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Improving Mathematical Skill: The Perceptions of Rural Minnesota Mathematics Educators

Michael Haskins
Minnesota State University, Mankato

Improving Mathematical Skill: The Perceptions of Rural Minnesota Mathematics Educators

By

Michael W. Haskins

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Examining Committee:

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Dr. Scott Wurdinger, Advisor

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Dr. In-Jae Kim, Committee Member

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Dr. Mark Zuiker, Committee Member

Abstract

This qualitative phenomenological study is focused on the perceptions of mathematics educators on how to improve mathematical skill in high school students. The main purpose was to describe, recognize, and interpret the lived experience that have allowed educators to achieve the best results for their students. The population for the current study was mathematics educators that were located in a rural Southwest Minnesota city with medium population. These educators were either college educators or middle and high school teachers. The measures that were used to select the participants for the study were that they must hold at least a bachelor's degree, be a mathematics educator in rural southern Minnesota along with teaching either middle or high school mathematics or teaching developmental mathematics at the college level. Mathematics educators that participated in the study strive to improve themselves, create comfortable learning environments, and want their students to be better mathematics learners.

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CHAPTER I

Introduction

Not being college ready, math anxiety, and underprepared college faculty are just some of the many factors that hinder a student's lack of mathematics preparedness, both academic and nonacademic. Better understanding the factors that contribute to student's lack of mathematics proficiency, educators can create courses, programs, and services to help increase student skills in mathematics and better prepare them for success in mathematics. This qualitative, phenomenological study explored the perceptions of mathematical educators on how to improve mathematical skill in high school students. The introduction chapter included background on the problem, the problem statement, purpose of the research, the research question, the significance of the research, and the definition of terms that will be used throughout the research.

Background of the Problem

Conversations about student performance in mathematics typically revolve around how to improve knowledge and skills in students. Middle and high school students in the United States continue to rank in the middle of the pack in mathematical performance in comparison to the world. According to Organisation for Economic Co-operation and Development (OECD), students from the United States ranked 41 out of the 74 countries and economies that were part of the 2015 Programme for International Student Assessment, which was a slight increase from 2012, when the United States ranked 36 out of 65 countries (OECD, 2016). In 2015, thirty-eight countries showed an increase from the previous assessment, in 2012 (OECD, 2016). Low ranking numbers like this

have been a recurring theme for the United States, as the mathematics literacy average score has not changed much since 2003. Eighteen countries did report increases in scores from 2012, with the United States showing a very minimal increase from previous years (OECD, 2014a). The Programme for International Student Assessment is a worldwide study conducted by the OECD on 15-year-old school students' scholastic performance on mathematics, science, and reading. The assessment was first conducted in 2000 and repeats every three years. The concept behind the assessment is to help administrators assess how well schools are equipping today's youth for adult life, whether education systems are fair, and whether some schools and teaching methods are more effective than others, which will help students succeed (OECD, 2014b). These incoming freshman that are participating in the Programme for International Student Assessment, whose ages range from 15 to 16, are just starting their high school career and beginning their mathematics sequence of classes; general math, pre-algebra, algebra, and geometry. These classes help students strengthen problem solving skills, help them identify and analyze patterns, solve real-world problems, and promote the ability to think critically (OECD, 2014a). These are the classes that eventually lead students in different directions during their high school years and continue after graduation. Students who enroll in these types of classes tend to learn more and are more likely to pursue higher level mathematics classes such as trigonometry and calculus in their junior and senior years.

Problem Statement

Despite the increase of technology and new techniques to improve mathematics instruction and learning, the United State is still far behind the rest of the world. There is

a need to better understand what will allow high school students to improve their mathematical skills before they enter college.

Purpose of the Research

The purpose of this study was to analyze the perceptions of mathematics educators on mathematical skill improvement needs, for students entering college. Specifically, this study examined the perceptions of secondary and post-secondary mathematics educators at selected middle schools, high schools, two-year, and four-year colleges and universities in Southern Minnesota.

Early enrollment among high school freshman in algebra is important as it serves as a stepping-stone for further math study and success in science courses (Gamoran & Hannigan, 2000). Participation in both science and mathematics classes carry long-term benefits for students' educational careers and will better prepare them for college level mathematics courses allowing them to bypass the dreaded developmental/remedial mathematics courses (Gamoran & Hannigan, 2000). Many of these high school students also have the opportunity to be dual enrolled at local universities or community colleges. Dual enrollment programs allow students to not only get ahead in their pursuit of a degree but avoid lagging behind in their sequence of high school math courses. This is also an effective approach for institutions to reach students while they are still in high school (Abraham, Slate, Saxon, & Barnes, 2014). Dual enrollment programs allow students to take college courses for college and high school credit enrolling as early as their freshman year (Blackboard Institute, 2011). In a report from the National Center for Educational Statistics for the 2010-11 school year, 82 percent of high school had students

that where dual enrolled, which was around two million students and 69 percent of high schools had students taking Advanced Placement (AP) or International Baccalaureate (IB) classes, roughly 3.5 million students (Thomas, Marken, Gray, & Lewis, 2013). The percentage of students that took both AP and IB classes was 59 percent (Thomas et al., 2013).

For the past 20 years, the effectiveness of developmental education for improving students' success has attracted the attention of researchers and policymakers nationwide (Fike & Fike, 2007; NCPPHE & SREB, 2010). At the start of every collegiate school year in the United States, approximately 60 percent of first-year college students find out that, despite being accepted to the college of their choice, they are not ready for college level courses (Bailey, 2009; NCPPHE & SREB, 2010). These students will find out that they will be required to take developmental mathematics courses that will not count towards their degree. Not only are developmental students taking classes that will not count towards their degree but they are paying for these classes as well, and extra classes equal extra tuition costs. Developmental education is costly to developmental students, both psychologically and financially (Bailey, 2009). According to Bailey, when students find out that they are placed in developmental mathematics courses and are delayed in taking college level courses, they may become psychologically discouraged, and risk dropping out of college altogether (p. 21-22).

While enrolled in developmental mathematics courses, students accumulate debt and spend time, money, and financial aid eligibility while not earning college credits toward a degree (Bailey, 2009). Developmental education cost colleges and students an

estimated $3.6 billion a year nationally and this is increasing every year (The Alliance, 2011). This causes developmental students to borrow and spend more money, and it forces the university to hire additional faculty or assign an overload of credits to faculty members that already have a full load for the semester. This puts pressure on the department's budget and could limit their future funding.

A lack of readiness for college is a major culprit in low graduation rates, as the majority of developmental students who begin in remedial courses never complete their college degrees (Horn & Nevill, 2006; NCPPHE & SREB, 2010). Taking developmental mathematics courses lengthens the time required to complete a degree (Bailey, 2009). A student placed in a development mathematics sequence may be faced with two full years of mathematics classes before they can enroll in college level courses (Stigler, Givvin, & Thompson, 2010). Graduation rates in community college by developmental students who have taken at least one remedial course is 9.5 percent versus 13.9 percent by those who did not take remedial courses (Complete College America, 2012). In four-year universities, the graduation rates for developmental students that take one remedial course is 35.1 percent compared to 55.7 percent for those who do not take remedial courses (Complete College America, 2012). With the graduation rates between taking a remedial course and not taking a remedial course so far apart, especially in four-year universities, an improvement in college readiness must be an essential drive for federal, state, and local policymakers to increase the efforts to increase college achievement.

The preparedness of high school students for college level math courses has always been an issue in the United States. According to the National Center for

Educational Statistics (2014), since 2003, approximately 3 million students graduate every year from high school in the United States, with this number holding steady for years to come. Based on the immediate college enrollment rate, which is defined as the annual percentage of students that complete high school or attain their GED and who enroll in 2 or 4 year colleges in the fall immediately after completing high school, almost 2 million of those students will attend college every year (Department of Education, 2015a).

Now, are these students fully prepared for college let alone college level math? Conley (2007) stated that college readiness can be defined operationally as the level of preparation a student needs to enroll and succeed without remediation in a credit-bearing general education course at a post-secondary institution such as a community college or university (p. 5). Making sure students are fully prepared for the next level of their education is a common concern for students, parents and educators. Post-secondary education can be expensive and if students are enrolling in remedial math courses, they are only delaying their plan of study and extending their graduation. Remedial education is costly in a financial and physical way on the student (Bailey, 2009). Developmental students face pressure to succeed because of the need to pass these courses to continue their college career. Consequently, graduation rates plummet as the number of remedial courses a student enrolls increases because of the added pressure and the extra time spent in remedial courses. Every year many students are underprepared to take college mathematics courses and are required to take developmental mathematics courses since they did not meet the required test scores. Not only does this derail the students from

their plan of study but it creates a burden on their financial well-being. With the cost of attending post-secondary institutions increasing every year, students are having to spend more on their education, not to mention pay for classes that do not count towards a degree (Department of Education, 2015b).

The need to find qualified and dedicated individuals to teach these types of classes is also a challenge. Developmental instruction not only addresses the remediation of mathematical deficiencies, but motivational and learning deficiencies as well (Ahlering et al., 2002). Students who enter college at the developmental level have different needs than the students who are college ready. Developmental mathematics students have a collection of characteristics that distinguish them from other students. These students might have fallen behind in their sequence of classes, lost interest in taking mathematics, have been exposed to various teaching styles that have not been successful, or lack the correct amount of effort and seriousness (Ahlering et al., 2002). At the same time, colleges are finding it difficult to find qualified and experienced faculty who can teach developmental mathematics. Developmental mathematics students need instructors that care about them and are passionate about developmental mathematics. Developmental instructors need to have the patience to give the developmental mathematics students the individual attention they need to succeed along with being able to deliver the material in a way that will not only help the student understand and retain the information but also help the student remove any doubts about their ability to succeed in mathematics classes. It takes a skilled and patient instructor to be good at teaching

developmental mathematics courses and this person needs to be understanding of the circumstances that developmental mathematics students face (Apfaltrer & Zyman, 2008).

It is unknown if mathematics educators in both secondary and post-secondary settings share the same views of the challenges and concerns experienced by developmental mathematics students. It is additionally unknown what solutions, if any, these educators believe are possible in reducing the number of developmental students who need developmental mathematics courses. Identifying the commonalities of the perceptions of mathematics educators is necessary for establishing the collective need and identifying strategies for improving mathematic skills for students entering college.

Research Question

The research question for this study states: What are the perceptions of rural mathematics educators on how to improve high school mathematical skills in high school students?

Significance of the Research

With such a vast number of high school students enrolling in college and discovering that they are not prepared for college level math, the need to improve mathematics skills in these students has become a priority of administration in high school. These students are enrolling in developmental mathematics courses, which creates a heavy burden on their college careers. These developmental students are faced with spending extra time and money on courses that will not count towards their degree.

The significance of this research will be backed by the information the math educators provided based on their perceptions on how to improve mathematical skill in

students. Mathematics educators at both the secondary and post-secondary education levels will benefit from this study as it will provide them with the tools and ideas they need to help better educate students and ultimately improve mathematical skill. This information will be useful to educators in k-8 as well as parents.

Limitations

This qualitative study's main purpose was to collect, describe, recognize, and interpret the lived experience of mathematics educators on how to improve mathematical skill in high school students consistent with the phenomenological research design. The study was limited by factors, which can occur in phenomenological qualitative research. The first factor was the mathematics educators all teach in the same demographic area, which was a rural Southwest Minnesota city with medium population. The United States educational system is a diverse area with many different educational institutions, so multiple locations would only expand the knowledge received by the study. A second factor was limitations with respect to researcher bias. The researcher is a mathematics instructor that has taught at both the 2-year and 4-year school where some of the participants were selected. The researcher has been teaching developmental mathematics since 2004 at both the community college and university level. As a mathematics instructor, with experience teaching developmental mathematics, the researcher has close interactions with the some of the individuals that participated in the study and may have developed assumptions and attitudes about developmental education. Although measures were taken to assure accurate accountability, analysis and interpretation bias could have occurred and could possibly limit the study's results.

Definition of Key Terms

This section will outline the definitions of common terms that are unique to my research and study.

Alternative high school. An alternative high school is an educational environment that is designed to accommodate educational, behavioral, and/or medical needs of children and adolescents that cannot be adequately addressed in a traditional high school setting.

American college test (ACT). The ACT is a standardized test that is used to measure the college readiness of a high school student in the United States. The four areas the test focuses on are English, Mathematics, Social Studies, and Natural Sciences.

Charter school. Charter schools are public schools operating under a "charter," essentially a contract entered into between the school and its authorizing agency. In addition to allowing the school to open, the charter allows the school with significant operational autonomy to pursue specific educational objectives. The autonomy granted under the charter agreement allows the school considerable decision-making authority over key matters of curriculum, personnel, and budget. Charter schools are often not a part of states' current districts and, therefore, have few if any zoning limitations. Therefore, students attend charter schools by the choice of their parents or guardians rather than by assignment to a school district (National Charter School Resource Center, n.d.).

College level mathematics courses. College level mathematics course are courses that have a one or higher as the first digit of the course number and the course counts towards a student's degree.

College readiness. College readiness can be defined operationally as the level of preparation a student needs to enroll and succeed—without remediation—in a credit-bearing general education course at a postsecondary institution that offers a baccalaureate degree or transfer to a baccalaureate program (Conley, 2007, p 5).

Developmental/remedial courses. Developmental or remedial courses help students who need additional academic support make the transition from high school to college. Schools often require students to take placement tests or other admissions tests to gauge academic proficiency in areas such as reading, writing, and math. When a student struggles in any of these areas, the college recommends that they enroll in developmental classes, which differ in several ways from typical college classes (Kokemuller & Media, n.d.).

