students engaged, teachers should encourage peer tutoring and student centered learning activities; as well as a balance of linguistic and cognitive demands. Other findings included using clear and consistent vocabulary when

introducing a topic, in this case, vocabulary should align and correlate with the topic being introduced and taught (Shyyan, 2008). In order for students to improve their academic performance, math vocabulary will have to be mastered and well comprehended, students who understand math concepts but are not conversant with key math operational vocabulary such as quotient meaning division, product meaning multiplication, difference meaning subtraction and sum meaning addition, find it difficult to pass summative math tests, it is therefore imperative to master math vocabulary through the methods enumerated. The mentioned methods and techniques can be applied to general education students who are performing below grade level in mathematics because in several instances, quite a number of general education students may have special needs but have not been identified and tested for an individualized education plan.

When teachers are familiar with teaching techniques that will help in instructing children with special needs, math instruction is improved. In addition, certain students in a math class may have unidentified learning disabilities, effecting the need for teachers to know procedures and processes that will help educate students with disabilities.

Professional Development

Professional development is the backbone of educator success in the school system. The lack of professional development sessions on various educational topics such as classroom instruction, using technology, using data, classroom management and peer mentoring and collaboration can lead to poor instruction in the classroom.

Roberts insists that PLCs should ensure students learn at high levels, create a culture of collaboration and should be focused on academic results. The author relates the difference between teacher perceptions and student learning. Findings depicted anytime teachers possessed all three themes of PLC mentioned, teacher performance was at its peak and students benefited

the most by attaining high academic standards. PLCs thrive, succeed, and produce positive results in a school environment when teachers conduct collaborative sessions where they effectively communicate with each other about various topics (Roberts, 2010).

In one study, Svendsen (2016) found that

Professional Development is the set of knowledge- and skill-building activities that raise the capacity of teachers to respond to external demands and to engage in the improvement of practice and performance The findings suggested that the objective of professional development is to produce competent teachers who have at their disposal a range of methods they can use, based on a comprehensive understanding of what will work and professional instinct that has been refined over time. (p. 318)

Svendsen claimed that professional development allows teachers to reflect on practices and share such practices with their colleagues to the benefit of the entire organization. Svendsen (2016) further stated, “Through interactions and relationships between people, theories and value systems hosting knowledge are developed, established, refined, negotiated and changed” (p. 326).

Steege and Lambson (2015) found that

professional development research in recent years supports collaboration and teacher inquiry into topics and issues happening in teachers’ classrooms. These qualities ensure that professional development is not disconnected from teacher practice and brings teachers together for conversations about the questions arising out of their practice. (p. 477)

One study found that the benefits of professional development include greater self-confidence in teaching, better connection between theory and practice and improved collegiality and collaboration between educators (Taymans et al., 2012).

Educators will need professional development sessions to improve math instruction and ensure student learning. During these sessions, educators learn from each other and adopt new teaching strategies and methods which tend to increase teacher effectiveness in the classroom.

Data Teams

Data in the form of demographics, parent and student perception data, and staff perception data should be used in planning instruction. Data teams must be established in schools, where a selected group of staff will meet to analyze students' data on a weekly, biweekly, or monthly basis with the aim of planning instruction based on data results.

Shen et al. wrote about using data for decision-making reflecting perspectives from 16 principals in Michigan, USA. The study looked at how school leaders access and use data for decision making, what kind of data is used and what decisions are made with the data. During the study, the leaders talked about what the data process consisted of as well as the advantages and disadvantages. Data was retrieved and categorized into three sections: student community background study, school process data, and student achievement data. Results showed that data records were based on student grouping and placement, identifying weaknesses in standards and accessing proficiency in curriculum taught. Student achievement data is used more for accountability purposes while other forms of information such as student demographics and economic status is not used in the process of evaluations. Without test score data, it will be difficult to instruct students effectively and efficiently, information from previous test scores serves as a guide to teaching students the right skills needed for future assessments. A data

driven school community stands the chance of enhancing student academic growth (Shen et al., 2010).

In William's view, many districts have adopted the idea of data-driven decision-making, which sounds unexceptionable, but should be done purposefully. If data is not collected with a clear theory of action about how they are to be used to improve schooling, then little is likely to change (William, 2013). According to William (2013),

Rather than data-driven decision making, it seems to me we need a culture of decision-driven data collection, the data are collected only after a clear theory of how they are to be used has been developed, to be certain that they will be usable. (p. 58)

In effect, the purpose and use of the data should be established before data is collected, after a diagnostic test, the data team should decide to identify math standards in which the average student is underperforming based on average student score. The data team must plan the number of priority standards (underperformed benchmarks) to be identified each semester, teachers will then have to teach and re-teach each priority standard over a period by preparing pretest and posttest on each priority standard to ensure students have mastered the skill (William, 2013).

Data informs educators on the past and present of students' achievement. Such information enables the teacher effectively and efficiently to instruct students to improve their future academic performance.

Response to Intervention

The RTI or multitiered system is practiced in most inner-city schools but it is not always efficiently implemented. According to Turse and Albrecht (2015),

Response to intervention (RTI) was added to the Individuals with Disabilities Education Act in 2004 as an alternative evaluation procedure. RTI is a process designed to identify

struggling learners early, to provide access to needed interventions, and to help identify children with disabilities. (p. 1)

Turse and Albrecht (2015) reported, “RTI has two main goals: The first is to deliver evidence-based interventions and the second is to use students’ response to those interventions as a basis for determining instructional needs and intensity” (p. 83).

A diagnostic standardized test is usually taken at the beginning of the school year through which students are placed in Tiers I, II, III, and IV (special education). Tier I consists of all students, Tier II is usually students performing a year below grade level while Tier III are students performing two or more years below grade level depending on test results. It must be mentioned that schools adjust the tiered systems to suit their academic needs, so in effect, certain schools and or districts may have differences in the way students are sorted. The mentioned system allows students to be served more effectively by teachers and teacher assistants through small group, one on one and differentiated instruction. According to Dulaney (2013)

RTI infrastructure building and implementation research indicates that these teams can help teachers use instructional and management methods considered to be best practice in the field Student success teams (SSTs) can encourage the type of self-awareness and shared inquiry promoted by data-driven decision making and problem-solving methods to help ensure the academic success of all students. (p. 55)

Prewett et al. (2012) found that RTI has the

potential to be a practical and effective school-wide framework for ensuring academic and behavioral success for students... Clearly, middle schools are capable of implementing a fluid multilevel instructional system complete with academic and

behavioral screening, progress monitoring, data-based decision making, multilevel instruction and fidelity of instructional practices. (p. 147)

Pool, Carter, and Johnson (2013), realized that “the specific systems and processes that will be effective will vary from school to school. It is important to identify the strengths and challenges of a particular school and plan accordingly” (p. 238). Pool and others believe the RTI process is most successful when the following procedures are followed: A request made by an educator and/or a review of universal screening or behavioral referral data, setting a goal for the student, identifying and selecting an intervention, supporting the selected strategy in the classroom and monitoring students’ progress during the intervention as well as evaluating the results of the intervention program (Pool et al., 2013).

The RTI system is an excellent way of placing students in groups by their ability levels and instructing them accordingly. This system seeks to move students from one tier to another depending on their academic progress. When implemented properly, it results in improved student math academic performance and teacher instructional skills.

Positive Behavior Intervention Support

The PBIS system is another form of multitiered system designed to curb student behavior problems and create a reward system by focusing on academics, behavioral and environmental issues. Students are rewarded intrinsically and extrinsically for improved behavioral performance, which has a positive impact on academics. The system is tiered in three. Tier I is considered universal and consists of all students. Tier II is made up of selected students who have exhibited certain deviant behaviors out of the norm. Tier III students are a selected few that have shown severe behavior problems, which may have caused safety concerns for other students (Lampron & Gonsoulin, 2013).

As stated by Lampron and Gonsoulin (2013),

After years of trying to correct negative behaviors with strong discipline, researchers demonstrate that punitive philosophies focused on control and coercion are not effective and do not work to reduce recidivism in juvenile populations; and may actually increase it When punitive methods are the main response from adults to undesired behavior, youth primarily learn that the main goal is not to get caught rather than understanding the reasons not to engage in the behavior altogether. (p. 163)

Lampron and Gonsoulin (2013) further explain five main reasons why the PBIS system is essential:

Arranging the environment to prevent the development and occurrence of problem behavior, and teaching and encouraging pro social skills and behaviors Safety for all within the facility, education and social skill acquisition, and a focus on responsibility and accountability. (p. 164)

Some of the key advantages of implementing the PBIS system effectively is to improve student behaviors, improve attendance and tardiness, involve and include parents in the student decision making process, nurture and mold students to become responsible and productive citizens. Other benefits include the improvement of students' academic skills through an incentive package for the pupil, and better social and interactive developmental skills of the child (Lampron & Gonsoulin, 2013).

Sugai and Horner (2006, as cited in Bradshaw (2013) mentioned an effective way of managing the PBIS system, which will in the long run yield tremendous benefits to improving math instruction, saying, "PBIS is a data-informed approach that emphasizes the collection of

multiple data elements on both desired and problem behaviors to monitor implementation quality and program outcomes” (p. 289). Sugai and Horner (2006) recommended,

The school’s PBIS team regularly reviews multiple data elements, such as office discipline referrals, and develops interventions accordingly for the whole school, groups of students, and/or individual students. The data are also used to determine if the interventions implemented for individual students or groups of students are producing positive effects. (p. 289)

Johnson et al (2013), found certain interesting aspects of the PBIS system:

In summary, problem behaviors improve after the implementation of the PBIS system. After adopting the PBIS system, schools experience dramatic gains in time spent in the classroom and instruction rather than on disciplinary activities. However, the conclusions about the effects of the PBIS system on increasing academic achievement remain equivocal. (p. 139)

Johnson and others conducted an elaborate study on the PBIS system in a juvenile facility in Texas. The conclusion of the study indicated there are positive effects on student academic achievement and proficiency levels when the PBIS system is practiced effectively and efficiently (Johnson et al., 2013).

Lampron and Gonsoulin (2013) claimed,

Education cannot be effective and learning cannot take place if both educational disabilities and the social, emotional, and behavioral concerns of all youth are not addressed. Positive Behavior Intervention Support allows each of these aspects to be emphasized. PBIS focuses on modifying behavior not only through a change in environment and the manner in which adults’ approach interactions with students, but

also through teaching new skills and modeling the appropriate behaviors that students may take with them when they leave. (p. 166)

Yeung et al. (2016) defined the PBIS system as a Proactive instructional approach to support prosocial behavior in schools. The implementation of PBIS involves building the capability of teachers to embed the teaching and monitoring of social skills into the curriculum. Teachers structure the environment so that prosocial skills are used by students more often... The evidence suggests that programs with high implementation fidelity will have a more positive impact on student outcomes. (p. 147)

Conceptual Framework

Conceptual and procedural learning methods are key styles used in improving math instruction. According to Ngu and Phan (2016), conceptual and procedural knowledge represents essential components of mathematical proficiency and are defined as such: “conceptual knowledge is a principle that governs a domain, and procedural knowledge is a step-by-step sequence of actions to obtain a solution (p. 63).

PBL is known to be one of the best ways of improving math instruction and student achievement. According to Angelou, Capraro, & Yetkinar (2008), PBL “typically begins with an understanding of a clearly defined product In contrast to problem based learning which is focused on a problem students are expected to solve” (p. 1). Students can have several ways of completing an assignment, in most instances through diverse means and media but are expected to have an identified expected outcome. When students are given the opportunity to produce math facts and concepts tangibly through the building of a product, it enhances the understanding of the subject.

The concept of establishing a PDS is a phenomenon that drives the essence of this research. Professional Development Schools are a quality instructional model that creates professional opportunities among educators through collaboration and conversation. Through extensive collaboration between educators, a partnership between experts and practitioners is developed with the aim of exploring classroom culture, shared agendas, and quality efforts for building a conceptual framework for teaching mathematics (Cozza, 2010). According to Cozza, the PDS is grounded in the following philosophy: “It has been noted that good teachers must be grounded in the areas of the content of the subject they teach, research based strategies to provide instruction, data to make instructional decisions and differentiated instruction” (p. 1). This concept will strengthen teacher knowledge and skill, which will lead to a higher quality learning and effective teaching of the subject.

The leadership roles that educators play are a significant contributor to improving math instruction, as indicated by Northouse (2013), who said, “Transformational leadership is a process that changes and transforms people, it is concerned with the emotions values, ethics, standards, and long-term goals, it includes assessing followers’ motives, satisfying their needs and treating them as full human beings” (p. 185). Northouse (2013) believed that, “although the transformational leader plays a pivotal role in precipitating change, followers and leaders are inextricably bound together in the transformation process” (p. 186). Northouse (2013) made a statement that supports the framework of this study:

Transformational leadership is concerned with improving the performance of followers and developing followers to their fullest potential. People who exhibit transformational leadership often have a strong set of internal values and ideas, and they are effective at

motivating followers to act in ways that support the greater good rather than their own self-interest. (p. 191)

Leadership is a skill educators will need to boost and improve students' math skills. From my personal experience, I realized when all educators share the leadership roles mentioned above, the quality of math instruction improves considerably. When school administrators, teachers, and teacher assistants embark on leading students by exhibiting transformational leadership qualities, the quality of teaching and learning improves. Collaboration and communication between administrators, teachers and students must be at its best to realize academic improvements. Teaching pedagogies, learning styles, professional developments and using data should be a school-wide practice that should involve all stakeholders: teachers, students, educators, the board, parents and the community. Underperforming inner-city middle schools will need leaders who will be able to encourage, motivate, inspire and stimulate both students and teachers to excel and perform at their best through collaboration and communication. Transformational leaders should be able to inspire students to work harder and smarter to excel in math. Students should be encouraged to find innovative ways of studying and learning by adopting hands-on and interactive study techniques in the classrooms as well as using PBL styles and the prolific use of technology.

In practicing the mentioned theories, educators should transform mathematics teaching methods by using differentiated instructional strategies in the classroom to be able to instruct all students at their level, this can be done effectively through using stations and multiple intelligence techniques (Douglas, 2008) as well as practicing one on one teacher to student tutoring techniques (Kim, 2010). Educator PLCs(PLC) will support teachers so they can strive to ensure students learn at high levels. They create a culture of collaboration among educators who

focus on academic results (Roberts, 2010). Professional development activities held frequently for educators with frequent follow-ups through classroom observations by administrators improve teacher instructional performance (Rosenkras, 2011). Such training can address other dimensions of instruction. To be proficient in math, students' reading skills must be highly proficient (Glenberg & Wilford, 2012), students must practice math concepts consistently to sharpen their skills (Rozalski, 2008), as developing student early literacy skills through preschool is one of the solutions to bridging the academic gaps at the elementary school level (Jairrels, 2009). Mastering the math vocabulary assists students in understanding math story problems on standardized tests (Shyyan, 2008). Finally, parental support and involvement in the student's academic process improves the pupil's academic performance and behavior (Gu et al., 2011).

The researcher has noticed that students of this day and age are technologically savvy and seem to be very attentive when some form of technology is used during instruction. Computer delivered instructional methods assist in boosting student comprehension of math facts (Burns et al., 2012), and students grouped and instructed by their ability level, through the RTI or multitiered system, is yet another resourceful method used in improving instruction (Albrecht, 2015). An instructional system driven by past student test score data can be used as a tool in improving future academic performance, and math standards identified as areas of weakness on a test can be taught and retaught by teachers to ensure student proficiency in future tests taken. A summary of the explained conceptual theory is depicted in Figure 2.

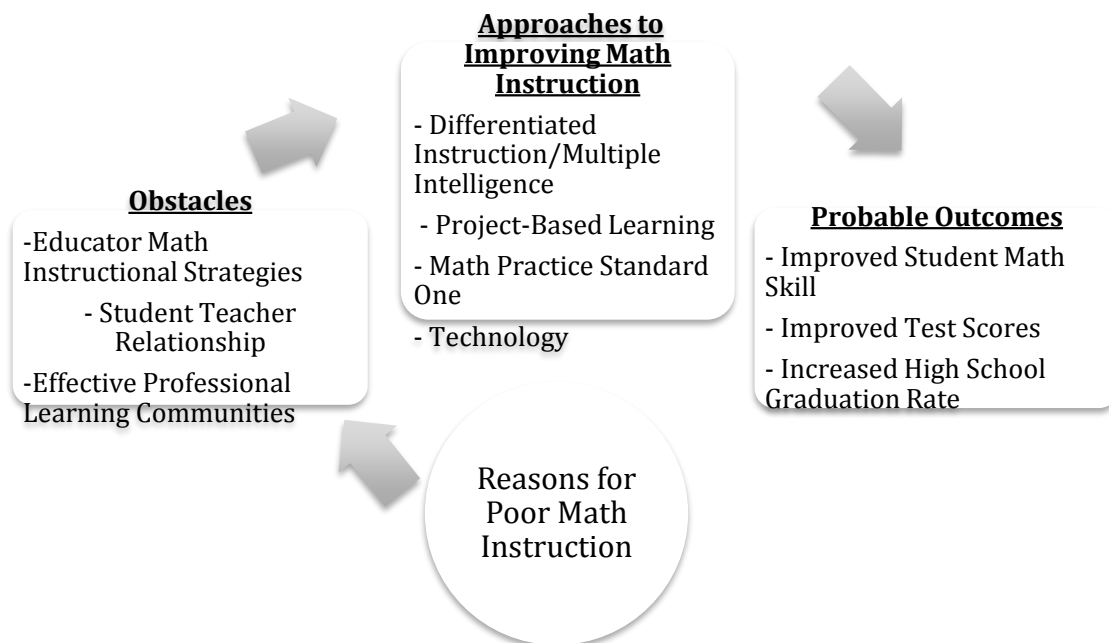


Figure 2.2. The Concept Map.

Conclusion

Although most of the books and articles deliberate on the problems associated with low achievement in elementary schools, most of the research materials presented here do not address the root cause of the problem. The research materials dwell on solutions to deficient academic performance, but fail to reiterate practical and laudable solutions to the problem. Student services in the form of after school activities, mentor-mentee programs, and programs meant to educate students on responsible adulthood are not covered in most scholarly materials on school improvement and academic achievement. Most scholarly materials are not concentrating on ways and means of reaching the individual child's needs at home. What circumstances and situation do students find themselves at home that contributes to low academic achievement?

Majority of students find themselves in low-income and single family homes, a single mother in most instances who has two to three jobs trying to make a living and cater for the child, in effect, it is difficult to actively get the parents involved in the child's education. Further,

students are left without positive role models in their lives and are therefore engaged in deviant behaviors at an early age. The mentioned factors can possibly disrupt the students' academic capabilities and potential, therefore resulting in low academic achievement. It is unfortunate that most literature on reasons for low academic achievement in inner city schools do not address the mentioned causes; rather blame is placed on educators much of the time. This study examines teachers' application of solutions to the underperformance in mathematics among urban students. In addition, the completed document will be used by educators in strengthening the teaching of mathematics in inner city middle schools.

CHAPTER 3

METHODOLOGY

The purpose of this study was to learn how educators determine whether conceptual and procedural math teaching approaches are useful teaching strategies in an urban middle school. Participants were asked to describe instructional strategies they believed were beneficial to teaching mathematics to urban middle school students?

Educators examined included: Teachers, teacher assistants, instructional coaches and school leaders. The research was a case study held in one urban school in the mid-western part of the United States of America with interviews granted to middle school math educators, which included instructional leaders, teacher assistants and mathematics teachers. Questions answered during this report were as follows:

1. How do educators determine whether conceptual and procedural math teaching approaches are useful teaching strategies in an urban middle school?
 - i. How do educators characterize conceptual math teaching instruction?
 - ii. How do educators characterize procedural math teaching instruction?
2. What instructional strategies are beneficial to teaching mathematics to urban middle school students?

The qualitative research approach was used in this study. According to Creswell (2013), it is a

Set of interpretive, material practices that make the world visible. These practices transform the world...it begins with the use of interpretive theoretical frameworks that

inform the study of research problems addressing the meaning individuals or groups ascribe to a social or human problem. (p. 44)

Qualitative researchers assemble information from multiple sources such as documents, observations, interviews, and surveys. Data gathered is then organized arranged and sort into categories that benefits the research. The grounded theory approach was used in this research, According to Creswell (2013), this

theory moves beyond description to generate and or discover a theory, a unified theoretical explanation for a process or an action. Participants in the study have experienced the process and the development of theory might help explain practice or provide a framework for further research. (p. 83)

In this study, literature documented effective ways of improving math instruction. Teacher interviews were used to find out how they sought solutions to enhancing mathematics instruction. The project was an action research study.

According to Coghlan and Brannick (2014), action research is defined as an emergent inquiry process in which applied behavioral science knowledge is integrated with existing organizational knowledge and applied to solve real organizational problems. It is simultaneously concerned with bringing about change in organizations, in developing self-help competencies in organizational membership and adding to scientific knowledge. (p. 5)

This definition aligns with and applies to the research process conducted as ideas and opinions about math instruction were solicited from school leaders, instructional coaches, teachers and teacher assistants. The completed document serves as a tool that particularly inner city middle

school math educators can use in refining and improving mathematics instruction in the classroom.

Site Selection

The survey was held in an urban middle school with collectively about 700 students. Twelve middle school mathematics educators were interviewed. The math educators included educators who are directly involved in teaching or supporting math instruction in the classroom. Specifically included in this group are math teachers, teacher assistants, instructional coaches and school leaders. Participants are educators from an urban school in the Detroit area. The school leader was supportive of developing methods and strategies of improving math instruction in the school. Below is a description of the number of educators interviewed in percentages and numbers in Figures 3.1 and 3.2 respectively.

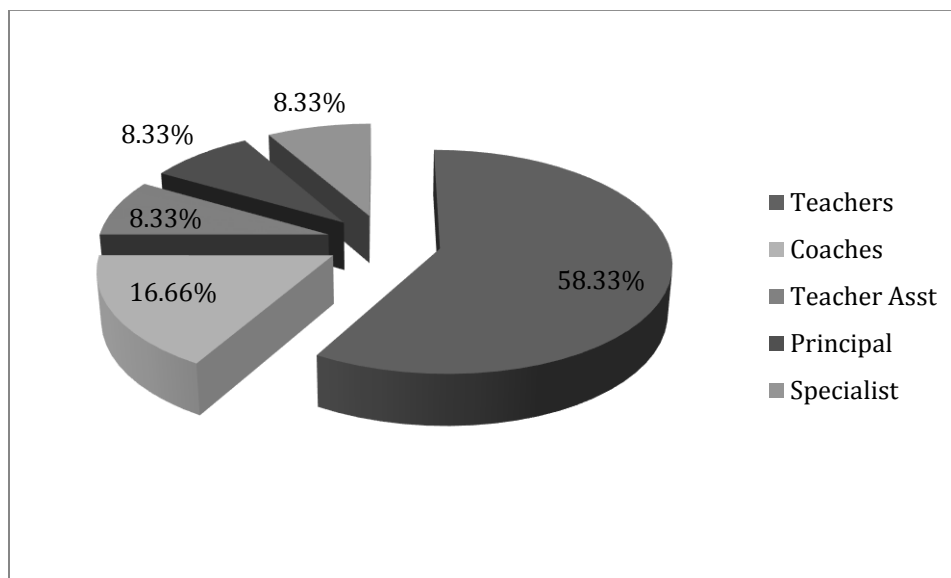


Figure 3.1. Survey participants.