Developmental education. Developmental education is a field of practice and research within higher education with a theoretical foundation in developmental psychology and learning theory. It promotes the cognitive and affective growth of all postsecondary learners, at all levels of the learning continuum. Developmental education is sensitive and responsive to individual differences and special needs among learners. Developmental education programs and services commonly address academic preparedness, diagnostic assessment and placement, development of general and discipline-specific learning strategies, and affective barriers to learning. Developmental

education includes, all forms of learning assistance, such as tutoring, mentoring, and supplemental instruction, personal, academic, and career counseling, academic advisement, and coursework (NADE, n.d.).

Developmental mathematics courses. Developmental mathematics courses are designed to help strengthen the students' mathematics ability by refreshing basic concepts and skills. Developmental mathematics courses start with basic arithmetic, then proceed to pre-algebra, elementary algebra, and finally intermediate algebra. The sequence of all must be passed before a student can enroll in a college level mathematics course. Developmental mathematics courses are courses that have a zero as the first digit in the course number and the course does not count towards a student's degree.

Developmental mathematics students. Developmental mathematics students are students who have taken a math placement test and did not meet the required cutoff score to be placed into college level mathematics courses. They are required to pass a sequence of courses before they are allowed to enroll into college level mathematics courses.

Developmental students. Developmental students are students who have taken a placement test and did not meet the required cutoff score to be placed into college level courses. These students are required to pass a sequence of Mathematics, Reading, or English courses before they are allowed to enroll into any college level Mathematics, Reading, or English courses.

First-generation student. First-generation students are students whose parent(s) or legal guardian(s) have not completed a bachelor's degree. This means that they are

the first in their family to attend a four-year college or university to attain a bachelor's degree.

Formative assessment. Formative assessment refers to a wide variety of methods that teachers use to conduct in-process evaluations of student comprehension, learning needs, and academic progress during a lesson, unit, or course. Formative assessments help teachers identify concepts that students are struggling to understand, skills they are having difficulty acquiring, or learning standards they have not yet achieved so that adjustments can be made to lessons, instructional techniques, and academic support (Great School Partnership, 2013a).

Nontraditional students. Nontraditional students are students that possess one or more of the seven identified characteristics by The National Center for Education Statistics (NCES). To be considered a nontraditional student, a student does not immediately continue their education after they graduate from high school, they only attend college part time, work fulltime, which is the equivalent to 35 hours or more per week. They are also financially independent and have children or dependents other than their spouse. These nontraditional students might also be a single parent and have only a GED.

Scholastic aptitude test (SAT). The SAT is a standardized test used for high school students for college admissions in the United States. The SAT consists of five subject areas that include; English, History, Languages, Mathematics, and Science.

Summative assessment. Summative assessments are used to evaluate student learning, skill acquisition, and academic achievement at the conclusion of a project, unit,

course, semester, program, or school year. Generally speaking, summative assessments include some of the following: tests, assignments, or projects that are used to determine whether students have learned what they were expected to learn at the conclusion of a specific instructional period and are generally evaluative, rather than diagnostic. Summative assessment results are often recorded as scores or grades that are then factored into a student's permanent academic record, whether they end up as letter grades on a report card or test scores used in the college-admissions process (Great School Partnership, 2013b).

Traditional students. Traditional students are students who are between the ages of 18 and 22, proceed to college right after graduating from high school, and receive parental financial support and have lived on campus.

Underprepared students. Underprepared students are students that do not hold the academic skills and knowledge that will allow them to be successful in college-level courses.

Summary

The purpose of this qualitative study was to analyze the perceptions of mathematics educators on how to improve mathematical skill in high school students which will lead to better proficiency in mathematics. Studies show that over half of first-year college students are not academically college ready even though they are eligible to attend college. Most of these first-year college students do not have the required skills to enroll or even complete college level courses.

The current study explored the perceptions of mathematical educators and how they can improve mathematical skill in their students. The next chapter will review relevant literature and current studies relating to the field of college readiness, math anxiety, development educators, developmental educations, developmental mathematics, and the characteristics of developmental mathematics students.

CHAPTER II

Review of Literature

The purpose of this qualitative study was to recognize, describe, and interpret the perceptions of mathematics educators on how to improve mathematical skill in high school students which will lead to better proficiency in mathematics. The literature review concentrated on developmental mathematics education in secondary, university, and community colleges. The searches conducted required the use of MavScholar, ERIC, ProQuest, and Google Scholar, which were used to identify key terms (e.g., mathematics achievement, college readiness mathematics, developmental mathematics education, remedial mathematics education, college mathematics education, developmental education, developmental teaching, developmental college faculty, developmental teaching techniques, developmental mathematics students, college remediation, remedial education, remedial teaching, remedial college faculty, high school achievement, mathematics anxiety, and test anxiety). Information from state and federal government educational websites, and university and college reports were used to collect data for the research.

College Readiness

Over the past several decades, the ambitions of high school students to continue their college education has increased, but there remains a significant gap in how college-ready some of these students are for college (Roderick, Nagaoka, & Coca, 2009). College readiness is a term used by many secondary and post-secondary institutions to identify the level of preparedness incoming students are for college-level courses. The

idea behind college readiness is to prepare the student to succeed in college-level courses rather than on fulfilling basic eligibility requirements (Cline, Bissell, Hafner, & Katz, 2007). Research suggests that one of the reasons students do not do as well as they hope in college is the gap between their high school experiences and the expectations of college (Barnett, 2006; Born, 2006; Byrd & MacDonald, 2005). A study done by the National Center for Public Policy and Higher Educations and The Southern Regional Education Board showed that roughly 60 percent of first-year college students are not academically ready for college even though they are eligible to attend college (NCPPHE & SREB, 2010). The more college-ready students are, the better chance they will succeed without remediation (Conley, 2007). College-ready students that understand what is expected in a college course, can deal with content that is presented to them, and can take away the important lessons that the course offers (Conley, 2007).

Getting students college-ready is something that needs to start early in their high school career. These students need to know that enrolling as soon as they can in their mathematics sequence of classes, such as general math, pre-algebra, algebra, and geometry, will only help build and improve their analytical skills. The general sequence of mathematics classes will help guide students as they experiment with other classes in high school and eventually in college. Students that enroll early in the sequence of mathematics classes as freshman are more likely interested in upper level mathematics classes and eventually participate and succeed in science and technology classes (Gamoran & Hannigan, 2000). Long-term benefits can be seen for mathematics students' educational careers that participate in science and mathematics classes (Gamoran &

Hannigan, 2000). They will be better prepared for college-level mathematics courses by understanding the basic concepts, principles, and techniques of college–level mathematics (Conley, 2007; Gamoran & Hannigan, 2000). College instructors expect students to make inferences on what they observe in class, interpret results found by exploring new ideas, and back their result with evidence (National Research Council, 2002). Processing the ability to be able to have a formulaic understanding of how mathematics works, knowing when and how to approximate solutions to determine the reasonableness, and having the ability to solve problems without a calculator are valuable assets of college-level mathematics students (Conley, 2008). These college-level mathematic students should also be able to apply the conceptual understandings of mathematics, use mathematics as a tool to problem solve and find solutions to complex problems and reach conclusions on these problems (Conley, 2008; National Research Council, 2002). They should also be able to offer explanations to support these answers, excel at research, engage in class conversation, and have an open mind about that they are learning in and outside the class room (Conley, 2008; National Research Council, 2002).

Students need a solid foundation of learning to build on when they enroll in college-level courses. Students achieve this by taking challenging academic courses such as honors English, Math, and Science for at least three to four years of high school. According to David Conley (2008), schools need to also contribute to the transformation of college-ready students.

Conley mentions that a comprehensive college preparation program should address four distinct dimensions of college readiness: Cognitive Strategies, Content Knowledge, Self-management Skills, and Knowledge about Postsecondary Education (p. 3-8). The first-dimension Conley (2008) suggests is Cognitive Strategies, which stated that colleges expect their students to think about what they learn. Any student entering college is more likely to succeed if they can formulate solutions to problems, evaluate research, interpret philosophies, think analytically and logically, and use precision and accuracy as they apply their methods (p. 3).

The main idea of the second dimension, Content Knowledge, is to make sure the students have a firm grasp on the key concepts and terminology, have the ability to link ideas, and hold the ability to organize principles that form the structure of each academic subject area (Conley, 2008). When exposed to standardize testing, administration and faculty can use information gathered to help identify which ideas and concepts students can use to help strengthen their post-secondary education and which concepts need to be addressed. Conley also stated that students making the connections among the big ideas is of great importance to their education and it will allow them to support their understanding in a way the postsecondary education can build on (p. 4-5).

Developing Self-Management Skills is the third dimension that students must master in college. Conley mentions that this requires students to prioritize their time and prepare for massive amounts of information, keeping themselves organized to meet deadlines (p. 6). Students must be able to process this information by way of studying independently, working together in study groups, and by seeking out assistance from

academic support services. Knowing when to withdraw or drop from a course is also a valuable management skill that can be useful to students (p. 6).

The last dimension is Knowledge about Postsecondary Education. This requires students to be knowledgeable in choosing a college, applying for and accepting financial aid, and adjusting to life away from home while living on campus. The necessary information students should possess includes: matching personal interests with college majors and programs, understanding how and when to complete the appropriate forms for federal and college financial aid programs, when and where to take the required admissions and placement exams, when to apply to college and when to submit all necessary paperwork, and perhaps most important, understanding how the culture of college is different from that of high school (p 7-8).

Conley (2008) found that mastery of these four dimensions is very rare among high school of students and readying these students for their next level of post-secondary education is very important for their development in college. It is crucial that high schools put in the required amount of time and effort to meet the needs of all students who wish to go on to postsecondary education (Conley, 2008). The needs of some students require a more planned, structured, and comprehensive program of preparation that is carefully calibrated. First-generation students, students from immigration families, students who are members of racial and ethnic minorities groups, and students from low-income families are more vulnerable during their journey into college if an adequate level of mastery does not exist in any of the four dimensions (Conley, 2008).

Preparing high school students for college is a huge task and this study will uncover the ideas and thoughts on how this can be improved by addressing what the challenges students experience in learning mathematics and what issues bring on these challenges, the perceptions on requiring mathematics for all four years of high school, and how prepared faculty think students are for college.

Math Anxiety

A feeling of tension, apprehension, or fear that interferes with mathematics performance is how Ashcraft (2002) defines math anxiety. Curtain-Phillips (1999) described math anxiety as the emotions that clutter one's understanding and recall as one attempts to solve mathematics problems. Math anxiety has been defined by Tobias (1993), as feelings of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations. Math anxiety can cause one to forget and lose one's self-confidence.

Math anxiety affects many high school and college students which creates an unwillingness to enroll in higher mathematics and science courses because these students are convinced they will not be able to succeed (Tobias, 1993). Tobias (1993) believes that this idea may have originated early in their schooling when they were given the impression that some people can do mathematics and other people cannot. Other research stated that math anxiety, which is widespread and poses a serious problem in our society, often stems from early negative childhood experiences, including intimidation and humiliation (Rossnan, 2006; Ruedy & Nirenberg, 1990).

When confronted with mathematics, some common signs of math anxiety that a student may experience are sweaty palms, instances of panic, nausea, forgetfulness, experiences paralysis of thought, pressure to complete an exam within a given time, uncertainty from a lack of self-confidence, feelings of tension and doubt in their intelligence (Curtain-Phillips, 1999; Krantz, 1999; Tobias, 1993; Woodard, 2004). Avoidance of taking future mathematics classes along with participating in class are other symptoms that math anxious students possess (Maloney & Beilock, 2012).

Why do students fear mathematics? Some of the more common causes are a student having a negative or embarrassing experience during a math class or having an undesirable experience with a math teacher, the student was told that they are not very good at math, pressure of timed exams, fear of failure, unprepared teachers and even parents of students (Curtain-Phillips, 2004; Perry, 2004; Woodard, 2004). According to Curtain-Phillips (2004), there are three practices that cause great anxiety in students and is part of the traditional mathematics classroom: imposed authority, public exposure, and time deadlines (Curtain-Phillips, 2004).

Math anxiety is very real and occurs in a wide variety of people ranging from school age to adult (Zaslavsky, 1994). Much of this anxiety happens in the classroom due to the lack of consideration for different learning styles, the unpreparedness of instructors and the unwillingness of the student to seek out additional help if one source is not enough (Perry, 2004). Many colleges and universities offer overcoming math anxiety courses and hands-on workshops. Workshops present a comprehensive diverse approach to math anxiety that may help students redirect their thinking in a way that will

promote self-confidence and success in mathematics (Curtain-Phillip, 1999). Recognizing mathematical difficulties and formulating a plan, which includes seeking appropriate assistance and asking questions when necessary, is one way for students to start overcoming math anxiety (Perry, 2004).

There should also be more emphasis on improving teaching methods, which include less lecture, more student directed classes, and more discussion (Curtain-Phillips, 2004; Rossnan, 2006). Educators must re-examine traditional teaching methods, which often do not match students' learning styles and be more flexible in how they present the material to better match the skills that are needed to succeed at the next level of mathematics. (Curtain-Phillips, 2004). The educator needs to take a more proactive role in encouraging students to become more interested in mathematics (Rossnan, 2006). One-way developmental mathematics faculty can help ease the pain of math anxiety is to show the student that they, as a developmental mathematics instructor, enjoy mathematics (Rossnan, 2006). Other methods that can help students is making mathematics more enjoyable and show how mathematics is used every day in careers and life (Rossnan, 2006). Adapting instruction to students' interests and providing successful activities, establishing short-term and attainable goals, and using meaningful methods of teaching to help simplify mathematics so it made sense are other methods that developmental faculty can use. (Rossnan, 2006).

Math anxiety is a problem that affects many people regardless of age and gender. This study hopes to uncover some of the perceptions mathematics educators have on how to reduce math anxiety students encounter in mathematics courses by talking about the

relationship math anxiety has with success in mathematics and pinpointing the main challenges students face in mathematics, be it a fear of mathematics or the teacher.

Characteristics of Developmental Educators and Faculty

Developmental mathematics instruction's main goal is to improve the mathematical skills of underprepared students and to provide them the same opportunity to complete college-level mathematics courses successfully (Penny & White, 1998). Program administrators, researchers, and authorities in the field of developmental education have been interested in the characteristics of developmental faculty since the inception of developmental classes (Penny & White, 1998). Many program administrators have been exposed to evidence that developmental mathematics students can be served best by being educated by full-time faculty that are well-trained and experienced in teaching developmental mathematics (Boylan, 1999; Penny & White, 1998). Developmental programs that succeed are staffed by professionals who know and understand the needs of their audience, but not every faculty member can teach developmental courses just because they have an advanced degree (Boylan, 1999). According to Boylan (1999), successful developmental educators know more than their subject matter. They have the knowledge and ability to relate and connect with developmental students by making learning easier. Developmental faculty are at their most effective when they are in an environment that values what they accomplish and need to work closely with college tutoring services, provide instruction in learning labs, and provide counseling and advising to help aid in the transition to college. Successful developmental educators know more than their subject matter, they have the knowledge

and ability to relate and get through to developmental students by making learning easier and are most effective when they are in an environment that values what they accomplish (Boylan, 1999).

Research done by Snyder and Dillow (2012) showed that in 1999, there was 1,027,830 total faculty members teaching at degree granting institutions (p. 377). Out of this total, 291,246 were part-time faculty members, which is 28 percent. There were 1,211,800 faculty teaching at a degree granting institution in 2003 with 530,000 of those teaching as part-time faculty, which was 44 percent (p. 390). Out of those 530,000 that taught as part-time faculty, 43 percent taught at public 2-year colleges (p. 390). The number of part-time faculty at degree granting institutions increased in 2009 to 710,167, which was 49 percent of the total (p. 376). The number of part-time faculty that taught at a public 2-year college was 260,954, which was 37 percent of the total part-time faculty that taught in 2009 (p. 378)

In another study done by the National Study of Developmental Education in 1995, Boylan, Bonham, and Bliss (1994) found that 66 percent of all faculty teaching developmental courses at 4-year institutions did so as part-time faculty. According to the National Center for Education Statistics (1998), the total number of part-time faculty that taught during the same time was 31 percent. Of the faculty that were teaching developmental mathematics course, 69 percent were teaching as part-time faculty and 70 percent of these educators had fewer than five years of teaching experience (Boylan et al., 1994). If we look at the preparedness of these developmental faculty, 56 percent of the developmental mathematics educators that taught at 4-year institutions held a master's

degree (Boylan et al., 1994). This was very close to all developmental instructors at 4-year institutions at 57 percent (Boylan et al., 1994). Developmental mathematics instructors at 4-year institutions, however were more likely than other disciplines to have only a bachelor's degree (Boylan et al., 1994).

The performance of part-time faculty needs to improve for developmental mathematics students to succeed (Penny & White, 1998). Institutions that employ a large number of part-time developmental mathematics faculty should have policies and procedures in place for their employment, orientation, professional development, and evaluation that are relatable to those used for full-time mathematics faculty (Penny & White, 1998). Part-time faculty members that teach developmental mathematics courses should be included as active members of the developmental education unit and become familiar with the mission of the institution and of the developmental program (Penny & White, 1998). Many part-time faculty members do not get the opportunity to meet and collaborate on a regular basis with the full-time developmental faculty staff. Meeting regularly allows all developmental mathematics faculty to share problems they encounter with students and discuss successful methods of instruction (Boylan, 1999).

Understanding and complying with grading policies and standards should be required for part-time developmental mathematics faculty (Penny & White, 1998). Part-time developmental mathematics faculty need to be well acquainted with the knowledge and skills required for success in college-level mathematics course (Penny & White, 1998). Developmental mathematics faculty need to possess the ability to recognize when developmental mathematics students are at risk of falling behind in the course and when

to seek out support services designed specifically for development mathematics students (Penny & White, 1998). Developmental mathematics faculty must be able to manage their classroom by using competition carefully, avoiding situations in which highly anxious students will be in front of a large group, and by making sure all instructions are clear (Rossnan, 2006). Promoting a positive disposition and removing time pressures on homework and tests will also help alleviate pressure on students thus creating a better learning environment (Curtain-Phillips, 2004; Rossnan 2006).

Having dedicated faculty members that are willing to put the student first is important to the development of the students. Searching out the answers to how educators challenge their students in the classroom, how educators define successful mathematics teachers, and which techniques and delivery methods work optimize the chances of high school students testing into college level mathematics rather than enrolling in developmental courses.

Developmental Education and Developmental Mathematics Education

There are many reasons we have developmental courses, but the main reason that developmental or remedial courses exist is to remediate student deficiencies in mathematical skill, which are required to succeed in college-level mathematics courses (Ahlering et al., 2002; Boylan, 1999; Boylan, Bonham, & White, 1999; Johnson & Kuennen, 2004). Successful developmental education places the student at the center of the learning experience (Boylan, 1999). Developmental education contains a wide range of tools that are designed to help underprepared students succeed in higher education (Boylan, 1999). Some of these tools that schools and institutions use include tutoring,

special academic advising, learning labs, and specialty learning centers designed around the curriculum (Boylan, 1999). Developmental or remedial education programs have been around as long as there have been colleges and universities in America (Kull, 1999). The main purpose of development education is to assist under-prepared students with poor mathematical skills and prepare them for college-level courses (Boylan, 1999; Boylan et al., 1999; Johnson & Kuennen, 2004). If we look at the number of institutions that offer some type of developmental course, the percentage of 2-year institutions is over 90 percent and for 4-year institutions, it ranges from 70 to 80 percent (Boylan, 1999; National Center for Educational Statistics, 2001; Pretlow & Wathington, 2012). When students enroll in college, they are required to take assessment tests in mathematics, reading, and writing (Bailey & Cho, 2010). These tests categorize students into two areas; college- ready, which allow the students to enroll in college level course or development or remedial students that need to take specific courses to enhance their skills (Bailey & Cho, 2010).

The number one goal of developmental mathematics education is to strengthen the basic skills in mathematics of academically unprepared students so they have the ability to be successful in college-level course work (Penny & White, 1998; MDRC, 2013). Over the past few decades, the number of students that enroll in developmental mathematics courses has been increasing (Hall & Ponton, 2005). Developmental mathematics education is different from school to school, but most post-secondary institutions have a sequence of developmental mathematics courses that are available to students (Stigler et al., 2010). The sequence might start with a basic mathematics course

and then lead into pre-algebra, elementary algebra, and finally intermediate/introductory algebra (Cullinane & Treisman, 2010; Fike & Fike, 2008; Stigler et al., 2010). These students must show that they are proficient in all courses before enrolling in transfer-level college mathematics courses (Stigler et al., 2010).

Forty percent of all freshman that enter a 4-year university or college are required to enroll in developmental courses (Smittle, 2003). Almost 50 to 60 percent of all students entering community colleges require some sort of developmental course (Benken, Ramirez, Li, & Wetendorf, 2015; Foshay & Perez, 2000; Merseth, 2011). Every year approximately 60 percent of incoming college students find out they are not ready for college-level courses and are required to take developmental courses that will not count towards their degree (Bailey, 2009; NCPPHE & SREB, 2010). In 2000, the percentage of first-year students that attended a public 4-year institution that needed to take a developmental mathematics class was 80 (Duranczyk & Higbee, 2006). Looking at the percentage of undergraduates that took developmental mathematics courses in 2003-04, almost half of all undergraduate students were enrolled in at least one developmental course, with 41 percent enrolling in a developmental mathematics course (Asmussen & Horn, 2014). At public 2-year institutions, the rate of students enrolling in developmental mathematics was 58 percent (Asmussen & Horn, 2014).

The need to increase the success rate of student performance in developmental courses at the post-secondary level has always been a major hurdle for educators (Fike & Fike, 2007; NCPPHE & SREB, 2010). According to the National Education Longitudinal Study (NELS) done in 1998, 40 percent of the students took at least one

developmental course in college, with 28 percent taking a developmental mathematics course (Attewell, Lavin, Domina, & Levey, 2006). Nine percent were enrolled in developmental reading courses and 18 percent in developmental writing courses (Attewell et al., 2006). The number of students that enrolled in developmental courses was staggering. From the NELS data at community colleges, 44 percent took between one and three courses, and 14 percent enrolled in more than three developmental courses (Attewell et al., 2006). At nonselective four-year colleges, 26 percent of the students surveyed took between one and three developmental courses and 5 percent took three or more (Attewell et al., 2006). Sixty-nine percent of nonselective four-year college students did not enroll in any developmental courses (Attewell et al., 2006). For most college degrees, mathematics is required for graduation (Stigler et al.,2010). Of the students that took developmental courses, only 30 percent of the students passed all their developmental mathematics courses compared to 71 percent that passed their developmental reading courses and 68 percent that passed their developmental writing courses (Attewell et al., 2006; Bailey, 2009; Fike & Fike, 2008). Additional information from the NELS study showed that students who enrolled in developmental reading courses are more likely to earn a degree compared to their peers that enroll in developmental mathematics courses (Attewell et al., 2006). This can be a difficult task for a developmental mathematics student to overcome as they see mathematics as the roadblock to their degree.

Research by Bailey (2009) from the Achieving the Dream study, which involved eighty-three community colleges in fifteen states, showed that around one-fifth of all

students that were referred to developmental mathematics courses did not enroll in them within three years after registering for classes. According to his data, about 33 percent of all students entering college are assigned to the lowest level of math remediation (Bailey, 2009; Bailey, Jeong, & Cho, 2010). Twenty-eight percent of students are placed in the lowest-level courses in colleges that offer two levels of developmental mathematics (Bailey, 2009; Bailey et al., 2010). Many students failed to complete their developmental mathematics course sequence, with only 31 percent completing the sequence compared to 44 percent completing the reading sequence (Bailey, 2009). The percentage of students that enroll in a developmental mathematics course and pass their sequence is 45 percent (Bailey et al., 2010). Only twenty percent of students that are referred to developmental courses pass these courses (Bailey et al., 2010). The percent that enrolled in developmental mathematics courses and successfully passed college-level mathematics was 33 percent (Bailey et al., 2010).

With 58 percent of all graduating high school student seniors being equipped with adequate skills for college-level work, 42 percent are required to enroll in some sort of developmental course (McCabe, 2000). He also mentioned that 62 percent of the group that are not prepared for college-level course work, are deficient in mathematics. These students will be required to spend more money on classes that will not count toward their degree. Developmental education is taxing both financially and physically to developmental students (Bailey, 2009; Bailey & Cho, 2010). When students realize that they will be placed in developmental education classes, they become psychologically

discouraged and the risk of dropping out increases (Bailey, 2009; Complete College America, 2016; Deil-Amen & Rosenbaum, 2002; Horn & Nevill, 2006).

When students are placed in developmental mathematics courses, they accumulate debt and spend time and money, sacrificing financial aid eligibility without earning credits toward their degree (Bailey, 2009; Complete College America, 2016). Around 50 percent of developmental community college students have personal income that is less than 150 percent of the federal poverty line (Fernandez, Barone, & Klepfer; 2014). The Alliance for Excellent Education found that the cost for developmental education in the United States at all colleges and universities during the 2007-08 school year was an estimated $3.6 billion (2011). Data from the 2011 National Center for Education Statistics Digest of Educational Statistics showed that the annual cost for developmental education at community colleges was close to $4 billion (Scott-Clayton & Rodriguez, 2015). For all colleges and universities, the annual cost for developmental education was nearly $7 billion (Scott-Clayton, Crosta, & Belfield, 2014). Students are forced to borrow additional funds to pay for these courses and post-secondary institutions are required to hire additional faculty to meet the needs of these students. Along with the high costs of developmental education, taking developmental courses extends the students graduation deadline. Developmental education not only lengthens the time required for students to complete their degree but it also affects the probability of students even completing college altogether (Bailey, 2009; Bailey & Cho, 2010; Complete College America, 2016; Horn & Neville., 2006; Lesik, 2007; NCPPHE & SREB, 2010). Additionally, students that are placed in developmental courses are

discouraged when they find out that they must postpone their enrollment into college-level courses (Bailey & Cho, 2010; Deil-Amen & Rosenbaum, 2002). Students that are placed in a development mathematics sequence are faced with the probability of taking up to two full years of mathematics classes before they can enroll in college-level courses (Complete College America, 2016; Stigler et al., 2010).

A study done by Complete College America's (2016), Alliance of States, showed that students of color and low-income students are far more likely to be placed into remedial education (p. 2). They are also less likely to pass college-level courses in math and English (p. 2). Seventy percent of African-American college students are enrolled in at least one developmental class at a two-year institution while that number dips down a little bit to 44 percent in four-year non-flagship institutions. For Hispanic students, the percentage that take classes at two-year and four-year institutions is 63 percent and 35 percent (Complete College America, 2016). Fifty-three percent of White students take developmental classes at two-year colleges versus 23 percent at four-year institutions (Complete College America, 2016). Students who receive some sort of financial assistance, like a Pell grant, are also likely to be placed in developmental courses. The percentage of students that receive financial assistance and were placed in developmental courses was 69 percent at two-year institutions and 37 percent at four-year institutions. These students end up using their financial resources to fund courses that do not count towards their degree (Complete College America, 2016).