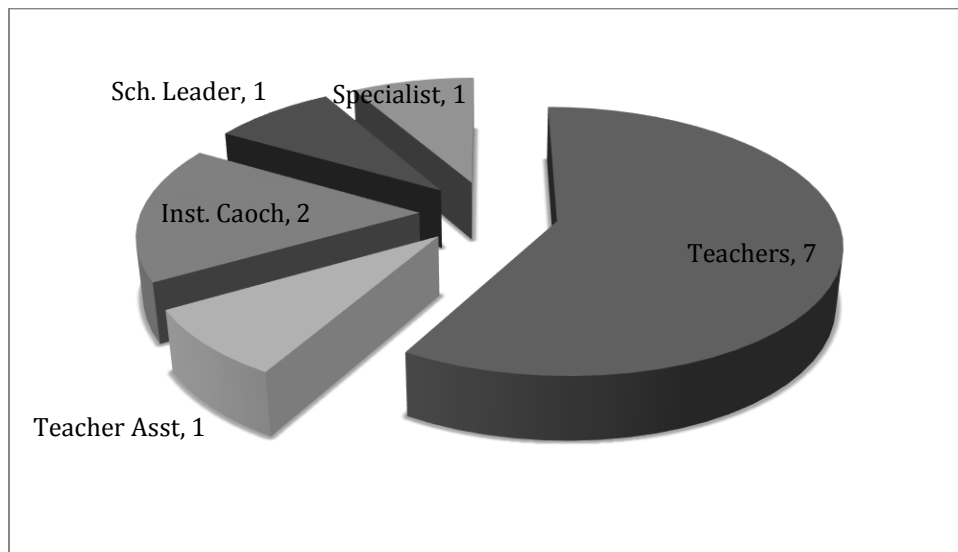


Figure 3.2. Survey participants.

Participants and Stakeholders

Twelve participants from one urban middle school were selected for this case study. The 12 educators were made up of seven middle school math teachers, one teacher assistant, two math educator coaches, one math specialist, and the school leader. One of the participants was a school leader with the title: principal/assistant principal. A letter was sent out to participants inviting them to participate in an interview. All participants were given a two to three week notice before interviews were conducted.

Method Selection

Through this research, the data collection was organized to assemble different kinds of data, such as conducting interviews, making observations, and obtaining documents (Merriam, 2009). The research had the typical characteristics of a qualitative research such as being piloted in an educational setting where students have low math skills, using several methods of acquiring information and relying partially on the views, ideas and opinions of people who teach students mathematics in under resourced institutions (Creswell, 2013). This investigation was conducted to gain a better understanding of the reasons for low math skills in middle schools with the idea,

as Creswell (2013) recommended, of empowering educators to “share their stories, hear their voices, and minimize the power relationship that often exist between the researcher and the participants in a study” (p. 48)--all with the aim of improving middle school student’s skills in mathematics and teacher skills in teaching mathematics. A pilot study interview was conducted with one of the 12 participants prior to the interview research in the month of October. The pilot interviewee was asked the same set of questions as the scheduled interviewees in October and November.

Data Collection

The objective of this qualitative, grounded study and action research design was to learn about teachers’ understanding of conceptual and procedural math instruction along with certain key math teaching practices. The completed project served as a tool used in improving the quality and effectiveness of math lessons in middle schools. Participants were interviewed in October/November; questions created strictly adhered to researched interview questions guidelines.

The names and responses of participants was kept confidential and shall not be disclosed to a third party. Survey/interview documents were kept on the researcher’s private computer.

Data Analysis and Validation

Interviews were transcribed and analyzed by hand and not by computer software, considering that there were only 12 participants. As Creswell (2012) recommended, the survey “Findings were represented in visual form and include figures, diagrams, and comparison tables” (p. 262). The categorized findings were compared to each other to demonstrate patterns in participant responses. The findings will be presented in the next chapter. Collected data was validated by having a qualified colleague review the legitimacy of the gathered information.

Limitations, Biases, and Ethical Concerns

Sampling one math department in one school out of tens of inner city middle schools among hundreds of mathematics teachers may not be a fair representation of most urban middle school teachers' perspectives, opinions, and contributions in the state of Michigan. Considering that the teaching of mathematics includes dynamic teaching methods and strategies, the present findings may not be valid in ten years' time. Also, educators may not have stated their honest opinion during interviews. Certain educators may prefer using teaching strategies that are contrary to the research proven learning styles such as the enactment of Math Practice One or PBL. Such biases may influence the validity and reliability of results.

Participants' Rights

Participants were informed via invitation letters, the entire survey/interview procedure was voluntarily, in effect; members could have opted out of the process at any time. Candidates did not have to make assurances and guarantees of participating in the interview process. All participants and schools involved remained anonymous. A copy of the completed report was compiled without the names of partakers. Each participant was provided with a copy of the finalized report.

CHAPTER 4

PRESENTATION OF THE FINDINGS

Chapter four will present an analysis of the results of the study, and each research question will be analyzed in relation to findings from data collected from educators. The objectives of this qualitative, grounded theory and action research are as follows: (a) develop tools that can help teachers improve the quality of mathematics teaching, (b) how educators characterize and view certain conceptual approaches in teaching mathematics, (c) how educators characterize and view certain procedural approaches in teaching mathematics.

Two research questions guided this study:

1. How do educators determine whether conceptual and procedural math teaching approaches are useful teaching strategies in an urban middle school?
 - i. (i) How do educators characterize conceptual math teaching instruction?
 - ii. (ii) How do educators characterize procedural math teaching instruction?
2. What instructional strategies are beneficial to teaching mathematics to urban middle school students?

This grounded theory approach and action research methods were used to study math teachers' understanding of instructional practices in an urban school in the metro Detroit area. Twelve educators from the math department of a middle school were interviewed with the aim of finding out the opinions, views, beliefs, perspectives and ideas on how teachers perceive conceptual and procedural approaches in teaching math and what strategies can be used in the classroom to better improve the teaching of mathematics.

Participants were asked 11 questions that were framed in a semi structured open-ended interview format. The interview questions aligned directly with the study research questions and were intended to elicit the account and experience of educators in the math department of an urban middle school. Data was collected over a duration of about two weeks from October 24th to November 4th 2016. A pilot interview was held with participant SPE 1 prior to the study interviews which began on the 24th.

Besides the mentioned objectives of this study, the qualities of Math Practice One were also a guide throughout the survey and data collection. Math Practice One means that: solving math problems should include a dialogue, conversation, thinking and reasoning between students without basing the conversation on solely finding the answer to a problem but the process involved in solving the problem. Participants answered questions that aligned with tools used in achieving the aims of objectives of Math Practice One: technology, multiple intelligence techniques, audiovisuals, quality pacing guides, having a cordial relationship with students through efficient classroom management and practicing PBL methods. Other strategies and methods that can be used in promoting practice one include using the PBIS system and conducting weekly PLCs that support teacher collaboration and communications. In addition, professional development activities were geared towards supporting teachers to develop instructional strategies. Professional development activities were designed to improve the implementation of Math Practice One was studied, which included: practices such as differentiated instruction through the RTI tool, Project-based Learning, teacher Professional Development and Professional Learning Communities. Others included using curriculum maps, technology and using various learning methods such as kinesthetic, tactile, and audio visuals in delivering instruction.

The 12 participants in the math department were as follows: seven mathematics teachers, all certified by the state of Michigan in mathematics. One math specialist who is also a certified mathematics teacher by the state of Michigan; as well as one senior administrator who holds the position of the school principal, the principal is a state certified administrator and supervises the math department. Two academic coaches also known as academic specialists were surveyed: one coach is a certified math teacher with the position Title-I Math Coach/Specialist and the math coach is a state of Michigan certified math teacher while the other coach is not a certified math teacher but is a state certified administrator and supervises multiple departments. The final participant is a teacher assistant who is not a certified teacher. All participants have experience in their field ranging from 2 to 24 years. Participants were given codes as indicated in table 4.1.

Table 4.1

Participant Credentials

Participants	Years of experience	TEA	AD	COA	Certified math educator	Certified administrator	Not certified
TEA1	2	✓			✓		
TEA 2	3	✓			✓		
TEA 3	5	✓			✓		
TEA 4	9	✓			✓		
TEA 5	10	✓			✓		
TEA 6	12	✓			✓		
TEA 7	24	✓			✓		
COA 1	16		✓	✓	✓	✓	

Participants	Years of experience	TEA	AD	COA	Certified math educator	Certified administrator	Not certified
COA 2	16		✓	✓	✓		
AD 1	10		✓			✓	
SPE 1	14	✓			✓		
TA 1	7						✓

Note. TEA = Teacher; COA = Coach; AD = Administrator; SPE = Specialist; TA = Teacher Assistant.

Analysis of the content was conducted on answers provided by educators. The 11 questions answered were aligned with the research study questions. Research question one states: 1. How do educators determine whether conceptual and procedural math teaching approaches are useful teaching strategies in an urban middle school? This question is answered by interview question one: From your experience, why is it important is it to understand math vocabulary? Ex. The synonyms of the four math operations: Addition, subtraction, multiplication and division. Synonyms of math vocabulary and math vocabulary tend to promote both conceptual and procedural learning. Question one sub question (i) specifically states: How do educators characterize conceptualize math teaching instruction? This question is answered through interview questions two, three and five. Interview question two asks educators to indicate what are the cognitive advantages to a student when they can relate math concepts practically to their “day to day” lives, while question three requires math educators to state what are the cognitive advantages to students when they can use concrete objects or pictures to help conceptualize and solve math problems. Question five asks teachers how they present materials to students in an expository style such as demonstrating, describing and explaining concepts and skills.

Research question two is about what instructional strategies are beneficial to teaching mathematics to urban middle school students. Interview questions 6-11 address this question. Question six asks educators about how they promote discussions and brainstorming activities; and question seven is about why using curriculum maps, technology in the classroom and kinesthetic, tactile and audiovisuals ensure the quality teaching of math. In questions eight and nine educators were asked about how Project-based Learning instructional methods and the PBIS system respectively, ensure quality teaching. Question ten seeks teacher opinion on how professional development and professional learning community collaborations supports high levels of teaching mathematics in urban schools. Question eleven asks educators about why the RTI tier system contributes to effective and efficient math teaching.

Findings

Twelve math educators completed face to face interviews; each interview lasted between 15 to 20 minutes. The interviews were recorded on an audio tape and transcribed afterwards. Each transcript was read many times by the researcher who independently conducted a hand coding to analyze the meanings of the responses of participants. The researcher designed a Code Chart which depicts 34 groups labeled "key themes" and 38 sub codes labeled "subgroups". The key themes and sub codes are dependent on the various groups of the responses of participants. The aim of the data analysis was to categorize the common themes among participants' responses. In maintaining the confidentiality of all participants, codes were assigned to each participant as shown in Table 4.1, names will not be disclosed during the analysis but rather their codes will be referred to when direct quotes, views and opinions of participants are stated.

Conceptual and Procedural Learning

Research Question 1. This question delves into why it is essential to use procedural and conceptual math teaching practices and approaches in a math class. In a nutshell, per educator's responses, it can be concluded that procedural methods of teaching are more aligned with memorizing math formulas and facts while conceptual teaching and learning approaches are associated with learning the subject practically and applicably. Burns et al. (2012) citing Kilpatrick, Swafford, and Findell (2001), indicated "Per the National Research Council, math proficiency is composed of (a) conceptual understanding, (b) procedural fluency, (c) ability to formulate and mentally represent problems, (d) reasoning, and (e) successful application of math to daily activities" (Burns et al., 2012, p. 184).

Evidence that teachers practice both methods of teaching and which method is preferable will be illustrated in the quotes from interviewees. Participants were asked the following interview questions regarding research question one:

Interview Question 1. Interview question one states: From your experience, why is it important to understand math vocabulary? Ex. The synonyms of the four math operations: addition, subtraction, multiplication and division? Educators used certain common themes when answering this question which included: story problems, assessments, relate to life, recall and the better understanding of math topics. All educators surveyed agreed that familiarizing school children with math vocabulary was a means to both effectively instructing students procedurally and conceptually.