The study done by Complete College America also found students of color and low-income students are more likely to be enrolled in remedial education and there is a

greater chance that they will be placed in both remedial mathematics and English. The percent of African American students enrolled in both developmental mathematics and English is 40 percent while 59 percent are enrolled in developmental mathematics and 50 percent in developmental English (Complete College America, 2016). The percentage of Hispanic students that enrolled in both developmental mathematics and English is 30 percent, with 54 percent taking developmental mathematics and 37 percent taking developmental English (Complete College America, 2016). The lowest of the three groups sorted by race was White students. Twenty percent were enrolled in both developmental classes with 50 percent taking mathematics and 24 percent taking English (Complete College America, 2016). Of students who received the Pell grant, 32 percent were enrolled in both developmental courses, 60 percent in mathematics and 40 percent in English (Complete College America, 2016). These students, regardless of race and economic status have at a minimum two additional courses they must enroll in, pay for, and complete with a passing grade. (Complete College America, 2016). Information also gathered from the Alliance of States study showed that students of color and low-income students that are enrolled in developmental education course are less likely to complete their sequence of developmental mathematics or English courses. Twenty-three percent of White students passed their sequences within two years of enrolling while 20 percent of Hispanics, and 11 percent of African American passed theirs (Complete College America, 2016). For students who have received financial aid, they represent 19 percent (Complete College America, 2016). Some of these students will be required to complete the full sequence of developmental mathematics or English courses before they can

register and take any college-level courses. This causes frustration, ultimately decreasing the completion and graduation rates (Bailey, 2009; Complete College America, 2016; Deil-Amen & Rosenbaum, 2002).

Data from the 2011-2012 school year for community colleges showed that 56 percent of first-year students enrolled in developmental education courses were female and 50 percent were part-time students (Fernandez et al., 2014; Horn & Radwin, 2014). Over a six-year period, part-time students took as many as three developmental education courses (Horn & Radwin, 2014). Of these part-time college students over the six-year period, only 23 percent completed college-level mathematics courses, which is roughly half the rate of full-time students. While community college enrollment has increased, the degree completion rates remain low due in part to many of the students not starting or not completing their developmental education sequences (MDRC, 2013). The graduation rates of many developmental students are relatively high compared to non-developmental students. Information gathered from the NELS study showed that less than 25 percent of community college students who enrolled in any developmental education courses, complete a degree or obtain a certificate within eight years of enrolling in college, while the percent of students that transfer to a four-year college without having completed a degree is 14 percent (Bailey, 2009). The percentage of students that do not enroll in any developmental education courses and completed a degree or obtained a certificate within eight years of enrolling was forty (Bailey, 2009). Data from Complete College America (2012) showed that 62 percent of two-year college students complete their required remediation courses while 74.4 percent of four-year college students finish theirs (p. 10).

The percentage of college students that take at least one developmental course during their time at a two-year college is 9.5 compared to 13.9 percent that do not take any developmental courses (p. 10). The graduation rate for developmental students at a four-year university is higher than community college developmental students at 35.1 percent (p. 10). Comparing this to a four-year university student that does not take a developmental course, they graduate 55.7 percent of the time (Complete College American, 2012, p. 10).

Graduation rates are far lower than anyone would like them to be. Students that are enrolling in development courses are less likely to graduate then students who do not take developmental courses. Researching the reason what issues could be causing this will require examining the responses from the participants as to what are the challenges students experience in learning mathematics and how do mathematical educators assess their students and determine if they are progressing effectively or struggling.

Characteristics of Developmental Mathematics Students

Developmental mathematics students do not see the importance of learning mathematics and rarely see the connection it has with their future education and career. Developmental mathematics students do not see the connection mathematics has as a stepping-stone for many other areas of academia and the advantages it can have in their personal and career choices. Academically, students who enrolled in developmental mathematics course are vastly different from students who do not enroll in these types of courses (Lesik, 2007). A majority of college students arrive unprepared for college-level classes, which leaves colleges and universities with the task of preparing them for

college-level courses (Bailey, 2009; Boylan, 1999). Colleges and universities address these issues with extensive and costly programs of developmental education, which are designed to strengthen and enhance the skills of students so they can successfully complete in college-level courses (Bailey, 2009; Boylan, 1999). Colleges also incorporate tutoring programs, special advising and counseling programs, and learning labs and centers to help developmental students succeed (Boylan, 1999). This allows students to get the extra attention that they need to succeed at the college level, be it a two-year college or a four-year university.

Students that take developmental mathematics courses have many common characteristics and they fail to understand what it takes to be successful in college. They lack the common intelligence, such as attending class regularly, being prepared for tests and assignments, using course materials to assist in the learning process, and collaborating with their fellow classmates (Lesik, 2007; Merseth, 2011). Many of these developmental mathematics students are grossly underprepared for college (Boylan, 1999). Colleges measure this by using standardized tests, such as the SAT and ACT tests as well as the college's placement tests (Boylan, 1999; Conley, 2007). The scores from these test for the developmental students are usually towards the bottom (Boylan, 1999). Not having strong generalized learning skills, along with poor study skills and time management skills are other characteristics of developmental mathematics students (Ahlering et al., 2002; Boylan, 1999; Merseth, 2011). These developmental students are eager to enroll in college-level course but need additional help to strengthen their learning skills (Ahlering et al., 2002).

Some students are adequately prepared for college-level courses outside of mathematics but lack the ability to master developmental level concepts in mathematics (Ahlering et al., 2002; Boylan, 1999). Most developmental mathematics students do not take a full four years of high school mathematics classes (Benken et al., 2015). These developmental mathematics students may have fallen behind in high school out of disinterest, insufficient effort, flippant, lack of motivation, and no self-confidence. (Ahlering et al., 2002; Boylan, 1999; Boylan & Bonham, 2007; Merseth, 2011). Nontraditional developmental mathematics students were once good at mathematics but have been out of school for so long, they need developmental courses to refresh the basic topics (Bailey & Cho, 2010; Boylan, 1999). Many developmental mathematics students that attend community colleges are fulltime students that often work fulltime jobs (Jones, 2011). Approximately 20 percent of students that attend a four-year college work more than 20 hours per week (Jones, 2011). At community colleges, 60 percent work more than 20 hours per week and 25 percent are working 35 hours or more per week (Jones, 2011). Some students that take developmental mathematics classes are also first-generations college students (Merseth, 2011). These students are not only struggling with developmental mathematics courses, but with life on a college campus and adjusting to life as a student (McCarron & Inkelas, 2006). Some developmental mathematics students have language barriers that create problems with the placement tests, thus resulting in lower scores while other minority students and students from low socioeconomic backgrounds over populate developmental mathematics courses and are less likely to

complete the required sequence of developmental mathematics courses (Attewell et al., 2006; Bailey et al., 2010; Berkner & Choy, 2008).

Possessing a learning disability is another characteristic that many development mathematics students share (Ahlering et al., 2002). Mathematics students with disabilities need modified teaching strategies, special equipment that will help them process the information better, assistive technology, extra attention in class, and extend time to work and finish assignments and tests to help them learn the information better (Kenyon, 2000). Learning Disabilities Association of America (2016) defines a learning disability as neurologically-based processing problems, where these processing problems can interfere with learning basic skills such as reading, writing and/or math and can also interfere with higher level skills such as organization, time planning, abstract reasoning, long or short term memory and attention. According to the Learning Disabilities Association of America (2016), some common learning disabilities include Dyslexia, which affects reading and related language-based processing skills, Dyscalculia, which affects a person's ability to understand numbers and learn math facts, and Dysgraphia, which affects a person's handwriting and fine motor skills. Along with the mentioned learning disabilities, there is also math anxiety. Math anxiety is a feeling of tension, apprehension, mixed emotions, pure anxiety, and the loss of self-confidence that interferes with the manipulation of solving mathematical problems and mathematics performance (Ashcraft, 2002; Curtain-Phillips, 1999; Tobias, 1993). These students need alternant means of instruction to help them succeed at the highest level (Ahlering et al., 2002). The final area of concern for students is when they possess a wide range of

deficiencies in multiple areas. These areas could include poor mathematical ability, underdeveloped learning and organizational skills, and minimal motivation (Ahlering et al., 2002). Students that possess multiple deficiencies in multiple areas will have the greatest difficulty performing at the highest level and transferring to the next sequence of mathematical courses even if the structure, program, and methods of developmental instruction are at their highest.

There is no blue print for a struggling mathematics student. Each student has their own set of factors that inhibit them in learning mathematics. The issue could be poor study skills or not being fully prepared in high school for college and college level courses. These students could have had an inadequate teacher or a diagnosed learning disability. The research should uncover some of the reasons why students struggle with mathematics and how prepared they actually are.

Summary

The review of the literature suggested that many college students lack the mathematical skills that are required to be successful in college-level mathematics courses and the reasons that could affect them. Institutions need to implement plans that will accommodate these students. These college students need to have a clear path to graduation. Complete College America plan of action was to eliminate these no credit remedial course and offer students that need the assistance redesigned first-years courses that contain built-in support and tutoring, along with meeting five days a week instead of three (p. 3). The student would receive tutoring and assistance during the two non-instruction days (p. 3). Research showed that many high school students are not college

ready when they graduate from high school (Camera, 2016). Many students think that college will be similar to high school, but the college atmosphere is very different. These high school students end up being underprepared for a number of college level scenarios. Some of the scenarios are the student/teacher relationship changes, the expectations for engagement, independent work, motivation, and intellectual development, and the fact that this could be the first time the student is on their own as a young adult. There is also a difference between the types of instruction that a college student receives versus a high school student. Some high school graduates think that college courses are similar to courses they took in high school because it has the same title. This is not always the case. College instructors have different expectations for the students versus their high school teachers.

There is research that demonstrates that the student is not the only one at fault when it comes to being successful or not successful in mathematics. The quality of instructor that the student meets and their inability to learn from a condition out of their control, such as a learning disability, are other areas that can affect students' performance. Some college instructors try to cover as much material as possible, which is not always a good thing. This limits students with weak learning abilities. These students do not always benefit from vast amounts of material and they need to be taught in a different way that will benefit their learning style or learning disability.

The review of literature chapter contained the results from searches of literature and information on college readiness, developmental education, and factors affecting developmental mathematics students, which are all major pieces in the progress of this

study. The research design chapter introduced the research design and methodology used in the study, who are the subjects of the study, and confidentiality information for the study. Information on the process of collecting the data, the steps to analyze the data, and how it will be verified is included in the research design chapter.

CHAPTER III

Methodology

This qualitative study focused on the perceptions of mathematics educators on how to improve mathematical skill in high school students. The main purpose was to describe, recognize, and interpret the lived experience that have allowed educators to achieve the best results for their students. This chapter provided detailed information on the qualitative phenomenology research method and the reasoning behind selecting this method to analyze the perceptions of mathematics educators on how to improve mathematical skill in high school students. This chapter discussed the research design, the participants of the study, data collection, data analysis, and validity of the study.

Design

Qualitative research methods are used in a variety of different fields, which include social sciences, natural sciences, market research, and business (Denzin & Lincoln, 2005). Qualitative research is a method that locates the observer in the real world by using assumptions and interpretative frameworks that inform the study of research problems, addressing the meaning individuals or groups ascribe to a problem (Creswell, 2012). Qualitative researchers are interested in understanding the meaning people have constructed, that is, how people make sense of their world and their experiences (Creswell, 2012; Merriam, 2009). Qualitative researchers also study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them (Denzin & Lincoln, 2005). Collecting data in a

natural environment allows the participants to feel more comfortable and less restricted in describing their lived experiences within the phenomenon.

The main goal for this research was to gain a thorough understanding of the perceptions of mathematics educators on how to improve high school mathematical skill. The qualitative approach that was used in this study was phenomenology, which is the study of individuals' perceptions, feelings, and lived experiences (Creswell, 2012; Guest, Namey, & Mitchell, 2013). Creswell (2012) described phenomenological research as research where the researcher is looking for human experiences through the descriptions provided by the participants involved in those experiences. A phenomenology approach was appropriate for this research since the main purpose of the study was to understand the lived experiences of the mathematics educators and their perceptions on the techniques and methods that they believe can improve mathematical skill in high school students.

Qualitative research focused on the lived experiences of its participants in a natural environment and was best suited for this study versus quantitative research, which focused on finding a relationship between variables mathematically and examining the relationship between those variables (Creswell, 2013). Quantitative methods implore mathematics and statistics to formulate a conclusion to data. Therefore, a qualitative design was the optimal method for the study of the perceptions of mathematics educators on how to improve mathematical skill in high school students.

Participants

The population for the current study was mathematics educators that were located in a rural Southwest Minnesota city with medium population. These educators were either college educators or middle and high school teachers. For this study, the researcher chose purposive sampling to select the participants. Purposive sampling is considered the most appropriate for qualitative research as it will help the researcher understand the problem and the research question (Creswell, 2013). Creswell (2012) suggested that 5-25 participants is the optimal sample size for a qualitative phenomenological study, which allows the researcher to have the opportunity for a more detailed examination of the participant's experiences (p. 81). Nine mathematics educators participated in this study. The researcher contacted mathematics educators to gauge their interested in the study by using an invitation through email or by phone. The measures that were used to select the participants for the study were that they must hold at least a bachelor's degree, be a mathematics educator in rural southern Minnesota along with teaching either middle or high school mathematics or teaching developmental mathematics at the college level.