TEA 1 indicated that without math vocabulary students will find it difficult to pass standardized test since at the middle school level most standardized test questions are in story form and contain rich vocabulary and synonymous of vocabulary. TEA 2 particularly related to

story problems by indicating, if students are not taught synonyms of math vocabulary then procedures and concepts will be of little or no use because the student will not know what to do when asked a question. TEA 3 dwelt on recalls, stating that with an enriched vocabulary, students will be able to recall math facts thereby enabling the students to comprehend the subject procedurally and conceptually. TEA 4 indicated that math facts and procedures are building blocks, which requires the knowledge of various vocabularies to better understand future topics: It is important to understand that because it forms the basis and building block of math, students must understand math vocabulary starting from Kindergarten. TEA 5 uniquely stated, math vocabulary and its synonyms are essential for cross-curricula enrichment while TEA 6 stated that it helps middle school students develop a connection between concepts and procedures in mathematics. TEA 7 stated: vocabulary helps strengthen the understanding of math by helping students develop steps through drawings when problem solving. COA 1 distinctively stated that, an enriched vocabulary helps develop the critical thinking capabilities of the student which then leads to higher order thinking:

Students need to understand several math vocabularies to be able to do a couple of things:

First to understand and solve word problems, pass standardized tests, critically think

about math problems and find solutions to them, vocabulary helps in relating math

concepts to their day to day lives instead of always memorizing math facts and formulas.

COA 2 said math is a constructivist subject where one topic builds on to the other, in effect, the synonyms of vocabulary used is needed to strengthen the conceptual and procedural approaches in teaching the subject. Participants AD 1, SPE 1 and TA 1 made similar comments indicating that vocabulary enrichment in math helps students know what to do and the action to

take when given a problem, in effect, it creates a deeper understanding of the subject or topic being taught.

Summary. As supported by the evidence of the quotes by TEA 4 and COA 1, it can be concluded that middle school math educators recommend using both procedural and conceptual teaching methods in strengthening and enriching the teaching of mathematics at the middle school level. This finding supports the concept of Math Practice One: allowing students to develop critical thinking skills through collaborations, perseverance, and commitment. Teachers can develop and apply ideas from this finding in the classroom: it is necessary and essential to use both procedural and conceptual teaching methods in educating middle school students.

As found by Hudson and Miller (2007),

When the goal of mathematics instruction is to help students understand the meaning associated with the procedures they are learning or the concepts being taught, it is important to provide various modes of representation...in three dimensions (i.e., manipulative devices) and two dimensions (i.e., pictures)” (p. 49).

Teacher views and opinions support the saying by Ngu and Phan (2016) “conceptual and procedural knowledge represents essential components of mathematical proficiency” (p. 63).

Conceptual Learning

Research Question 1 (i). This sub-question of question one focuses on how math educators characterize and perceive conceptual math teaching at the middle school level.

Interview questions 2, 3 and 5 were associated and aligned with research question 1 (i).

Interview Question 2. This question asked participants to explain the cognitive advantages to students when they can learn math by relating concepts and procedures to their day-to-day lives. All educators surveyed believe it is imperative to teach middle school math

from the conceptual point of view where students should relate facts and figures to something they experience practically in their day to day lives.

TEA 1 said relating math facts to life creates an understanding of the topic, students can connect concepts and procedures through examples they can relate to. TEA 2 mentioned conceptual approaches to learning helps students retain math facts for a long time, the facts slip into their long-term memory because they can relate to it. TEA 3 particularly noted that procedural methods leads to better retention of math concepts while TEA 4 realized students see the importance of math and tend to appreciate the subject and realize the need to study mathematics. TEA 5 reiterated the fact that all students learn differently, in effect, procedural learning cognitively aid students who learn kinesthetically, tactile and through audio-visuals: “Every student learns differently, some students learn by moving things around kinesthetic, tactile and the like, it is important to use examples that relates to the student’s life to have a good understanding of mathematics.” TEA 6 also indicated that the procedural methods strengthens the math comprehension skills of students which leads to higher test scores, TEA 7 claims it leads to the rapid mastery of the common core state standards and a rapid move through the curriculum. COA 1 discussed how understanding concepts leading to student interest in the field which further leads to the solving of complex math problems and the interest in science and engineering careers. COA 2 believes conceptual learning of the subject leads to the following transition: knowledge to actionable information then to a better understanding of mathematics. SPE 1 said if students retain math knowledge through life examples they will have a grasp of the subject which will lead to graduation in high school and college leading to the securing of good jobs and becoming a productive citizen which will in the long run curb the unemployment and

crime rates in the inner cities. AD 1 made a statement which implied mastering math skills conceptually promotes the understanding of the subject:

Students should be able to relate math to their lives. It should be made real, for you go to the market and you buy an item you will be able decipher the change you need to receive that will help understand the topic subtraction better. If a child goes to a store and instance, when he is told an item is discounted; this will help in percentages as a math topic.

TA 1 mentioned the same idea as most participants, which is, teaching from the conceptual view strengthens the understanding of the subject but framed it in an outstanding manner:

When students relate math to themselves it has more meaning them and it improves student comprehension skills on the topic when students can relate to the topic they have a common interest in the subject. If a teacher can cite examples that students are familiar with, students can internalize the concept, it keeps them in touch with the topics.

Interview Question 3. Interview question 3 solicits answers from educators about the cognitive advantages to students when they can use concrete objects or pictures to help conceptualize and solve math problems. Teachers are expected to provide examples through their experience as math educators.

All educators questioned agreed that using objects and pictures while teaching helps middle school learners grasp math concepts conceptually. TEA 1 believes that particularly the topic fractions must be taught using differential teaching styles such as using pictures, objects in the form of manipulative as well as videos. TEA 2 claimed most of students hear it and they forget but when they hear and see it they retain the concept for a while. But when they hear it,

see it, and do it, they retain the concept for a long time, if not a lifetime. TEA 3 and TEA 4 stated that manipulatives are the best way to develop the interest of students in mathematics. COA 1, COA 2, SPE 1, AD 1, TA 1 and TEA 5 all believe the best way to help conceptualize math is through pictures in the form of videos and using hands on activities which will all strengthen the understanding of student's math skills. TEA 6 claims when students are taught conceptually through pictures and objects they can problem solve by connecting math facts through mapping and drawing story problems on a paper: "Again, it is the connections when they are able to map out a math problem by even drawing the problem it helps them connect it to something they relate to and this creates a deeper understanding of the subject."

Interview Question 5. Educators are expected to share their experience on how they present materials to students in an expository style: demonstrating, describing and explaining concepts and skills. Educators are expected to share examples of how lessons are presented conceptually in the classrooms.

TEA 1 has students sit in groups and poses different questions on the introductory topic to the various groups, so students think critically about the topic. TEA 2 uses a five to 10-minute introductory lecture exhibiting the step by step the procedure and relating it to life scenarios, then followed by a 5-minute dramatization of the concept. TEA 3 introduces topics conceptually through songs sometimes; the teacher believes students are focused and attentive when their interest is used as bait in introducing a topic. TEA 4 uses games; technology and teacher stations in creating a rotational differentiated instructional learning experience for students:

For example, I practice stations in my classroom, where you have a teacher station, games stations, technology station etc. where students work together and in some cases, they create something, they create their own games sometimes or come up with note

cards and have a mini project sometimes by rotating through the classroom, I use the stations in checking the understanding of students as well.

TEA 5 did not answer this question while TEA 6 uses modeling in introducing and re-teaching lessons. TEA 7 exhibits lessons through modeling, explanations in steps, videos and dramatization: He stated that “I explain concepts in steps, modeling lesson showing video clips showing examples through dramatization are ways I use in introducing a lesson.”

COA 1 agreed with most educators but distinctively stated using field trips as a means of using conceptual teaching approaches in the classroom: “Materials are presented in the form of a video using manipulatives, field trips, modeling and sometimes in the form of a skit. Worksheets are usually used as practice assignments for reinforcement of skills.”

COA 2 relates math facts to life experiences, thereby creating the conceptual experience in the classroom, SPE 1 uses visuals and hearing aids while TA 1 has students present in class individually and in groups while in certain instances students solve problems on the board. Participant AD 1 exhibits lessons by using the ‘I do, we do and you do’ model: “I am more of a hands-on teacher who believes in the I do you do we do concept. I first exhibit it then I work together with students and then students work independently through an assignment or activity.”

Summary. Participants acknowledge that introducing and re-teaching lessons in the forms of using pictures and objects is a more resourceful way of instruction than always explaining the concept. Among all twelve participants only two mentioned that they orally apportion time to explain math concepts to students, one of whom mentioned they explain concepts in connection to day to day events of students. This statement indicates that middle school educators are gradually transitioning from the usual “talk and chalk” method of teaching to infusing other kinesthetic, tactile and audio visual methods which are more effective instructional methods in

the 21st century. Educators believe conceptual approaches are a more effective way of instructing the urban middle school student. Educators practicing conceptual learning in an urban middle school are likely to produce positive results according to findings of this study. As found by Goldman and others (1997), conceptual learning is “a connected web of information which in linking relationships are as important as the pieces of discrete information that are linked” (p. 4). Teacher views and opinions about conceptual learning confirms the definition by Rittle-Johnson, Schneider, and Star (2015): “conceptual knowledge is defined as knowledge of concepts, which are abstract and general principles, for example, the National Research Council defined it as comprehension of mathematical concepts, operations, and relations” (p. 588). Students learn effectively and efficiently when the pupil can relate and connect procedures learned to practical life circumstances and scenarios.

Procedural Learning

Research Question 1 (ii). This question seeks to find how educators characterize procedural learning of mathematics. Interview question four asked about how the memorization of math facts and formulas helped their students. Half of the educators interviewed believe memorization is completely not beneficial to teaching mathematics, three believe it is highly beneficial in the learning process while the other three think there are pros and cons associated with teaching math procedurally.

TEA 1 shared the opinion that memorization is good. The participant characterized it as a positively ideal situation and that it was necessary that students memorized their facts because it ensures rapid movement throughout the curriculum and is a highly effective way of ensuring that students are taught the length and width of the curriculum:

At the middle school level when facts are memorized it helps me move quicker in my lesson and I can service students better, when students do not know their facts mentally then I must go back and reteach the lesson that slows down the lesson. For example, when it comes to students changing mixed numbers to improper fractions if students do not know their multiplication facts then it becomes a problem or in simplifying a fraction it cannot be done.

TEA 2, on the other hand, completely disagrees with memorization of math facts but agrees math should be presented to students in a conceptual manner and that, through experience, the teacher has come to realize that presenting math facts in a conceptual manner ensures a better understanding of the subject:

Students in this present age struggle with the remembering part, you are old school, you know in our time, we had to memorize everything. Having them engage with the terms in different ways improve their understanding of the topic using flash cards manipulatives and the like is a better system than memorization this is because they will forget when they memorize but when they practice, they will get a better understanding. Technology is wiping away memorization, students want everything quick and have no time for memorization. That is the mindset of students these days.

TEA 3 has the opinion that memorization is temporal and unproductive, whereas when students learn in an environment where they can relate facts to what they see and experience daily, the teacher obtains the attention of the pupil. TEA 4 shared positive and negative thoughts about memorization, as this educator believes if one memorizes, it increases the probability of passing assessments. There was concern, however, that the facts learned will not last and can be detrimental to the student's learning in the long run. AD 1 shared the same opinion and called

memorization a blessing and a curse at the same time. COA 1 indicated that there are pros and cons to memorization. The pros are that a lot of standards can be taught throughout the year if students are good with facts, but on the other hand, it is not the best way to fully understand why and what students are learning. TEA 5 and SPE 1 showed that it is absolutely a necessity to memorize facts, most especially, the multiplication times table. Memorization ensures the understanding and rapid movement through the state standards and helps students in passing standardized tests. TA 1 believes memorization is completely the wrong way of learning mathematics in this day and time. Children prefer using pictures, objects, videos and games when being taught a math lesson. Lastly, TEA 7 verbalized the fact that teaching from the conceptual point of view served students a better purpose than memorizing:

I do not think memorizing math facts and formulas is helpful to students at all, I do not see how it benefits in any way, students will forget after a while anyway. Understanding finding the perimeter of certain shapes may not require a memorization of formulas because when you know it is the distance around the figure you know you must add the distance around the shape there is no need for memorizing a formula.