Purposive sampling begins with the researcher creating specific perspectives that they wish to examine and then seeks to find research participants that best match those perspectives (Blackstone, 2012). With purposive sampling, the researcher selects the participants and the sites for study to purposefully provide the researcher with the information they are analyzing (Creswell, 2012). This method provides a better

understanding of the research problem and central phenomenon in the study (Creswell, 2012).

The schools that participated in this study are a selection of middle and high schools in a medium-sized public school district in rural Southwest Minnesota. The seven schools were selected for this qualitative study so that the results of the study can serve as a representation of mathematics educator's perspectives across an entire mid-sized city in the Midwestern United States. The intended participants represent a range of years of experiences teaching, a range of grade levels taught, and a range of class sizes. There are a total of twenty-one mathematics educators that teach in the area at this level. For this study I would like to include at least six mathematics educators from the middle and high school district, with two coming from the middle school and four coming from the high school.

This qualitative study searched out mathematics educators that teach mathematics after high school. These participants teach lower level mathematics at the collegiate level. This study looked at one 2-year college and one 4-year college in rural southern Minnesota that are members of the Minnesota State University System. The 2-year college, which is a comprehensive community and technical college, has four full time faculty and four adjunct faculty members that teach a majority of developmental and entry level mathematics. There are 5,300 students that attend this community college with about 47% of them being full time. For this qualitative study, the researcher would like to include at least three mathematics educators from the 2-year college. The other college institution that participated in this study is amid-sized 4-year college that is also

part of Minnesota State University System. This 4-year college employs twenty-three full time mathematics faculty and I would like to have two of these educators participate in the study.

Informed Consent

The focus for this study was to gather the perceptions of mathematics educators on how to improve mathematical skill in high school students. According to Sarantakos (2005), informed consent contains a set of standard elements that recognizes the protection of the participant's rights during the study. All mathematics educations that agreed to participate in the study were required to sign the informed consent form. The consent form informed the participants of the benefits of taking part in the study, any potential risks from participation in the study, and also verified that participates where 18 years or older at the time of the study. The informed consent form can be found in Appendix A. Before obtaining informed consent from the participants, the researcher contacted participants for the study through email and by phone. The researcher informed the participants about the description of the study, information pertaining to the confidentiality during the research and the role the participants played during the research. Participants were also informed of the time commitment that was needed to gather the research data and where the interview could take place. The researcher let the participant choose the place where they wanted to be interviewed.

During the interview, the participants were again reminded of the purpose of the study, the benefits from participating, any potential risk that might arise, and the right to withdraw from the study without consequence. The researcher also reminded the

participants that their decision to participate in the research is voluntary and that if the participants chose not answer a question or discontinue the study, they would be free to do so. The participants were also informed that if they decided to discontinue the research that their decision would not affect their relationship with the researchers educational institution. The participants were also told about the benefits of this research to society and to other educators. The research gathered can be used to help inform new teachers about key aspects of teaching mathematics or to help the parents of students better understand what is being done to improve mathematical skill. The anonymity of the participants was preserved throughout the entire research process by using pseudonyms. Teacher X was used where X was a whole number starting with one and was assigned to each participant. The participants were also informed that the consent forms would be stored in locked filing cabinet in a secured office at the researcher's education institution. All audio recordings, transcripts, notes, and data analysis documents are stored in the researcher's office and locked in a desk drawer which is only by the researcher.

Data Collection Procedures

The researcher interviewed participants that are experts in the mathematical field, by conducting open-ended individual interviews. This allowed the researcher to focus on the individual experiences, beliefs, and perceptions of these educators. When the interviews were conducted with these local mathematics educators at the middle school, high school, and college levels to identify their perceptions on how to improve high school mathematics skills, the researcher asked these questions.

Interview Questions:

1. How many years of experience do you have teaching mathematics?
2. What is the highest degree that you hold?
3. In your perspective, what are the main challenges students experience in learning mathematics?
4. What are your perceptions on how prepared high school students are for college mathematics?
5. What do you think is the relationship with math anxiety and success in mathematics?
6. What are your thoughts on requiring mathematics for all four years of high school versus three in Minnesota?
7. What do you do in the classroom to challenge your students?
8. What do you do to assess your students?
9. What are your perceptions of a successful mathematics student?
10. What characteristic to you feel define a successful mathematics teacher?
11. What do you do to improve yourself and your instruction?
12. What are your perceptions of the instructional techniques and/or delivery methods that are most effective in your classes?
    a. What methods are not effective?

Instrumentation. When the researcher conducts this qualitative phenomenological study, he used in-depth, semi-structured, face-to-face interview questions with the participants. The researcher met with the participants at a private

location of the participant's choice with a majority of the interviews taking place on the participant's home campus. The interviews lasted between 20 to 60 and were recorded using an audio recorder. From the sample size, the researcher was able to collect the required amount of perceptions on how to improve mathematical skill in high school students from the participants.

Researcher bias. The qualitative study on how to improve mathematical skill in high school students had limitations with respect to researcher bias because the researcher is a mathematics instructor that has taught at both the 2-year school and the 4-year school where some of the participants were selected from. The researcher has fourteen years of experience teaching developmental mathematics at both the community college level and the university level. As a developmental mathematics instructor, the researcher had close interactions with the some of the individuals that participated in the study and may have developed assumptions and attitudes about developmental education. Although measures were taken to assure accurate accountability, data collection, analysis, and interpretation bias might occur and could possibly limit the study's results.

Data Analysis

Data analysis in qualitative research starts by preparing and organizing the data that has been collected, understand what the data is representing, breaking down and organizing the data into groups and themes by using codes, and finally summarizing what has been discovered (Creswell, 2012). When researchers perform phenomenological analysis, it requires them to approach the transcripts with an open mind, seeking what meaning and structures emerge (Rossman & Rallis, 2016). At the conclusion of the

interviews, the researcher gathered, organized, and prepared the data for analysis. The researcher transcribed the audio files from the interviews along with any field notes that were used. The researcher read and reread the text and to capture what the participants perceptions revealed. This allowed the researcher to find any common themes that were represented throughout the group. After the analysis of the texts, the researcher started the coding process. Forming codes in qualitative research represents the heart of the analysis of the data (Creswell, 2012). During the coding process, the researcher created detailed descriptions, developed themes, and provided an interpretation in light of his own views.

Summary

The research design chapter outlined the research method, the design of the study, how the data was collected, and how it was analyzed along with the reasoning for choosing a qualitative method and a phenomenological design for the study. The current study was conducted with a qualitative phenomenological approach, using the human experiences through the descriptions provided by the mathematical educators in rural southern Minnesota that are involved in those experiences. Participants were selected from schools in rural southern Minnesota, data was collected using in-depth, semi-structured, face-to-face interviews that are recorded with an audio recording device and were transcribed word for word. After the interviews ended the researcher coded the transcripts, by creating detailed descriptions and themes. The next chapter contains the analysis of the data collected from the interview process along with the results of the study.

CHAPTER IV

Findings: Interpretations and Themes

This qualitative study of the perceptions of mathematics educators on how to improve mathematical skill in high school students was conducted to collect, describe, recognize, and interpret the lived experience that have allowed mathematics educators to achieve the best results for their students. The interview questions allowed the mathematics educators to recount their lived experiences on how they improve mathematical skill in high school students and the techniques and methods they have used. The main research question, "What are the perceptions of rural mathematics educators on how to improve high school mathematical skills in high school students, was used as the foundation for the interview questions that were presented to the participants?" This chapter summarized the findings and the results of the qualitative study and included the data collections process, the research questions used, information about the participants, data analysis, and the summary of the findings.

Data Collection Process

To collect the data for the study, the researcher conducted nine individual, in-depth, semi-structured interviews with mathematics educators. The face-to-face interviews took place over a three-week period. The length of the interviews 20 to 60 minutes each, depending on each participates responses and how in-depth they were with their answers. The semi-structured interviews were recorded using an audio recording device and transcribed verbatim by the researcher to ensure accuracy. Using semi-structured interviews allowed the researcher to address specific issues during the

interview process and allowed the researcher to gather additional information from the participant if needed.

The participants for the interviews were given the option to choose the location for the interviews. The researcher met the participants at their schools and the face-to-face interviews were conducted in the participant's classrooms or offices. This allowed for a more comfortable environment for the participants and allowed them to relax more for the interview. After the researcher introduced himself to the participants, the researcher engaged participants in casual conversation using the interview questions. The researcher's goal during the interview process was to keep the interview as relaxing and comfortable as possible for the participants. Before any questions pertaining to the study were asked, the researcher presented the informed consent form to the participants and had them read and sign the form. Following the signing of the informed consent, the participants were given a copy of the interview questions that were going to be asked. This allowed the participant an opportunity to see the interview questions that were going to be asked during the interview and let them gather their thoughts allowing them to reread the questions as the interview took place.

After the participants had time to review the interview questions, the researcher read the interview protocol form for the study. This document informed the participants that they were going to be asked questions pertaining to the general research question: The perceptions of mathematics educators on how to improve mathematical skill in high school students and that they had the option to decline responding to any of the questions.

The interview protocol form also informed the participants that they could withdraw from the study at any time without any negative consequences.

When the researcher finished with the interview protocol form, the researcher asked if the participants were ready to start the interview. The interview started with a question about their educational background and how much experience they had teaching as a mathematics educator. This question served multiple purposes. The question allowed the researcher to gain an understating on the demographics of the participants and allowed the participants to answer in order to gain confidence in the interview. During the rest of the interview, the interview questions focused on fielding the perceptions on topics that revolved around improving mathematical skill in high school students.

Participants Demographic Information

The participant pool contained a wide variety of mathematics educators. To select the participants for the study, the researcher used purposive sampling to select the participants. The participant pool consisted of one 4-year college professor, one 2-year college instructor, two middle school teachers, and five high school teachers; three from traditional high schools and two from charter/non-traditional high schools. Of the nine participants, three were female and six where male. Education of the participants ranged from Bachelor's degree in Mathematics to a PhD in Mathematics. One educator held a PhD in Mathematics, three held Masters in Mathematics Education, one educator had obtained a Maters in Mathematics, two educators held a Bachelors in Mathematics and one educator held a Bachelors in Mathematics Education. One educator had a Masters in

Special Education. All of the educators had ample amounts of teaching experience. The least experienced educator had fourteen years of experience while the most experienced educator has been teaching for forty years. The mean number of years of teaching experience for the participants was 24.89 years. The median was 24 years with a range of 26 years of teaching experience.

Research Questions

The reason behind the study was to dig deeper and uncover the perceptions, techniques, and methods mathematics educators use to better prepare high school students for college level mathematics. The questions that were used to probe the main research question were as follows.

Interview Questions:

1. How many years of experience do you have teaching mathematics?
2. What is the highest degree that you hold?
3. In your perspective, what are the main challenges students experience in learning mathematics?
4. What are your perceptions on how prepared high school students are for college mathematics?
5. What do you think is the relationship with math anxiety and success in mathematics?
6. What are your thoughts on requiring mathematics for all four years of high school versus three in Minnesota?
7. What do you do in the classroom to challenge your students?

8. What do you do to assess your students?
9. What are your perceptions of a successful mathematics student?
10. What characteristic to you feel define a successful mathematics teacher?
11. What do you do to improve yourself and your instruction?
12. What are your perceptions of the instructional techniques and/or delivery methods that are most effective in your classes?
    a. What methods are not effective?

The researcher gained valuable information from the participants during the interview process. The interviews were in-depth and semi-structured, which allowed the participants to freely and openly describe their experiences in teaching mathematics.

Data Analysis

This research study used the method of phenomenology to gather data on the lived experiences of mathematics education and their perceptions on how to improve mathematical skill in high school students. The researcher used themes to categorize and organize the lived experiences of the educators. According to Creswell (2012), themes in qualitative research is information that consists of statements, that when combined together, form meaning and show the experiences that occurred within the research. To obtain these themes from the data the researcher, multiple steps were taken.

First the researcher listened to the audio recordings multiple times before transcribing the interviews verbatim. These transcriptions where typed using a word document program on the researchers computer and stored in a file on the researcher's computer. The researcher decided to use manual data analysis software to obtain a more

personal experience with the data and to be able to fully understand what the participants were saying during the interview. Notes that were taken during the interviews were added to the transcriptions in their suitable location during the interview. Accuracy of the transcriptions was done by the researcher after all notes and audio recorded interviews were finished by rereading and listening to all notes and recordings.

Next, the researcher color coded each participant's answers to the interview questions and compiled them together in a word document file. Each participant's answers were organized underneath the appropriate questions. The researcher then proceeded to the first question and started to analyze the data that was discovered. The researcher read through the answers to the first question that pertained to the research question and started to search out any common statements or experiences. These common statements were recorded on the word document in the margins. After reading through the first question multiple times and making sure that all common statements and experiences where recorded, the researcher then tallied the number of times a statement or experience occurred and recorded it right below the question on the word document. The steps that were described for question one continued throughout the remainder of the data analysis process with the researcher evaluating each individual question and gathering the common statements that occurred.

Once the process of gathering and organizing the common statements was finished, the researcher analyzed the statements for each individual question to find any common themes that occurred during the interview process. The researcher grouped together common statements made by the participants for each question and created

themes for each question. Using the themes that were discovered, the researcher recreated the perception of the mathematics educators on how to improve mathematical skill in high school students. The researcher examined the transcripts, notes, and themes to ensure that the accuracy of the lived experiences of the participants was correct. All nine mathematics educators were given pseudonyms, i.e.,: Teacher One, Teacher Two and so on, to protect their privacy and ensure confidentiality throughout the study.

Research Findings

The interviews conducted consisted of twelve research questions. The first two questions gave the researcher information about the experience and education of the participant. The next seven questions focused on how educators proceed in improving mathematical skill in high school students. The last three questions centered on what the mathematics educators do to improve their instruction and characteristics of a successful educator. Many themes emerged from the interviews with the mathematics educators and those were reported as their perceptions on how to improve mathematical skill in high school students. Quotations from the interviews are included to support the themes that were found.

Question 1: How many years of experience do you have teaching mathematics?

The nine mathematics educators that participated in the study all have vast amounts of teaching experience. The least experienced educator in terms of number of years teaching was fourteen and the most experienced was forty. The mean number of years of teaching experience was 24.89 years. The median was 24 years with a range of 26 years. Most of the educators have been teaching in their respective areas for their entire careers

with the exception of Teacher Nine. Teacher Nine had forty years of teaching experience, with thirty years at the high school level and ten years at the college level. Table 1 outlines the teaching experience of each of the participants.

Table 1

Participants Teaching Experience Data

Teacher	Experience (Years)
One	19
Two	24
Three	35
Four	14
Five	27
Six	23
Seven	24
Eight	18
Nine	40

Question 2: What is the highest degree that you hold?

To select the participants for the study, purposive sampling was used. To be qualified for this study educators had to possess at least a bachelor's degree, be a mathematics educator in rural southern Minnesota and be teaching either middle or high school mathematics or teaching developmental mathematics at the college level.

Table 2

Participants Educational Background Data

Teacher	Gender	Education	Educational Institution
One	Female	PHD in Mathematics	4-year College
Two	Female	Bachelors in Mathematics	Alternative High School
Three	Male	Masters in Mathematics Education	High School
Four	Male	Masters in Special Education	Charter School
Five	Male	Bachelors in Mathematics Education	High School
Six	Male	Bachelors in Mathematics	Middle School
Seven	Male	Masters in Mathematics Education	High School
Eight	Male	Masters in Mathematics Education	Middle School
Nine	Female	Masters in Mathematics	2-year College

The next seven questions were used to help the researcher gather the perceptions of mathematics educators on how to improve mathematical skill and what obstacles middle and high school students' face as they journey through mathematics.

Question 3: In your perspective, what are the main challenges students experience in learning mathematics?

Four themes emerged from question three. The first theme was that most students lack basic mathematical skills. The second theme was students have no confidence in becoming a better mathematics student. Theme three was that students put little effort into their homework. Theme four unstable home/family life. Teachers One, Two, Three, Four, Five, and Eight made statements that supported theme one. Teachers Two, Seven,

and Nine made statements regarding theme two. Teachers Three, Five, and Seven all mentioned statements that support theme three. Theme four was backed by Teachers Two, Four, and Five.

Here are statements that support theme one:

Teacher One: "Students do not know how to start working on their homework problems and have trouble formulating a plan of action."

Teacher Two: "One challenge is that students lack the basic skill they need to succeed."

Teacher Three: "Students do not practice their skills enough anymore and do not do the math. They just watch others do the math and are looking for the short cuts and the easy ways out."

Teacher Four: "Lack of ability and skills to think logically make it difficult for students.

Teacher Five: "Students are just out to find the answers quickly."

Teacher Eight: "Students lack the basic skills, such as adding and subtracting of integers."

Here are statements that support theme two:

Teacher Two: "Because the student lacks the basic skill, then the student will lack the confidence to be successful."

Teacher Seven: "If the student does not see success, then they believe that they cannot be good at math."

Teacher Nine: "Students come to a math class assuming they will not understand the material or just not like the subject."

Here are statements that support theme three:

Teacher Three: "Students are just looking for the short cuts and the easy ways in doing mathematics."

Teacher Five: "Students just want to find the quick answers."

Teacher Seven: "Students just want the answers and do not want to take the time to learn and think about the problems."

Here are statements that support theme four:

Teacher Two: "Home life can be a challenging thing for most of my students. They get home and no one is there to help them through their homework."

Teacher Four: "Education is not a priority in some of my student's household."

Teacher Five: "When some students go home, school is the last thing on their mind and they lack the supervision to finish their homework."

Question 4: What are your perceptions on how prepared high school students are for college mathematics?

The theme that emerged here was that most high school students are not prepared for college mathematics. Teachers One, Four, Seven, and Nine all stated that regardless of what the students' future holds, they are not ready for college mathematics, which supports the theme. Teachers Two, Three, Five and Six claimed that if the student is going to college then they are ready for college mathematics because they are taking the required mathematics classes that will place them into college level mathematics and if they are not planning on attending college then they would not be ready for college

mathematics because the students have not put in the time dedicated to learning mathematics that will prepare them for college.

Here are statements that support the theme:

Teacher One: "Most students that are going to college need to be better prepared." "Students need to be able to speak more mathematically and this will help when they are seeking assistant from teachers and peers."

Teacher Two: "Students that know they are going to college seem to be prepared because they are taking all the required math that they need." "If the students are not college ready, then they are usually not prepared to take college level math."

Teacher Three: "The best students are the best they have ever been and the worst students are the worst they have been." "Some students are prepared to go right into Calculus 2 in college and others should not be admitted to college, because they are not ready." "Colleges need to be more selective in who they admit to college. Some students are not meant to go to college." "High schools need to offer more career orientated classes like health occupation and shop and auto classes, more technically career classes."

Teacher Four: "High school students are unprepared. Students that are high risk in school have a higher chance of not being prepared for college level math based on their background and their previous experiences in math classes." "Students are unprepared. There is no motivation and desire to learn."

Teacher Five: "If students are interested in college and are not taking mathematics classes as a senior then they are not ready."

Teacher Six: “There are a large group of students that are not ready for college because they are not motivated enough to learn and take the more challenging classes.”

Teacher Seven: “Unprepared. Not every student is taking advantage of the ability to take as much math as they can. Students either like math or they hate math, there is no middle ground. Students always look to see what they need to do to be finished with math, not what they need to go on.”

Teacher Nine: “There are not a lot of high school students that are prepared to do college math.”

Question 5: What do you think is the relationship with math anxiety and success in mathematics?

The theme that emerged from question five was there is a relationship between math anxiety and success in mathematics. All but one teacher believe there is a negative relationship between math anxiety and success in mathematics. Teachers Two, Three, Four, Five, Six, Seven, Eight, and Nine all stated that if anxiety exists, then the chances the student will succeed will be less than if the anxiety was non-existent.

Here are statements that support the theme:

Teacher Two: “There is a huge relationship between anxiety and success.” “My students did not have confidence before they enrolled at the alternative high school and now that they are in a different environment, which is a smaller setting, they are now building that confidence and getting over their math anxiety.”

Teacher Three: “If there is math anxiety, then it is coming from the fact that the student is not interested in mathematics.”

Teacher Four: “Anxiety is a big concern at the charter school and the way students have been taught at a young age can aid in developing anxiety.” “Students are surrounded by things that make them anxious. Timed assignments and pressure to meet deadlines. Other anxiety comes from the fact that math requires focus and logical organization, and some students just do not possess these qualities.”

Teacher Five: “Students are pressured and they psych themselves out on math tests and assessments.”

Teacher Six: “Students self-label themselves. If they do not do well on a math test, then they feel they cannot do it in the future. They also think that if they are not the best at math, then they are not going to be good at it at all.”

Teacher Seven: “Any time a student is anxious and you can get them to relax, then they will perform better.” “Students are afraid to make mistakes and as educators we need to let them know that it is ok to make mistakes.”

Teacher Eight: “As students get older and do not have the basic math skills, they take longer to answer their problems and become more anxious because of it.”

Teacher Nine: “Math anxiety is a huge barrier to success in math.”

Here are statements that do not support the theme:

Teacher One: “Students that do not have math anxiety might have to high of a confidence level, which could result in lower scores.” “Pressure to be the best at mathematics can cause lower scores.” ”Students go into the classroom thinking they will succeed and know all the material, but in the end know very little.” “Math anxiety does not always effect student success.”

Question 6: What are your thoughts on requiring mathematics for all four years of high school versus three in Minnesota?

The Minnesota Department of Education (n.d.) states that high school students should take three credits (years) of mathematics. This includes algebra, geometry, and statistics and probability. Students in the graduating class of 2015 and beyond must complete an algebra II credit or its equivalent as part of the three credit requirement. In addition to the high school credits, students in the graduating class of 2015 and beyond must also complete an algebra credit by the end of eighth grade.

The theme that emerged was students should take as much math that is required for what they decide to do in the future. Teachers Two, Three, Four, Five, Six, Seven, Eight, and Nine all agreed that students should take four years of mathematics classes as long as they meet the student's needs.

Here are statements that support the theme:

Teacher Two: "There is a disservice to students when all they are required to take is high level mathematics." "Schools need to modify the courses that are required for graduation based on what the student's future is, college or not." "Graduation requirements are geared towards students that are going to college and not the students going into the workforce."

Teacher Three: "Two should be required." Math after geometry should be optional and if the students decides to take more than they have the option." "People think that if we have more people doing math, then we will have more people wanting to be scientists and engineers. Wrong! Less people in mathematics will produce more people in the STEM

fields. The quality of student will be better if most of the class cares about mathematics." "Let the school dictate the classes that need to be taken. Algebra in 9th grade and geometry in the 10th grade."

Teacher Four: "Not every students needs to be taking pre-calculus and if the fourth year is a course that applies to the career ready student then yes, it is a good idea." "Tailor the course to the student."

Teacher Five: "If the student will be attending college right out of high school then the student should be taking four years of mathematics, it would be a disadvantage for the student to skip one year of math." "Not every student needs to take math classes past their second year, which in Minnesota is geometry." "Not all students need algebra 2, not all jobs require algebra 2 skills."

Teacher Six: "Schools need to be offering mathematics courses that focus on more practical ideas for students that are not interested in attending college." "If students are exposed to real life math and how it works in society, they seem more engaged and are willing to take more math."

Teacher Seven: "There should be four years of math, but there needs to be a different path for students to reach four years." "No one has ever been damaged by doing more math, it just needs to be the right math for that particular student."

Teacher Eight: "I feel that students would benefit from four years of high school math."

Teacher Nine: "The selected courses should be carefully chosen in content and age appropriateness with brain development taken into account."

Here are statements that do not support the theme:

Teacher One: “Three or four years of mathematics does not matter for student’s achievement.” “The most important thing is how the students were taught and how they approach mathematics.” “It’s not about the number of math classes they take, it’s about the quality of education and instruction they receive.”

Question 7: What do you do in the classroom to challenge your students?

The first theme was that the teachers give their students problems that are more challenging that traditional material. The second theme that was present was getting the students to communicate with each other about mathematics. The last theme was requiring the students to think for themselves. Teachers Three, Four, Five, Seven, Eight, and Nine all made statements that support the first theme. Teacher One, Three, Six, and Seven made statements that support theme two**.** Teachers Two, Three, Four, Five, and Six all made statements that support the third theme. They all follow the curriculum that they are required to use, but just choose more challenging problems.

Here are statements that support theme one:

Teacher Three: “The curriculum at our school is already challenging for some students and I give them more challenging problems to advance their thinking.”

Teacher Four: “Coming to school is a challenge enough for these students and that they have inconsistent gaps in their knowledge from previous instruction, ADHD, learning disabilities, and depression.” “Hands on and intellectual engaging assignments that help relate math to the real world.”

Teacher Five: “I use application problems that allow the student to think and process the information differently than on routine problems.”

Teacher Seven: “I use challenging problems, like word and story problems.”

Teacher Eight: “I will make up challenging homework problems or search the internet for material that is challenging.”

Teacher Nine: “I try to challenge their skills by incorporating new material with where they are still wise.”

Here are statements that support theme two:

Teacher One: “I encourage the students to communicate with each other when I present them with problems. I then give them time to work on these problems in class together.”

Teacher Three: “I engage my class in large group conversation by asking open-ended questions about the material.”

Teacher Six: “I encourage interaction within the classroom by presenting the students with open-ended questions and letting them work together to find the solution.”

Teacher Seven: “I make sure that the work the students do is genuine and I allow them time in class to work together and to hone their skills.” “When students start talking about math and are able to help each other out, they are starting to know they understand the concepts.”

Here are statements that support theme three:

Teacher Two: “I try to get students to think on their own. This allows them to understand the mathematical concepts that they need.” “I present my students material that will allow them to think about the processes and how to come up with the next step.”

Teachers Three: “I try to give my students harder than normal problems, creating more active thinking.”

Teacher Four: “I try to find hands on and intellectual engaging assignments that help them relate math to the real world. This helps them get into active thinking and helps them articulate their thinking so that math feels authentic to them. Something they want to be part of.”

Teacher Five: “I try to introduce assignments that allow the student to think and process the information differently from normal problems. Things like projects.”

Teacher Six: “I give the students open-ended questions and then let them experiment with different tools to find the solutions like technology and their peers.”

Question 8: What do you do to assess your students?

The two themes that emerged from question eight were summative assessment and formative assessment. All teachers, except for Teacher Two, made statements that support the first theme, summative assessment. All nine teachers gave testimonials that support the second theme, formative assessment.

Here are statements that support theme one:

Teacher One: “I use homework, tests, midterm exams, and final exams.”

Teacher Three: “Completion points for homework and tests.” “Only way some students will do something is if it’s worth points.”