TEA 6 and COA 2 shared the same opinion, they disagree with memorization, TEA 6 made a very important statement:

Now we are into conceptual learning and the better you can connect your facts to the concepts you learn the better you can transfer the knowledge more quickly. I think it is important to know why you are doing those things, not just the rote facts. It is not about 'I can do my multiplication' but is about 'do you know what it means.'

Summary. Apparently, most teachers believe conceptual learning methods are a more productive teaching style at the middle school level than procedural ways of imparting

knowledge. Six out of twelve teachers do not agree memorization is a good thing while three educators think it is okay. Three other educators think there are pros and cons associated with memorization. Educators interviewed indicated when students understand a math topic they do not need to memorize facts, rather they understand the concept and will always remember that $3 \times 3 = 9$ simply means $3 + 3 + 3 = 9$. Educator perceptions on procedural teaching confirms the researched definition of procedural learning by Ngu and Phan (2016), who state it is “a series of steps, or actions, done to accomplish a goal” (p. 588).

Mathematics Instructional Strategies

Research Question 2. The track of inquiry for the second research question requires educators to provide teaching strategies that help deliver quality instruction in the classroom. Interview questions 6 through 11 found answers to research question two.

Interview Question 6. This question asked educators about how brainstorming activities are promoted in the classroom. All participants questioned believe group assignments and activities promote brainstorming and collaboration between students which leads to the development of higher order thinking skills. Students can persevere in solving math problems when they discuss the topic. Teachers agree that finding the right answer is not always the most important goal, but rather learning to continuously tackle math problems through logic and reasoning is. A clear majority of responses indicated that participants used group work in promoting collaboration. TEA 1 mostly practiced with groups using the “shoulder partner strategy” or sometimes the “think pair share” teaching method. TEA 2 limits collaborative groups to three, with the key strategy of mixed ability levels, proficient students are grouped together with less proficient students. TEA 3 practiced student centered learning techniques as stated below:

I model a discussion and brainstorming session with students and then I leave them to do it themselves in groups after this they have it and they own it they control the lesson. I pose the question, students lead the discussion, the class becomes a student-centered class, while I the teacher become a facilitator. The student's voice must be heard and conversation should be encouraged.

Educators TEA 4, TEA 5, TEA 6 and TEA 7 shared the same opinion about why brainstorming activities promotes quality math teaching. They all claim to use cooperative groupings where duties are assigned to each member of the group, they give every student some form of a responsibility, and got them involved in the thinking and problem solving process. Members of each group are assigned the following responsibilities: group leader, note taker, presenter, timekeeper and facilitator. Coach one uses several instructional techniques: small group, shoulder partners and rotational groups to encourage students to brainstorm and problem solve. COA 2 poses real world questions to students in alignment with the topic taught and allow students to partner with a different student once in a week to discuss findings of the posed real-life scenario question. AD 1 and TA 1 both stated they have students discuss how to solve a math story problem by unwrapping the key vocabulary terms in the problem while SPE 1 answers a math question with a question given to students in groups of not more than four.

Interview Question 7. Educators answered questions as to why they considered curriculum maps, technology, kinesthetic, tactile and audiovisual learning as important tools used in delivering instruction. Educators gave diverse opinions and thoughts on this question, and certain distinct words most teachers mentioned were: duration and pacing for curriculum maps, and “attention grabbers” for technology. Educators hardly talked about kinesthetic, tactile

and audio visual learning methods although in their answers to other questions they mentioned using all the mentioned learning styles.

TEA 1 said curriculum maps give the teacher a sense of direction as to what topic or state curriculum should be taught and at what time, TEA 2 and TEA 3 voiced a similar concern. TEA 2 indicated that one can adjust the curriculum and “move things around” to fit the level of instruction of students. TEA 1, 2 and 3 all stated technology attracts the attention of the students and serves as a means to an end and not an end by itself. In other words, technology does not necessarily make a student intelligent, rather it can serve as bait in gaining the interest of the child in mathematics. TEA 4 had a unique way of answering this question and was one of the few educators who answered the question on tactile, kinesthetic and audiovisual learning as a means of enriching the math learning process:

It is important to use curriculum maps as a teacher because it helps you know where you are going and helps in planning purposes, the curriculum has been set for you so all you do is just follow it through. It helps you follow the state standards and benchmarks and improves the quality of instruction. We are now in the technology age, incorporating technology brings out the interest of students and can help create a better understanding of the topic, it also keeps students engaged. Audio kinesthetic and tactile learning goes a long way in bringing out the multiple intelligence skills of the child.

TEA 5, 6 and 7 and AD 1 all indicated that learning maps can be likened to a roadmap, they tell the teacher what road to take next and how long to stay on a particular route. This gives the teacher structure and organization. SPE 1 and TA 1 respectively framed this answer distinctively:

SPE 1: Curriculum maps helps keeps a pace and structure in the learning process, it helps the teacher and students stay focused alert and attentive. A lot more time should be spent

on certain topics while other topics should be taught over a limited time. The use of technology is very imperative because we live in 2016, the student must compete globally so they can become productive citizens. TA1: It gives me a good idea of where I should be and how long I need to plan a lesson or skill or standard or unit it helps me plan for the next year as well as what topics I did not cover and how long I need to spend on certain topics. Using fraction strips and foldable, videos, tiles all help in promoting a quality math instruction.

Interview Question 8. This question asked instructors how they will support PBL in a math class. Most educators interviewed trust PBL does boost the quality of math teaching and ensures a better understanding of math standards. Students usually produce or complete a product during PBL through a tangible product. In the modern day, students can produce a video.

TEA 1 and 4 stated projects are supported in their classroom so that students can translate what they learned procedurally to something conceptual and relatable to their lives. TEA 2 and TEA 6 supported the fact that projects conducted in their classes were based on students' interests, in other words, math benchmarks are tied to student interest, the student comes up with their production based on their topic of interest. Teachers reiterated that students have a better understanding of math facts when their area of interest is connected to math standards. TEA 3 and TEA 5 admitted they have learned about PBL in professional development, but have not yet put it into practice in their classrooms. TEA 7 voiced certain opinions different in comparison to other participants, stating that projects aid children in developing ideas inventions and innovations, that pupils develop creativity skills beyond what is taught in the math class. Projects are completed after every unit of study, TEA 7 stated. COA 1 believes in having students create finished projects based on math concepts learned in class and tied to student interest. COA 2 had

a different way of supporting PBL, the participant took field trips with students to math-science-engineering and robotics program centers such as Center for Integrated Computing and STEM Education (C-STEM), the Detroit Area Pre-College Engineering Program (DAPCEP). Per COA 2, students are exposed to math, science and engineering at the middle school age and are given the opportunity to prepare reports in the form of a project after the visits. Students present their findings to the class on an individual basis or, in certain instances, in a group, and this participant is convinced this method leads to a better understanding of math topics. AD1 surprisingly stated supplies must be available and ready for teachers and students to undertake project assignments. SPE 1 and TA 1 made statements that summarize what all other participants said. SPE 1 stated: “In a math class, you learn the concepts and apply those concepts in a hands-on activity created by the student, these concepts improve the creativity skills of the student. We practice by doing projects once or twice a year.” TA 1 noted that: “Activities and concepts are transformed into a finished product on a deeper level which confirms higher level and higher order thinking and a better understanding of math concepts.”

Interview Question 9. The focus of this question is to inquire about teacher opinion on how the PBIS system supports the teaching of mathematics in an urban setting. All participants agreed that a reward system is a necessity in ensuring excellent classroom management. Educators expressed their views regarding how the proper enforcement of the PBIS system can create a serene and conducive teaching and learning environment which will in effect promote the teaching of mathematics. Teacher responses implied and confirmed this statement made by Gu and others: “In all these relationships, student Absenteeism classroom disturbance, and skipping class behaviors had very high negative correlation with teachers’ expectations for

student achievement. High occurrences of these problem behaviors, directly take place in the classrooms and influence instruction procedures” (Gu et al., 2011, p. 25).

TEA 1 has a ticket reward system, where on Fridays, students have an opportunity to use the tickets received in buying an assortment of items from a store. This participant claims a student rewarded for good behavior and with parent follow-up call raises the level of good behavior which positively influences quality instruction. TEA 2, TEA 5, COA 1 and TA 1 voiced similar views: educators insist when students are aware of a reward, it creates a change of behavior leading to a more peaceful classroom environment where students are focused and teachers can teach effectively. TEA 3 did not answer this question while TEA 4 said rewards should be a consistent phenomenon for it to have an impact in the classroom:

Rewards are always a good thing to help students stay on track if it is used effectively and you are continuously and consistently rewarding students, they are bound to stay focused academically which in the long run leads to an improved classroom learning environment. The change of behavior affects academics positively.

TEA 6 made an important point with this statement:

The better students act the more we get done, when students are rewarded for good behavior there is peace in the classroom and that creates a good environment for learning. Every child wants to be good or good at something so when you reward them it brings the good behavior in them which helps promote great teaching on the part of the teacher.

COA 2 said rewards serves as a push to students and not a pull. This participant said punitive and authoritarian methods do not work, and ADM 1 reiterated rewards should not be given only to students who are not of good behavior, but it should be given to students doing well so they can do better. SPE 1 indicated:

Students need to know that they are in an environment that is nurturing and caring, the need for a reward system becomes a vital tool used in motivating students to improve their skills and behavior which helps them develop and grow, it makes students open to receive more information and makes them ready to learn. Both positive and negative reinforcement makes students want to do more.

Interview Question 10. This question taps into the experience of educators regarding how PLCs and Professional Development contribute toward the effective teaching of mathematics in urban middle schools. All participants overwhelmingly agreed that PLCs and professional development did sharpen their skills as educators and that it is an extremely helpful tool in promoting and adding value to instruction.

TEA 1 talked about the benefits in an exceptional manner, when the participant reiterated the fact that professional development and PLCs help educators meet deadlines and therefore stay on task, and teachers mostly learn something new from collaborative sessions. TEA 2 and TEA 6 shared similar thoughts, as they both stated that no matter the amount of teaching experience one has, there is always something new to learn and try in the classroom. They both admit, however, that not all things learned during professional development and PLCs work when applied in the classroom. TEA 3 said although new ideas and strategies are a good thing, the process of always getting new information is useful and that one needs to pick and choose certain learned practices that works. TEA 4 was very particular about the benefits of teacher collaboration, the candidate specifically indicated PLC sessions are times when "iron sharpens iron", as teachers learn from each other. TEA 5 and SPE 1 shared the same thought, they both stated collaborative sessions help them learn classroom management techniques and strategies. TEA 7 claims data enrichment meetings with colleagues and professional development about

how to use data was most useful., mainly on the interpretation of student test scores is the most beneficial. It helps direct the teacher on what teaching methods are working and what needs to be done to effectively and efficiently train students to master mathematics skills. COA 1 reiterated the fact that such sessions provide teachers with researched and proven modern instructional techniques and strategies that work. AD 1 and TA 1 all made convincing statement as to how PLCs and professional development help in enriching math instruction:

AD 1: Educators are lifelong learners the way students learn a decade ago has changed in recent times, it is imperative that training sessions are given to teachers to upgrade and sharpen their skills. TA 1: PD activities has teachers staying abreast with modern trends and teacher styles which improves their teaching skills, they get the opportunity to meet with colleagues and share and exchange ideas and thoughts.

Interview Question 11. In question 11 educators explain why the RTI system is beneficial to the learning process. In this situation, most educators interviewed agree placing students in groups according to their ability levels and instructing them at their level of comprehension help boost student skills in mathematics.