Teacher Four: “Daily practice homework and chapter tests.”

Teacher Five: “I use homework, tests, and a final.”

Teacher Six: “Traditional paper tests and standardized tests.”

Teacher Seven: “Homework, quizzes, and tests.”

Teacher Eight: “We take chapter tests and quizzes.”

Teacher Nine: “Paper tests and homework.”

Here are statements that support theme two:

Teacher One: “I use true and false statements during lecture when I present the class with material.” “Group work is another way to assess students.”

Teacher Two: “I encourage my students to have conversation with each other about math. I walk around and listen to them and observe how they are working together.” “Class activities and projects.”

Teacher Three: “In-class discussion.”

Teacher Four: “I use a method called “Fist to Five”. This is a system that allows the students to hold up their fingers and give the teacher an idea on how well they understand the material.” “I have my students use a math journal where they can record topics that they did not understand.”

Teacher Five: “Students need to master the assignment before they can move on. This allows the student to see what they need to work on and what they are good at.”

Teacher Six: “I promote recall. I make sure the students can recall methods from previous days or weeks and be able to do that in the class on the spot.”

Teacher Seven: “I use a lot of open dialogue and asking them what they think. I ask them how they solved the problem and if there is another way.”

Teacher Eight: “I formatively assess as I’m teaching a lesson by walking around the room as they work on a topic we just covered.”

Teacher Nine: “I use in class conversation.”

Question 9: What are your perceptions of a successful mathematics student?

Theme one was students need to be hard working and motivated. The second theme that emerged was that students need to be able to take ownership on the learning. The third theme that was present was that a successful student should be confident. The fourth theme was that students should be able to recall previous information and be able to apply that to what they are working on in the present. The fifth theme that was present was students should be curious. Teachers Two, Three, Seven, Eight, and Nine all made statements regarding theme one. Teachers One, Three, Four, Seven, and Eight made comments that support theme two. Statements for theme three came from Teachers Two and Five. Teachers One, Five, Six, and Seven all made statements that support theme four. Teachers Three, Seven, and Nine all produced statement that backed theme five.

Here are statements that support theme one:

Teachers Two: “A successful student is one that will not shut down and quit.”

Teacher Three: “A successful mathematics student is one that will be here and do the work.”

Teachers Seven: “Hard working students are students that will try again after they fail.”

Teacher Eight: “A student that is motivated to learn every day, regardless of their ability is successful.”

Teacher Nine: “A successful mathematics student doesn’t give up easily.”

Here are statements that support theme two:

Teacher One: “If the student fully depends on teachers, peers or tutors for their learning, then they will not be that successful.”

Teacher Three: “Students that are excited about their own mathematical growth.”

Teacher Four: “A student that has shown growth and they realize that they finally need mathematics.”

Teacher Seven: “Students that are willing to be wrong and be ok with it. They will then take the time and figure out why they were wrong and adjust.”

Teacher Eight: “Low ability students should want to do their best. High ability students should not be happy with what they already know and should be striving to challenge themselves each day.”

Here are statements that support theme three:

Teacher Two: “If the student can work on math on their own and they can see that they are getting parts of the problem correct, then they will start to build the confidence that will help them succeed in the future.”

Teacher Five: “A successful mathematics student is confident and not afraid to make mistakes.”

Here are statements that support theme four:

Teacher One: “If students know how to correctly communicate mathematically with each other, then that makes assisting peers easier for both parties.”

Teacher Five: “A successful student should be able to explain what they have learned and be able to teach it to a peer correctly.”

Teacher Six: “A student that is able to recall what they learned and apply it. When they are given a problem from the past, they are able to reason and question their way through the problem versus just repeating a process they have seen before.”

Teacher Seven: “Students that can demonstrate mastery and recall.”

Here are statements that support theme five:

Teacher Three: “Successful students need to ask questions and be curious about mathematics.”

Teacher Seven: “Students that also show curiosity and a desire to learn.”

Teacher Nine: “Successful students are curious to know the problem solving techniques necessary to reach the goal of finding the solution and are not interested in just an answer.”

The next three questions focused on what the mathematics educators do to improve their instruction and themselves and the characteristics of a successful educator.

Question 10: What characteristic do you feel define a successful mathematics teacher?

Theme one that emerged was that teachers should care about their students and their well-being in the class. Theme two was teachers must possess multiple ways of instruction. Theme three was teachers should build confidence in their students. Theme four was that teachers should be math knowledgeable and theme five was that they should be personable. Teachers One, Two, Three, Five, Seven, and Nine all made statements regarding theme one. Teachers One, Six, Eight, and Nine all produced statements that support theme two. Teachers Two, Four, Six, and Nine all made statements that support theme three. Teachers One, Three, Seven, Eight, and Nine agreed

with theme four. Statements made by Teachers Four, Five, Six, and Seven all support theme five.

Here are statements that support theme one:

Teacher One: "Someone that cares about their students."

Teacher Two: "Teacher that cares about them and gives encouragement."

Teacher Three: "Someone that cares about the students and the content."

Teacher Five: "A successful teacher is one that gives back to the school and the students."

Teacher Seven: "As an educator, you want the best for your students."

Teacher Nine: "Teachers need to be willing to listen to students and let them explain to you their methods of solving math problems, especially if they do not coincide with the manner the teacher has chosen to show."

Here are statements that support theme two:

Teacher One: "A successful teacher tries to explain in multiple ways either by using a different method or a form of technology."

Teacher Six: "A teacher that can meet the students on their level can create a meaningful experience for the class."

Teacher Eight: "I try to explain how to do our problems in multiple ways."

Teacher Nine: "Be willing to listen to students and let them explain to you their methods of solving math problems, especially if they do not coincide with the manner you have chosen to solve."

Here are statements that support theme three:

Teacher Two: “A successful teacher is one that build confidence back into the students.”

Teacher Four: “Getting students to think on their own, so they have the confidence to tackle math outside that classroom is very important.”

Teacher Six: “A successful math teacher has the ability to change the perspective of students that math is hard.”

Teacher Nine: “Students will be more willing to fill in the gaps and complete the entire solution process successfully when their confidence is higher.”

Here are statements that support theme four:

Teacher One: “Someone that is a very experienced math teacher.”

Teacher Three: “Be knowledgeable.”

Teacher Seven: “Teachers need to be math knowledgeable.” “Teachers should experience higher level mathematics classes along with what is required for their teaching degrees in college.”

Teacher Eight: “I try to detect and teach about the common misunderstanding of topics before the students get to that point.”

Teacher Nine: “Teachers need to love their profession and have passion for their subject matter.”

Here are statements that support theme five:

Teacher Four: “I will produce a comfortable environment by creating professional relationships with my students, which helps build confidence and create more motivation.”

Teachers Five: “Engage in professional relationships with students.”

Teacher Six: “I incorporate enthusiasm, humor, and show the students that I enjoy teaching mathematics.”

Teacher Seven: “Teachers need to able to have fun in class and build the professional relationship that will make the students feel positive and build confidence.”

Question 11: What do you do to improve yourself and your instruction?

The themes that were found where feedback from colleagues, attending conferences, and by acquiring addition education. All the teachers except for Teachers Two and Seven made statements regarding first theme. Teachers Three, Five, Six, and Seven made comments that reinforces theme two. Teacher Five and Seven made statement regarding theme three.

Here are statements that support theme one:

Teacher One: “I will have colleagues sit in on my lecture and I use feedback from them to adjust my teaching style and lesson plans.” “I use feedback from my students and the teaching assistances that help with my instruction.”

Teacher Three: “Seeking out information from colleagues is crucial for self-improvement.”

Teacher Four: “Collaborate with my colleagues and ask questions.”

Teacher Five: “I speak with colleagues to update my teaching methods and to adapt to the changing student and world.”

Teacher Six: “Collaboration with other teachers.”

Teacher Eight: “I will regularly ask colleagues what they are doing differently to be able to improve my instruction.”

Teacher Nine: “I keep communication active between myself and other professors that I admire.” “I also keep the communication lines open between myself and my students.”

Here are statements that support theme two:

Teacher Three: “I will attend conferences for teachers that teach advance placement classes at the high school level.” “I work closely with training through AVID, which is training for K-12 and higher education educators which educates them on research based strategies and curriculum that develop students’ critical thinking, literacy, and math skills which is a program that prepares students for college and careers.”

Teacher Five: “I try to learn new technology that I can use in the classroom.”

Teacher Six: “I use my training that I have attained through AVID and other conferences that are available.” “Perfecting and understanding inquiry based learning and learning new technology is always beneficial.”

Teacher Seven: “I exposing myself to different types of math instruction and learn about the online programs that can help students further their learning.”

Here are statements that support theme three:

Teacher Five: “I have taken multiple graduate level mathematics classes and then incorporate what I have learned in those classes into my teaching.”

Teacher Seven: “I am a big believer of furthering your education.”

Question 12: What are your perceptions of the instructional techniques and/or delivery methods that are most effective in your classes? What method were not effective?

Theme one was that lecture and the traditional classroom were effective. Theme two was that group work is effective. Theme three was having students work on homework in the class. Theme four was using technology in and outside the classroom. Teachers One, Two, Three, Four, Five, Eight and Nine made statements towards theme one. Theme two had statements made by Teachers One, Three, Five, Six, and Seven. Teachers Three, Seven, and Eight all gave statements regarding theme three and Teachers Three, Five, Seven, and Nine gave statements that pertained to theme four.

Here are statements that support theme one:

Teacher One: "The most effective is teaching in front of the class using the board." "The traditional classroom."

Teachers Two: "Lecture and traditional instruction can be effective."

Teacher Three: "Lecture can be beneficial to the students." "Having students take notes using the Cornell note taking system."

Teacher Five: "Lecture can be effective."

Teacher Nine: "My students like to see examples worked out step by step with plenty of explanation and question answering."

Here are statements that do not support theme one:

Teacher Four: "We need to get information to the students in a different way, so they can process it more effectively."

Teacher Eight: “It is not the best method for 8th grades, since their attention span can be limited at times.”

Here are statements that support theme two:

Teachers One: “I use a method called pair and share, where two students work together on problems for 20 minutes and come up with the solutions to the problems together.”

Teacher Three: “I like using group work.”

Teacher Five: “Small groups and partners always seem to give me good results.”

Teacher Six: “I work at getting my students to communicate with each other in the classroom or in their group.”

Teacher Seven: “Let students work in groups and partners.”

Here are statements that support theme three:

Teacher Three: “Letting students work on homework in class gives them the opportunity to get help immediately.”

Teacher Seven: “I introduce material and then I give students time to practice and work on their problems.”

Teacher Eight: “I offer flexibility in selecting which practice problems students work on during the class period.”

Here are statements that support theme four:

Teacher Five: “Technology gives the students another opportunity to succeed.”

Teacher Seven: “I use online learning tools, such as web-based graphing calculators and homework programs.”

Here are statements that do not support theme four:

Teacher Three: “We once used a method called Flip the Classroom. Students would watch the lecture at home through videos and then do the homework at school. It never worked because the students never watched the videos.”

Teacher Nine: “My students are not generally accepting of work done on the computer. They like and appreciate the personal touch.”

Summary

The purpose of the qualitative study of the perceptions of mathematics educators on how to improve mathematical skill in high school students was conducted to collect, describe, recognize, and interpret the lived experience that mathematics educators have used to best improve student achievement. The research questions formed allowed the mathematics educators to recount their lived experiences on how they improve mathematical skill in high school students and the techniques and methods they have used. The main research question that was used as a foundation for the interviews was: What are the perceptions of rural mathematics educators on how to improve high school mathematical skills in high school students?

The data that was collected for the research was obtained using individual, in-depth, semi-structured interviews with mathematics educators. The interviews were recorded using an audio recording device and transcribed verbatim by the researcher using a word document program. The transcriptions were then analyzed and many themes were uncovered for each question on how to improve mathematical skill in high school students. Chapter 5 presents a summary of the findings and the interpretations

along with the conclusion of the study, any limitations that are present, and the researcher's recommendations.

CHAPTER V

Discussion

The purpose of this research on the perceptions of mathematics educators was to collect, describe, recognize, and interpret the lived experience that have allowed mathematics educators to achieve the best results for their students. The participants for this phenomenological study were selected because they met the criteria for the study. To collect the data, the researcher interviewed nine mathematical educators.

A phenomenological approach was used to understand the perceptions and lived experiences of the mathematics educators by recognizing common themes and ideas. Qualitative research uses methods that locate the observer in the real world by using assumptions and interpretative frameworks that inform the study of research problems addressing the meaning individuals or groups ascribe to a problem (Creswell, 2012). The researcher's goal was to better understand the methods and techniques that educators use to improve mathematical skill in high school students.

Chapter 5 will provide interpretations of the major findings and conclusions based on the research. The study's limitations, researcher's recommendations will follow this discussion and the concluding thoughts will end the chapter.

Research Questions

The main research question that was used to lead the research was: What are the perceptions of rural mathematics educators on how to improve high school mathematical skills in high school students? The sub questions that were used to uncover these perceptions are:

Interview Questions:

1. How many years of experience do you have teaching mathematics?
2. What is the highest degree that you hold?
3. In your perspective, what are the main challenges students experience in learning mathematics?
4. What are your perceptions on how prepared high school students are for college mathematics?
5. What do you think is the relationship with math anxiety and success in mathematics?
6. What are your thoughts on requiring mathematics for all four years of high school versus three in Minnesota?
7. What do you do in the classroom to challenge your students?
8. What do you do to assess your students?
9. What are your perceptions of a successful mathematics student?
10. What characteristic to you feel define a successful mathematics teacher?
11. What do you do to improve yourself and your instruction?
12. What are your perceptions of the instructional techniques and/or delivery methods that are most effective in your classes?
    a. What methods are not effective?