TEA 1 agrees tiers are beneficial to students but indicated there should be specific reading or math programs meant to accelerate student's academic progress, without such programs the tiers are not productive. TEA 2, TEA 4, TEA 7 and COA 1, all shared the same view. They mentioned RTI helps teachers differentiate instruction by placing students at their ability level and instructing them per their level of proficiency. Not only is it beneficial to the teacher but it is rather most profitable to the student, children learn in various ways, some through movement, others by moving objects, others by listening and seeing. Placing students in

groups tend to promote the different styles of learning as well. TEA 3 mentioned what most teachers said but had a twist to their story:

The good thing is you get to know where your kids are and it helps you to evaluate them as you teach at a much higher pace as you teach you can address their deficiencies immediately. Having a class that has a mixture of tiers allows you to group them at a more appropriate level so, you can meet their needs accordingly. Students learn from each other, sometimes you need to blend the tiers in other times you group them by their ability level. Tiers has its benefits but sometimes it doesn't help because you brand students and that limits the capacity of the student, some students feel disabled. The test that placed them in that situation (tiers) may not be accurate, maybe the student was having a bad day the day they took the test.

TEA 5 had an interesting view, this participant believed in keeping advanced students in the same tier so that they can keep advancing. TEA 6 thought blending Tiers 2 and 3 is the best thing to practice in a math class because RTI supports and promotes differentiated instruction, thereby satisfying various student's level of learning. COA 2 described how the various tiers can be supported by other school personnel during the process:

I believe in the RTI system in trying to meet the needs of all individual students it is important to know the level of all the abilities of each student. It promotes the differentiated techniques one needs to use, you can look at the data of students and categorize them by ability level, smaller groups in tier two and a more individual basis in tier three and develop individual plans for students with the help of the social workers, counselors, teacher assistants, academic tutors and all stakeholders involved in the learning process.

AD 1 is confident using tiers to group students is an excellent instructional tool, as the candidate mentioned that students should be able to know their tier and take ownership of the learning process hoping to move into a higher tier in the future. It also serves as motivation to students when they know they must work towards attaining a higher tier. SPE 1 talked specifically about the benefits of peer discussions in groups:

Peer to peer learning is the best way middle school students learn, sometimes they are afraid to ask their teacher a question they are embarrassed, but they prefer discussing and interacting with their friends, in small groups they feel more open and secure.

TA 1 believes the entire process is about having students attain grade level status and above:

Once students are placed in tiers depending on their ability level, the teacher can focus on student's deficiencies and instruct students at their level in a differentiated manner, kids at a higher level will be taken up further, students at the "bubble" level will climb to the proficiency level while students below grade level will receive the necessary help they need to obtain grade level status.

Summary. As evident in the preceding quotes, middle school math educators strongly believe certain practices and strategies contributes tremendously towards the effective, efficient and quality teaching of mathematics. These educators believe using strategies such as brainstorming activities, curriculum maps, technology, the PBIS system, PBLs, RTIs, PDSs and various multisensory teaching styles such as kinesthetic, tactile and audiovisuals are all productive tools used in teaching mathematics in an urban middle school. Steeg and Lambson realized that if a PDS has a connection with teacher practice and brings teachers together for conversations about the questions arising out of their practice, then educators are able to apply what they learn in the classroom (Steeg & Lambson, 2015). Teachers believe collaboration

between educators who have research-based information can enable high quality teaching in the classroom. Urban middle school math educators can implement the mentioned strategies and possibly realize positive results. Prewett et al. (2012) found that: “Secondary schools across the nation are continuing to implement RTI as a means of closing the basic skills achievement gap and perhaps preventing academic failure in content areas” (p. 1). Teachers believed that RTI is an important approach and supports quality instruction. The PBIS system is a viable approach for improving school behavior and offers a framework for practices that may improve behaviors directly related to academic performance. According to research conducted by Johnson and others (2013), “PBIS is a viable approach for improving school behavior and offers a framework for practices that may improve behaviors directly related to academic performance” (p.142). Educators believe having an efficient rewards program through the PBIS system creates a conducive academic environment which leads to effective teaching and learning.

Summary of Findings

An analysis of participants’ responses identified 15 themes and 39 sub-themes in answering the two research questions. A summary of the findings is depicted in table 4.2.

Table 4.2

Alignment of Research Questions and Key Themes

Focus of research questions	Key themes	Sub-groups
RQ1. How do educators determine whether conceptual and procedural math teaching approaches are useful teaching strategies in an urban middle school?	Story problems Assessments Standardized test	Better understanding of math topics, fun, real, meaningful connection, connect formulas to concept, critical thinking skills, higher order thinking skills, analysis, vocabulary, student interest, math facts
RQ1. (i) How do educators	Manipulatives	Application to life, easier to

Focus of research questions	Key themes	Sub-groups
characterize conceptual math teaching instruction?	Audio-visuals, tactile, kinaesthetic	comprehend, connectivity to life, various ways of learning, watching educational videos, using manipulatives, mastering standards, movement, hands-on, manipulatives, smooth transitioning from one topic to another, audio-visuals, smart board
RQ1. (ii) How do educators characterize procedural math teaching instruction?	Memorization Facts and figures Steps	Temporal application, good for passing a test, typically procedural, better to learn conceptually, that last longer in the mind, smooth transitioning from one topic to the other.
RQ2. What instructional strategies are beneficial to teaching mathematics to urban middle school students?	Group activity Pacing guides Academic environment Use of technology Projects	Students learn at their level of instruction, plan instruction at a conducive pace, projects create a finished product, connects interest with academics, strengthens student understanding of the topic, disciplined class leads to a better learning environment, teacher improved teaching skills and pedagogies, satisfies students who learn differently, "attention grabber."

Research question one yielded key themes from educators such as story problems, assessments and standardized test. Educators believe procedural and conceptual teaching strategies are both useful skills used in solving math problems, and passing all forms of assessments and standardized tests. Research question one sub question (i) had themes such as using manipulatives and various learning styles such as tactile, kinesthetic and audio-visuals are all used in characterizing conceptual math teaching instruction. Other noticeable sub-groups were the

connection of formulas to concepts and higher order thinking skills. Most educators believe conceptual forms of teaching math are the most productive way of teaching mathematics at the middle school level in an urban environment in comparison to teaching math procedurally.

Question one sub section (ii) had keys responses in the form of memorization, facts and figures and working in steps, educators associated procedural math teaching practices with the memorization of the multiplication times table, formulas and solving problems in steps. Other sub themes included the temporal application of formulas, and the lack of connectivity to real life scenarios as well as being good for passing a test. A minority of survey participants believe procedural techniques of teaching is a good way of imparting math knowledge to middle school children.

Question two had vital themes such as group activities, this helps students collaborate with each other, in effect, students have a better understanding of the topic. Teachers use of pacing guides was another key term used in expressing the quality of math instruction; the pacing guides ensure effective planning and pacing of the state curriculum while having a peaceful and serene atmosphere in the classroom promotes the effective teaching of mathematics. Yet another key theme was using technology, teachers admit it is an “attention grabber” and sometimes leads to a student developing interest in math simply because technology is being used as a means of instruction. Assigning projects was a vital method used in having students gain a better understanding of mathematical concept and procedures.

Conclusion

A majority of educators surveyed agree conceptual learning is a more productive teaching and learning tool in comparison to procedural learning. A number of educators however, believe both concepts have pros and cons. Teachers concur that when math topics are taught in relation

to student's life experience, the pupil tend to comprehend math concepts effectively. Most educators interviewed agree certain key methods such as PBL, PLCs, professional development, the PBIS system, and the implementation of a RTI program, all promotes the quality of math instruction at the middle school level.

CHAPTER 5

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this research was in twofold: the first was to find out how educators perceive conceptual and procedural methods of teaching mathematics; the second purpose was to ask instructors about how certain teaching strategies besides content pedagogies can help improve the teaching of mathematics in an urban middle school. A thorough review of the reason for this study, the analysis, findings, recommendations and conclusions will be presented in this chapter.

In considering the purpose of this study, it is important to know how the study was conducted. Inner-city or urban middle schools usually do not have the best resources as compared to suburban school districts. Mathematics standardized test scores in the state of Michigan clearly depicts suburban schools far outperforming schools in the inner-cities. Low test scores in urban schools then show poor results in the state scorecard which can possibly and eventually lead to the auditing of a school, and in extreme circumstances, school closure. Math educators in the inner-cities are equally qualified regarding content knowledge as their suburban colleagues, however, there are certain qualities that such intelligent educators may not have and therefore, choose not to teach in an urban school. Qualities required to teach effectively in urban schools are what this study addresses. Findings will better equip educators to effectively teach math in an inner-city middle school.

The eight math practices described in the Common Core promote the teaching of mathematics conceptually. This research focused on the definition of Math Practice One as a means of enriching the teaching of mathematics. Math Practice One is to make sense of a

problem and persevere in solving it: “Students analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution” (Christinson, 2012, p. 51).

Researched and proven teaching approaches known to improve the quality of teaching math include using technology, using multisensory methods of instruction and the proper use of a well-structured curriculum pacing guide. Other researched methods that improve the teaching of math include differentiated instructional methods of teaching, classroom management techniques which promote a conducive learning environment, and the PBIS system. Formulating data teams is yet another key strategy that promotes effective instruction, data teams analyze student test scores to discover strengths and weaknesses and hence develop strategies to improve student academic weaknesses. Research was conducted on how reading in mathematics serves as an essential tool in solving math story problems; the consistent practice of math topics makes students prolific mathematicians. PBL tends to create a better understanding of math as well as the practice of the RTI methods. Teachers benefit from using Professional Development sessions; academic coaches are essential in fine tuning teacher skills. Research was conducted on how school leaders can play a vital role in enriching the learning of math, this included the introduction of early childhood education in elementary schools and a student disciplined school community. School leaders can also play a role in having parents actively participate in their child’s educational process.

Conclusions and Implications

The literature reviewed on strategies and methods used in improving mathematics education in urban middle schools and data-based findings from participants’ interviews

substantiated the conclusions of this study. The conclusions of this research study will focus on the research questions that directed the study.

Conceptual and Procedural Learning

Conclusion for Research Question 1. Study participants concluded that both conceptual and procedural mathematics teaching methods are essential processes and procedures in educating urban middle school students. Interviewees indicated that procedural methods help students pass formative and summative tests and is temporal and not long lasting, in other words, it only remains in the short-term memory of the child. However, teaching students conceptually creates a better understanding of math topics which can be applied across curricula, encourage higher order and critical thinking skills and the ability to reason logically. In effect, conceptual teaching methods enables math facts and figures remain in the long-term memory of the child and can be applied throughout their lives not only in a math class but in other subjects and in their lives outside the classroom. It was expressed by participants the teaching of math vocabulary and synonyms of vocabulary ensures the teaching of the subject procedurally and conceptually.

Conceptual Learning

Conclusion for Research Question 1, Sub question (i). Educators who participated in the survey characterized the teaching of math conceptually as relating math procedures to students practically. Teachers voiced their opinions boldly by indicating conceptual learning is the ability to explain math facts in relation to something a student experiences in their day to day lives. Also, relating such facts to real life scenarios of student's interests creates a better understanding of the topic being taught, it was expressed that teaching math conceptually was a better way of promoting student interest in the subject. Participants indicated some of the

methods used in teaching math conceptually included using group assignments and activities, undertaking field trips, using kinesthetic, and tactile and audiovisual teaching techniques. This method of study aligns directly with Math Practice One which states: Make sense of problems and persevere in solving them (Christinson, et al., 2012).

It can be concluded from the research study conducted that most educators are in support of the conceptual methods of instruction and learning. The opinions of educators support the findings of Ngu and Phan (2016), which indicate that conceptual knowledge represents essential components of mathematical proficiency and is defined as follows: “conceptual knowledge is a principle that governs a domain” (p. 63). On the other hand, Rittle-Johnson, Schneider, and Star (2015), found that “conceptual knowledge is defined as knowledge of concepts, which are abstract, for example, the National Research Council defined it as comprehension of mathematical concepts, operations, and relations” (p. 588).

Procedural Learning

Conclusion for Research Question 1, Sub question (ii). Study participants characterize procedural methods of learning as the memorization of math facts and formulas and the solving of math problems in steps. Three participants out of 12 had strong opinions about the necessity of knowing and memorizing math facts and formulas, as educators interviewed believe the curriculum is taught comprehensively without interruptions when students know their facts through memorization. Three out of 12 interviewees said memorization had pros and cons while six out of 12 indicated it was the wrong method to use in educating urban middle school children.

It can be concluded that most study participants strongly believe teaching students conceptually is a more productive way of improving student proficiency in mathematics than

using procedural techniques. The views and opinions of educators aligned with the researched definitions of procedural learning and teaching styles. According to Ngu and Phan (2016), “procedural knowledge is a step-by-step sequence of actions to obtain a solution” (p. 63), while Rittle-Johnson, Schneider, and Star, (2015), defined procedural learning and teaching as “knowledge of a series of steps, or actions, done to accomplish a goal” (p. 588).

Mathematics Teaching Strategies

Conclusions for Research Question 2. Educators surveyed agreed conducting brainstorming activities was one of the key ways to efficiently educate students in mathematics. Students who will not answer a question in class can relate with friends and colleagues in groups and in most cases their friends explain concepts to them better than their teacher. Educators were careful to add: during group assignments, there must be some form of organization and structure, there should be a group leader, a note taker, timekeeper and presenter. The various roles given to students ensure that all students in a group participate in the discussion process, leading to student empowerment and the boosting of self-confidence.

Survey participants reported that, without curriculum maps there cannot be a strategic way of teaching the state curriculum. Topics are taught at a specific pace depending on the agency and need of students, for instance more time may be spent on teaching algebraic equations because several questions on this topic occur on standardized tests than probability and statistics. Also, maps serve as means of structuring teacher pacing guides in the future, so educators can plan for quality instruction the following academic year because they can determine what worked and what did not work the previous year. Technology is another quality method used in improving the quality of instruction. Participants claim it is a great way of having

students pay attention in class. Kinesthetic, tactile and audiovisual approaches are ways of teaching students with different learning styles and should be used in instruction at all cost.

Project-based Learning has a unique way of having students gain a better understanding of mathematics concepts. Students produce a finished product of a math standard or skill taught in class usually in relation to their topic of interest. Currently several students use media such as videos and the arts in the form of skits, dance and audio presentations, others come up with tangible innovations which strengthens their understanding of the subject.

Interviewees seem to be excited about the idea of practicing a student reward structure through the PBIS system. Teachers think this idea is phenomenal and can help create a positive atmosphere for teaching. Some educators were careful to say incentives should not only be given to students with bad behavior but also should be given to students with good behavior to enhance the good in the child. In an urban middle school, surveyed educators believe the key to ensuring effective and efficient instruction is to have an academic environment that promotes a smooth and uninterrupted learning. The PBIS system serves as a very resourceful strategy.

Professional Development and PLCs are very constructive methods used in sharpening the skills of the educator. Teachers collaborate through weekly PLC meetings on topics such as data, classroom management, teaching pedagogies, curriculum pacing guides and maps, teacher mentor mentee coaching sessions etc. Professional Development events serve as a source of acquiring new skills and refining already learned skills, new and innovative teaching ideas and pedagogies are usually learned when professionals are brought in to teach educators about research-based teaching methodologies and styles. Educators who participated in the survey consider PLCs and professional development as extremely resourceful techniques of providing quality mathematics instruction.

Study participants who understand RTI tend to have the advantage of grouping students by their ability level and sometimes combining high and low ability levels. One pertinent advantage about grouping students by their ability level is that the educator can focus on the skill level of the various groups with the aim of improving the skills of the pupil. On the other hand, having a mixed ability level encourages students with a high skill ability to assist those with low skills. Educators surveyed believe either situation can be helpful towards the learning process and should be encouraged.

It can be concluded that most educators surveyed agreed that the following teaching strategies aligns with the literature research conducted by the researcher. Surveyed educators agree technology heightens interaction between students and serves as an attention “grabber.” According to Papa, technology provides an open access to communication that brings students extensive models of teaching that enriches standards, broadens the problem-solving problem process and creates further possibilities for interactive learning (Papa, 2011, p. 190–191). The research found that teachers are in favor of using curriculum maps and pacing guides in support of Boylan’s discovery on the essence of having structured curriculum maps: It is imperative that educators create units about the content of the various standards with each unit having a pretest and posttest and having math topics that blend into each other without breaks to better strengthen student’s understanding of the topics (Boylan, 2011).

Educators concurred that Project-based Learning increases and improves students’ critical, collaborative and analytical thinking skills in support with Holmes and Hwang (2016) findings: “PBL has been widely recognized as an active, collaborative and integrative learning approach that engages learners while centering on practical-oriented education” (p. 451).

Teacher views and opinions about the benefits of PLC and professional development directly aligned with Svendsen's (2016) findings: "through interactions and relationships between people, theories and value systems hosting knowledge are developed, established, refined, negotiated and changed" (p. 326). Interviewees agree RTI is a phenomenal tool used in bridging the academic gaps between levels of students. As indicated by Turse and Albrecht (2015), "RTI has two main goals: The first is to deliver evidence-based interventions and the second is to use students' response to those interventions as a basis for determining instructional needs and intensity" (p. 83).

Most study participants approve of using the PBIS system reward systems. Educators believe it creates a conducive teaching environment which tends to promote quality instruction, in agreement with the findings of Lampron and Gonsoulin who believe the benefits of the PBIS system include the improvement of students' academic skills through an incentive package for the pupil, and better social and interactive developmental skills of the child (Lampron & Gonsoulin, 2013).

Interpretation of Key Findings

Findings on the teaching of math vocabulary and synonymous vocabulary in the classroom are confirmed by participants. Educators questioned agree about the enrichment of vocabulary in a math class, and this idea aids in boosting standardized test scores, increasing student interest in the subject, and helping students comprehend and solve math story problems. Educators interviewed indicated students can relate math to real life scenarios if they are familiar with math vocabulary which leads to a better understanding of topics taught. Interviewees claim when students relate procedures learned to their day to day lives they can connect math procedures and concepts. When students are taught math using objects and pictures, they have an

enriched understanding of math standards, this implies students will be able to graduate middle, high school and college thereby dropping the high school dropout rates. Lessons conducted in class that include the movement of students, using manipulatives, hands-on materials, videos and audio recordings, satisfies the various learning styles of the learner. These teaching methods can possibly lead to cross-curricula interests on the part of the student. Most educators interviewed do not believe having students learn math procedurally through the memorization of math facts led to the increase in student level of proficiency in mathematics. Educators think it is simply a temporal fix and can be productive in passing a test. Students tend to forget facts and procedures when they cannot relate the procedure to a concept of their interest. The few teachers who think it is necessary to memorize procedures think it helps teach the curriculum in a quick pace, where the teacher will not need to re-teach a topic, which can stagnate teaching of the curriculum. Apparently, educators surveyed had diverse opinions about how memorizing math facts lead to improvement in math skills.

Middle school math educators who participated in this research shared similar opinions about creating brainstorming scenarios in the classroom. This method supports Math Practice One, an ideology that promotes students focusing on persevering in solving math problems through dialogue. Practice One indicates: students persevere in solving a math problem by making sense of the problem and discuss the processes and procedures used in finding the answer, in this case, the procedure used in deriving the answer is very important. Teachers mentioned several methods used in promoting discussions in the classroom, ranging from group activities to shoulder partner activities. Educators praised using curriculum maps in properly and strategically pacing the teaching of math standards, without the maps, topics would be taught haphazardly leading to the ineffectiveness of math instruction. Technology does not necessarily

make an intelligent student in mathematics; however, it can help the child develop interest in mathematics if technology is used as a tool in teaching math. Findings indicated that PBL is the key to strengthening students understanding of math topics, this is because teachers allow students to choose projects that they are interested in, in relation to the math topic taught. Students can choose the tool they want to use in presenting their project, this can be in the form of a finished tangible product such as an audio/video presentation. Educators surveyed think the PBIS reward system is an asset in an urban middle school, rewards are needed to strengthen and encourage well behaved students to do better, and also, students who disrupt instruction can be given rewards when they are well behaved. Per surveyed instructors, this system is extremely helpful because it creates a favorable academic environment. Findings showed that teachers believe when students are grouped by ability level and instructed at their level of comprehension, it enhances the child's academic progress. Groups developed through the RTI system promote differentiated instruction, thereby ensuring quality instruction.

It was realized through interviews that professional development and PLCs are a benefit to educators, educators sharpen their skills by learning from their colleagues and learning from presenters who introduce research and improved teaching ideas, strategies, pedagogies, and techniques. Educators claim they become better teachers through PLCs and professional development and that they develop innovative ideas when such sessions are held.

Limitations of the Study

It must be reiterated; this study has some limitations. Out of the tens of middle schools in urban areas in Michigan, one school was used in the research process. Twelve mathematics educators ranging from classroom mathematics teachers, a mathematics specialist, teacher

assistants and school leaders were surveyed through an interview. This might not be a fair representation of all or most of urban middle school math educators in the state of Michigan.

Recommendations

Recommendation 1

The researcher recommends that educators use both procedural and conceptual teaching approaches in a middle school classroom. Through the researcher's experience, it was realized that students with technological abilities are unable to sit through long lectures, in effect, a usual class session should consist of a short time for instruction. In a typical 50 or 65-minute class session, instruction should be apportioned as such: not more than 10 - 15 minutes of introducing or re-teaching a skill or lesson (I do), the next 20–25 minutes is an assignment given to students but solved together with students (we do), then the following 20–25 minutes, students will be given an activity or an assignment that they work on individually, in partners or groups (you do). During the three-step process mentioned procedural and conceptual teaching methods should be infused in the learning process to accommodate the various learning styles of students.

Recommendation 2

The researcher suggests educators instruct students particularly from a conceptual point of view. As evidenced through survey participants of this study, majority of educators surveyed believe students grasp math concepts for a lifetime when taught conceptually, however the procedural aspect of teaching cannot be ignored. The researcher believes when procedures are applied conceptually it strengthens the understanding of math concepts. Memorization of math facts and figures is not outmoded and obsolete, when formulas and multiplication facts are memorized as well as the steps used in solving problems, because the students get a better understanding of the topic when they relate the procedure with something concrete, practical in

the form of a concept. Although truly conceptual knowledge of a math standard is essential, the procedures should not be completely ignored, a balance of both produces a proficient middle school mathematics student.

Recommendation 3

The researcher suggests group work assignments and activities should be promoted at the middle school level. Students at the middle school level learn efficiently when they interact with their peers and colleagues, it is imperative to group students in two ways: by ability level and a blend of ability levels, this ensures students who will not ask questions in class can ask and learn from their colleagues during group work activity sessions. The RTI method of instruction allows educators to place their students in groups that allows instruction to be made at the level of the student.

Recommendation 4

Curriculum maps are a must in a quality teaching environment. The educator should not have a fixed map which strictly suggests what topic should be taught at what time of the year, rather the curriculum maps should be flexible and should be changed regularly as the academic year progresses. This is because events and occurrences can disrupt and interfere in the academic process, it is therefore imperative that the curriculum guide can be adjusted to fit the needs of students. Using technology in the classroom must be encouraged always, students currently become attentive and want to inquire on what is taking place in the classroom when technology is used. In other words, the pupil can become interested in mathematics if technology is used as an instructional tool. Educators must be mindful using technology will not necessarily produce a bright and intelligent student, it can only serve as bait, possibly encouraging the interest of the student in mathematics.

Recommendation 5

Project-based Learning should be practiced in every middle school math class. This concept brings the best out of the student regarding creativity, inventions and innovations, it increases the curiosity level of the child and leads to the development of critical thinking skills and higher order thinking skills. Such projects should be embarked on at least twice throughout the academic year in a math class.

Recommendation 6

A well-structured and organized reward system is an essential tool used in promoting quality instruction in an inner-city school. Educators must reward all students and not only children with deviant behaviors. This will ensure students who misbehave in class will improve their behavior while the well-behaved will enhance their good characteristics. It is also necessary to keep parents informed about student's behavior. Parents should be informed not only when students are misbehaving but also when students show good and improved behavior. Such a system will ensure a quiet and peaceful class which is a prerequisite to quality teaching.

Recommendation 7

The researcher recommends a continuous and consistent PLCs and professional development sessions. Educators should strive to improve their skills as an educator by collaborating with their colleagues at the least opportune time. professional development should be organized frequently to educate teachers on researched methods and teaching styles that work, it is relevant to embark on such professional development because the needs of students changes with time, in effect, certain methods that worked ten years ago, may not be the best teaching practice presently. Educators should be reminded professional development and PLCs are one of the most effective ways of sharpening their skills.

Recommendations for Further Research

This research is one of the few studies dwelling on methods of teaching mathematics in urban schools without focusing on teacher pedagogies and educational qualifications and competencies. Rather, the study focuses on certain key methods and strategies educators can use in improving the teaching of the subject in an urban middle school in the state of Michigan. The researcher made suggestions about the participant sample and methodology.

Participant Sample

The number of participants chosen in one urban or inner-city middle school does not reflect the true opinions and views of the tens of urban middle schools in cities across the state of Michigan. Educators from math departments in at least three different schools from two districts should be considered. Districts usually have the same processes and procedures although one school may differ completely in operations from the other. Featuring at least two districts will tend to provide a better perspective of educators from completely different urban environments with entirely different processes. This will enrich the research study by providing a blend of teacher opinions on ways and means of educating students in math.

Methodology

The face to face interview provided lots of information for analysis, however, it would have been more effective if participants had taken an online survey on effective math teaching strategies in addition to the interviews held. Having both methods would have helped confirm the views and opinions of instructors. The inclusion of administrators who are involved with the supervision of math departments but are not state certified and trained math teachers should be avoided in the future. This is because their ideas and thoughts are from the perspective of a supervisor and does not provide the best information needed to enrich the study. However, math

teacher assistants can be included in the study process because such educators have a hands-on experience with students and are familiar with techniques that are successful in teaching math.

Conclusion

This research is essential because of the new school accountability process instituted by the state of Michigan. Schools who fall within the color code red are taken through a restructuring phase which can possibly lead to the closure of a school when improvements are not realized over a period. Under-resourced urban schools in comparison to suburban schools are victims of low math scores. This relatively new system of accountability requires student proficiency in mathematics on the Michigan Student Test of Educational Progress (M-Step), a yearly test which measures the academic proficiency of students in the four core subjects: math, language arts, social studies and science. Currently, math scores are one of the lowest in comparison to the other core subjects mentioned particularly in urban schools. It is therefore imperative to equip inner-city math teachers with strategies apart from pedagogical skills so they become successful and prolific math educators in urban middle schools.

To achieve the objective of equipping math educators to become better educators this research asked educators how they characterize math teaching from a conceptual and procedural point of view. Educators were asked about how they think certain teaching strategies such as using PBL, the PBIS system, professional development, PLCs, RTI, group assignments and activities can contribute towards ensuring the quality of teaching. The majority of study participants supported conceptual learning and teaching in comparison to procedural teaching and learning. Most educators surveyed supported the implementation of key strategies such as PBL, the PBIS system, professional development, PLCs, and RTI in an urban middle school

math class. Educators gave diverse opinions on why they thought the mentioned strategies were helpful to the instructional process.

Urban middle school math educators will have to strive towards engaging students when introducing and re-teaching math topics. Students are interested in math when the procedures taught can be related to real life scenarios that are relevant to the pupil. A combination of procedural and conceptual teaching is therefore a productive way of teaching mathematics to urban students. In practicing and implementing the two concepts mentioned, then, strategies and methods of teaching the subject such as PBL, the PBIS system, professional development, PLCs, and RTI can be enforced effectively and efficiently, all with the aim of promoting quality math instruction in the classroom.

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APPENDIX A**CONSENT LETTER**

January 12, 2015

Dear Colleagues,

I am conducting a research study designed to find solutions to low math skills in urban elementary schools in Michigan. The study will delve into how math practice one can be used as a tool in enhancing and promoting quality math education as well as measures, strategies and pedagogies educators can adopt in strengthening the implementation and practicing of math practice one.

All participants are expected to sign a consent form to participate in this research. Participants' participation is completely voluntary. Members can choose to answer only the questions with which they feel comfortable and can discontinue participation at any time. Some of the data may be used for future research purposes consistent with the original purpose stated in the consent document. The final data will be stored for a period of not longer than two years after which it will be destroyed.

There is a risk of loss of privacy, however, no names or any other identifying information will appear in any published reports of the research. The research material will be kept in a secure location, and only the researcher will have access to the data.

After you have signed and dated the consent form, please email it back to me at the following address: pdanquah@une.edu.

Sincerely,

Peter Danquah
Ed. D Candidate
University of New England

APPENDIX B

CONSENT FOR PARTICIPATION IN THE RESEARCH

Please complete this form after you have read the email.

Project Title: Improving mathematics instruction in urban elementary schools, Michigan

Principal Investigators: Researcher-Peter Danquah Phone: 248-225-7260

Advisor- Dr. Ella Benson, University of New England, Biddeford, Maine.

Introduction

Thank you for your interest in taking part in this research. Before you agree to take part, the person organizing the research must explain the project to you. The purpose of the study is to find solutions to improving the teaching of mathematics in urban elementary schools in Michigan.

If you have any questions arising from the information sheet/email already sent to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

Why is this study being done

This study is being conducted to equip elementary school educators with strategies and methods that can be used in improving math education in urban elementary schools and bridge the gap between underperforming and under resourced middle schools and suburban middle and upper class schools.

Participants of this study will not receive any form of compensation. The study is strictly voluntarily.

Who will be in this study

Participants in this study will include math educators and staff who support elementary school math educators. The participants will have the following titles: School principals, math teachers, educational assistants and instructional coaches.

What will I be asked to do

Participants will answer open ended questions via survey monkey, members will be asked to explain their knowledge of math practice one and the measures, practices and strategies that can be used in promoting and implementing math practice one in the classroom.

What are the possible risks and benefits of taking part in the study

There is a risk of loss of privacy, however, no names or any other identifying information will appear in any published reports of the research. The research material will be kept in a secure location, and only the researcher will have access to the data. Members will receive a copy of the research findings.

How will my privacy be protected and how will the data be kept confidential

Members can choose to answer only the questions with which they feel comfortable and can discontinue participation at any time. Some of the data may be used for future research purposes consistent with the original purpose stated in the consent document. The final data will be stored for a period of not longer than two years after which it will be destroyed. Data will be stored on the researcher's computer with a protected password known by only the researcher.

- Please note that sponsors, funding agencies, regulatory agencies and institutional Review Board may review the research records
- A copy of your signed consent form will be maintained by the principal investigator for at least 3 years after the project is complete before it is destroyed. The consent forms will be stored in a secure location that only members of the research team will have access to and will not be affiliated with any data obtained during the project.

What are my rights as a research participant?

- A copy of your signed consent form will be maintained by the principal investigator for at least 3 years after the project is complete before it is destroyed. The consent forms will be stored in a secure location that only members of the research team will have access to and will not be affiliated with any data obtained during the project.
- If you choose not to participate there is no penalty to you and you will not lose any benefits that you are otherwise entitled to receive. You are free to withdraw from this research study at any time, for any reason. If you choose to withdraw from the research there will be no penalty to you and you will not lose any benefits that you are otherwise entitled to receive.
- You may skip or refuse to answer any question for any reason.

Whom may I contact with questions?

- The researchers conducting this study are Peter Danquah and Ella Benson Ed.D. For questions or more information concerning this research you may contact Ella Benson Ed. D at 207-602-2631 or Ebenson2@une.edu.
- If you choose to participate in this research study and believe you may have suffered a research related injury, please contact Peter Danquah at 248-225-7260 or pdanquah@une.edu.
- If you have any questions or concerns about your rights as a research subject, you may call Olgun Guvench, M.D. Ph.D., Chair of the UNE Institutional Review Board at (207) 221-4171 or
- Please read the statement below, print your name and date and email this form to pdanquah@une.edu.

Participant's Statement

I agree that:

- I have read the email sent to me, and understand what the study involves.
- I understand that if I decide at any time that I no longer wish to take part in this project, I can notify the researchers involved and withdraw immediately.
- I agree that the research project named above has been explained to me to my satisfaction and I agree to take part in this study.
- I understand that the information I have submitted will be published as a report and I will be sent a copy.

Signature:

Date:

APPENDIX C

INTERVIEW QUESTIONS

This interview is in two parts; the first part is about how educators characterize conceptual and procedural mathematics teaching practices. The second part is about methods and strategies educators can take to promote quality math instruction in the classroom.

Part I: *Characteristics of procedural and conceptual math instructional practices*

1. From your experience, why is it important to understand math vocabulary? Ex. The synonyms of the four math operations: Addition, subtraction, multiplication and division?

(Conceptual and Procedural)

2. From your experience, what are the cognitive advantages to a student when they are able to relate math concepts practically to their “day to day lives”?

(Conceptual)

3. Through your experience, what are the cognitive advantages to students when they are able to use concrete objects or pictures to help conceptualize and solve math problems?

(Conceptual)

4. How has the memorization of math facts and formulas helped your students?

(Procedural)

5. How do you present materials to students in an expository style: demonstrating, describing and explaining concepts and skills? Can you share an example with me?

(Conceptual)

Part II: *Measures, practices and methods used in promoting quality math instruction*

6. How will you promote discussions and brainstorming activities among students in a math class? Can you share an example of an activity you have used?

(Strategy for improving math instruction = discussions/brainstorming)

7. Why is it important to use the following as tools in delivering effective instruction: curriculum maps, technology and the use audiovisuals, kinesthetic and tactile learning methods?

(Strategies for improving math instruction = pacing maps, technology, tactile, kinesthetic and audiovisual learning methods)

8. How will you support Project-based Learning (PBL) in a math class?

(Strategy for improving math instruction = PBL)

9. From your experience, how does the Positive Behavior Intervention (PBIS) reward system, ensure effective classroom management?

(Strategy for improving math instruction = PBIS rewards and punishments systems)

10. From your experience, how does teacher professional development and professional learning community collaboration sessions on math teaching pedagogies ensure quality math instruction?

(Strategy for improving math instruction = professional development and PLC collaborations)

11. What are the benefits of placing students in tiers through the Response to Intervention (RTI) program?

(Strategy for improving math instruction = RTI)

APPENDIX D

INSTITUTIONAL REVIEW BOARD PERMISSION LETTER



To: Cc: From: Date: Project # &Title:

Peter Danquah

Ella Benson

Olgun Guvench

January 13, 2016

120715-002, Improving Mathematics Instruction in Urban Elementary Schools, Michigan
(Initial)

The Institutional Review Board (IRB) for the Protection of Human Subjects has reviewed the above captioned project, and has determined that the proposed work is exempt from IRB review and oversight as defined by 45 CFR 46.101 (b)(1) and (b)(2).

Additional IRB review and approval is not required for this protocol as submitted. If you wish to change your protocol at any time, you must first submit the changes for review.

Please contact Olgun Guvench at (207) 221-4171 or oguvench@une.edu with any questions.

Sincerely,

Olgun Guvench, M.D., Ph.D. IRB Chair

IRB#: **120715-002** Submission Date: 11/25/15 Status: Exempt, 45 CFR 46.101 (b)(1) and (b)(2)
Status Date: 1/13/16

APPENDIX E**PARTICIPANT LETTER**

UNIVERSITY OF
NEW ENGLAND

January 14, 2016

Agency name,

Peter Danquah is currently enrolled in the Education Doctoral Program at the University of New England. Peter is in good academic standing and is working on his dissertation proposal.

University of New England's Institutional Research Board (IRB) requires every student and faculty member conducting any level of research to file an application with their office to ensure participants are afforded ethical protection should they choose to participate in a study.

Should he approach your agency for permission to conduct a study, you would be asked to provide "site permission" for his application to the IRB. If you have questions about our procedures or policies, please let me know. Thank for your interest in Peter's research.

Michelle Collay, Ph.D. Research Coordinator, Education Doctorate (Ed. D) in Educational Leadership mcollay@une.edu 207.602.2010