Explanation of Findings

Understanding the lived experiences of mathematics educators required the researcher to probe the educators on their beliefs on topics that relate to mathematics

education. This section will describe the meanings of the most important themes that were formed throughout the research.

The first major finding from the research was that students lack the basic mathematical skills that allow them to be successful in mathematics, have little to no confidence, and do not spend quality time working on homework. According to the research, six out of the nine indicated that students lack the basic skills to be successful in there mathematics classes. Anecdotal evidence from my own teaching since 2006 at the 2 and 4-year schools, suggests that most students struggle in developmental math courses and do not understand or possess the basic skills to be successful. Most of these students are coming from high school and cannot enroll in college level mathematics because their placement scores where to low. They are being placed into developmental courses. Developmental mathematics courses help pinpoint and strengthen the students' deficiencies and help build up their skill level (Ahlering et al., 2002). Teacher One teaches developmental mathematics to college students at a 4-year college and she sees first hand that high school students are lacking mathematical skills. "Getting students to start the problem correctly is difficult because they are missing the basic skills that are required to read and write math correctly." Students struggle to understand key terms like, solve, simplify, and evaluate. "Students do not know how to learn and are coddled by teachers", stated Teacher Five. Most students are interested in finishing their homework as quick as possible. They are just going through the motions and not practicing what they need to learn to become successful at higher-level mathematics.

When students do not put in the time that it takes to learn the basic skills required, their confidence drops. Students are not willing to participate in discussion or ask questions because of low confidence. They know that they do not understand the material and since their skill level is low, fail to ask questions. Some students go into math classes telling themselves that they were not successful before so why would they be successful now. This is very common for developmental students. All they have known is that they are not good at math. They are setting themselves up for failure before the syllabus is handed out. Teachers need to approach this type of student differently and build their self-confidence. Successful developmental educators have the ability to relate to students by making learning easier and show them that math can be fun. The first thing Teacher Nine does to build confidence is to show them how much fun math can be and how they can use it in everyday life.

Second**,** math anxiety is a huge barrier for many students. The research found that all but one teacher agreed there was a relationship with math anxiety and success in mathematics. The fact that these teachers recognize math anxiety in some of their students suggests that the students have been dealing with math anxiety well before high school. Math anxiety affects all types of people and can come in different forms. Anxiety can be in the form of being afraid to go to class, fear of being called upon, fear of math tests, and a fear of being wrong. Self-labeling is a big issues for younger students. They lack the self-confidence to believe in themselves because someone told them that they are not good at math. If their parents were not good at math then students often believe they will not succeed in math because their parents were not successful.

Teacher Six believes that this gives the student an "out" and gives them a reason to say that they are not good at math, which allows them to give up easier. Students need to know that just because someone told them they would not be good at math, does not mean they should give up. It is up to the teachers to recognize this and become the person that builds their confidence. Giving students the attention they need will help overcome anxiety and get them more comfortable with math. Teacher Seven creates environments that are comfortable for students with math anxiety. He allows students to work together every day in some capacity. Attending a different school, with small more specialized classrooms can also help these types of students. Teacher Two's students, who attend an alternative school, are now getting the attention they need to overcome their anxiety and build back their confidence. Math educators need to be aware that most students are going to struggle with math and there are going to be multiple roadblocks hindering them from succeeding. Teachers might consider doing less lecture and providing more hands activities where students can apply what they are leaning so they can understand the practical benefits.

Third, math educators need to appropriately challenge their students in the classroom. Providing the students with appropriate challenges will open up many opportunities for learning. During this study, "challenging material" was defined by the teachers as application problems, story problems, and problems that relate to the real world. Teacher Three is a big believer in application and story problems as they allow the students to grow mathematically and better relate math to the real world. "These types of problems challenge the student and allow them to think and process the

information differently than on routine problems." This creates an environment that allows students to relate their work to the real world and gets them thinking on their own. Problems that relate to the real world promote active thinking and articulates their thinking. This procedure creates authentic learning and gets them interested in wanting to be involved with mathematics. Thinking in this way allows students to develop critical thinking skills and build more confidence when working with mathematics. Becoming more confident in their ability will allow students to communicate more often with their peers. Using open-ended questions in class allows students to interact with each other and work together to come to a conclusion to a problem. "This will get the students more engaged in the classroom", stated Teacher Six.

By introducing students to challenging material that is appropriate, this will show them how mathematical concepts apply to real world situations, how they can explain mathematics better since they can relate it to something concrete and gain the confidence to explore mathematics on their own. The skills that students learn by working on application problems will show them how to solve problems using the skills they already possess. When students see the connection between math class and everyday life their motivation will increase. When students are able to explain mathematic concepts to their peers, then they begin to fully understand and are not only reinforcing their own understand but that of their peers as well.

Fourth, math educators want students to succeed and enjoy mathematics. For most students, success is defined as passing the class. Using creative and innovative ways to help keep students engaged and invested in their learning is a huge task for

teachers. Teachers that use lecture as their main instructional technique need to keep the students involved. Teachers need to be aware that not every student is going to flourish in the traditional classroom. Students take in information in many different was and teachers need to incorporate multiple was of instruction that keeps everyone engaged.

Lecture is a great tool to get information to students and to gauge how well the information is being received. Teachers notice if students are not understanding the material based on what type of questions they ask and if they ask questions at all. Including group work and discussion into lecture is a way to create a successful learning environment. This technique allows students that are too nervous to speak up in class to communicate in groups. This gives kinesthetic learners the opportunity to work on homework in class. Group work encourages students to help each other and allows them to speak mathematically to each other. Observing group work, offers teachers another opportunity to make sure students are understanding the material. Teacher Seven uses this technique to see how students are interacting. Technology can also be a powerful tool in class. Graphing calculators are more advanced, online homework programs allow students instant feedback, and apps that do homework for the student.

These methods are exceptional instructional techniques but in theory, not every method works for every student. Two teachers summed this argument up best. Teacher Three stated "The best technique that works is the technique that works for the students at that time and works best for the teacher at that time as well and every class is different, and I need to adapt to that class" and," Techer Five believes in giving his students a variety of ways to learn math." Every student in the public school system has different

strengths and weaknesses in the way they learn and I need to give them opportunities to succeed and fail." "You learn more when you fail."

Finally, educational improvement is crucial. Students are changing, technology is changing, and our world is changing. Feedback from colleagues, attending conferences and seminars, and acquiring addition education are the most common resources for teachers. Feedback from colleagues and students is essential for instruction improvement. It is important that teachers receive feedback on their instruction. Accepting constructive criticism is important to teacher development. Getting feedback from student evaluations lets educators gauge if the instruction is allowing the students to be successful. They are the fulltime audience and are there every day with the teacher. "I learn from the students and they learn from me", stated Teacher Nine.

Another tool for improvement is conferences and seminars. Three teachers participate attend AVID training. AVID (Advancement Via Individual Determination) is a program that closes the achievement gap by preparing students for college readiness and success in society. In this program, teachers are trained to support classes that are student-focused, using best teaching practices, and support content standards. Professional development opportunities gives teachers the ability learn about improving their teaching practices, technology, and guidance preparing students for college and careers. Teacher Five stated "learning new technology will improve my instruction and make learning easier for the student."

Advancing ones own education is a great way to improve student success. The opportunity to gain knowledge in your field will not only benefit the teachers but also the

students. Teachers that acquire advanced degrees improve their chances to teaching upper level mathematics classes. This also allows them to teach dual credit courses, which counts towards both high school graduation and college credit. Allowing the student to enroll in these courses will make the student more college ready and lessen the financial burden that they face when they do enroll in college.

Conclusion

The purpose of this qualitative phenomenological study of the perceptions of mathematics educators on how to improve mathematical skill in high school students was conducted to collect, describe, recognize, and interpret the lived experience that have allowed mathematics educators to achieve the best results for their students. Phenomenological inquiry was used with nine individual, face-to-face, semi-structured interviews with mathematics educators to understand the lived experiences of mathematics educators that teach in rural Southern Minnesota. The most relevant themes were used to complete the study and serve as information for any mathematical educator dedicated to improving mathematical skill in high school students.

Recommendations for Mathematics Educators

This qualitative study serves as the groundwork for many educators that are involved with mathematics education at the secondary and postsecondary level. To better prepare high school students for college level mathematics, middle and high school mathematics educators need to implement the proper techniques and methods that will maximize student's abilities. In addition, higher education educators need to be familiar with the needs of developmental students. Mathematics educators need to understand

why students are struggling with mathematics and why they are becoming more detached from the subject. Recommendations listed below are beneficial for mathematics educators to better prepare students for college level mathematics education.

Recommendations for Mathematics Educators

1. Middle and high school mathematics educators need to understand and recognize the challenges that students face in mathematics. Recognizing that students lack the basic skills they need to be successful in their mathematics classes, teachers will be able to prepare their lessons and provide students with the information they need to succeed. Many students lack confidence to be successful in math. Students need teachers that motivate and encourage them and be their best regardless of their mathematical ability. Students need additional time to work on their homework either in the classroom or at home. Some students are involved in numerous activities which limits their time to work on homework. In addition, students might not have a stable home life and are missing the one-on-one time with a parent to receive help. Math anxiety is also an issue that can cause students to lose their self-confidence and hinder building those basic skills. Math anxiety affects high school and college students and it creates an unwillingness to enroll in other mathematics classes because of the lack of confidence for success (Tobias, 1999). Mathematics educators need to be able to recognize the symptoms of math anxiety

and improve their teaching methods, which could include less lecture, more student directed classes, and more discussion (Curtain-Phillips, 2004; Rossnan, 2006). Creating a more relaxing environment will allow students to feel more comfortable in the classroom and lessen the anxiety. Students are pressured and they psych themselves out on tests and assessments. Recognizing this and addressing it before it happens can improve student growth and development.

2. Get high school students interested in taking more mathematics classes. Students need to understand that enrolling sooner in their mathematics sequence of classes, such as; general math, pre-algebra, algebra, and geometry, will only help build and improve their analytical skills. When students enroll in a sequence of mathematics classes as freshman, they are more likely to be interested in taking more mathematics classes (Gamoran & Hannigan, 2000). Also, not every student needs to take pre-calculus, so promoting other mathematics classes like consumer math and math that builds problem solving and logic skills is an option. Some students are not going to college but should be presented with the opportunity to improve their abilities and gain different mathematical skills that apply to what they plan to do after high school. Not every student is college ready and should not be pushed in that direction.

3. Challenge students so they are better prepared for the next level of mathematics. If educators believe their students are not ready for the next step then they need to start challenging them by incorporating advanced material in their classrooms. Even though most curriculum is already challenging enough, teachers need to introduce practical application problems without diverting from what they need to teach. Using hands on and intellectual engaging assignments helps students relate math to the real world, engage them in critical thinking and problem solving, allowing them to think and process information differently than with routine problems. Producing mathematical success in students early will motivate them into taking more math classes later in college. Students that enroll early in mathematics classes as freshman are more likely to be interested in upper level mathematics classes (Gamoran & Hannigan, 2000). Students will be better prepared for college mathematics courses by understanding the basic concepts, principles, and techniques of college level mathematics (Conley, 2007; Gamoran & Hannigan, 2000).
4. Embrace improvement. Middle and high schools are changing. Technology is being introduced and classrooms are becoming more student centered. Colleges are also embracing technology. Students are using online programs for homework. Educators need to keep pace with these changes, by attending conferences and training that is

sponsored by their district. Communicating with colleagues is also important to gain knowledge on techniques and methods that were successful in the classroom. Acquiring additional education by attending an institution of higher learning is also an excellent opportunity for improvement. Educators must embrace the opportunity to take graduate level courses that will allow them to receive an advanced degree or by taking upper level courses that will widen their opportunity to teach different and more advanced classes.

5. Be open to using a variety of different instruction techniques. Lecture can be an important tool when it comes to learning mathematics. Students benefit from seeing examples worked out and can ask questions at the same time. Group work can have its advantages and disadvantages. Teachers need to make sure that when students are in groups that everyone in the group is putting in the same effort. Group work allows for peer-to-peer teaching to take place. Giving students ample time to work on homework is also beneficial to the student. This allows them to address any questions and concerns about the assignment before they take it home. A mathematics educator needs to have a collection of teaching tools that they can use in the classroom and then be able to apply that tool when it is needed. The best technique is that one that works for the student and the one that works for the teacher at the same time.

Recommendations for Further Research

This qualitative study was conducted to collect, describe, recognize, and interpret the lived experience of mathematics educators on how to improve mathematical skill in high school students consistent with a phenomenological research design. The information that was found during the study further strengthens the fact that students are struggling in mathematics and that the perception of mathematics educators on how to improve these skills are valuable and beneficial. This information will be helpful to all secondary and post-secondary educators that teach mathematics. The following recommendations have been developed from the data collected.

1. Future research is recommended to investigate if students are benefiting from taking less than four years of mathematics instead of three, which is standard in Minnesota. Would students flourish if the math they take in years three and four were more aligned to their future after graduation?
2. Are developmental courses helping students improve their mathematical ability? Further research is required to see if students are actually better prepared for college mathematics courses by tasking these courses. Would students be better off enrolling in these courses during their years in high school or should they wait until college?
3. The current study focused on students that reside in a rural Southern Minnesota community. Further studies could include other rural areas along with urban communities in Minnesota and the United States.

Summary

This chapter contained the findings that were collected while analyzing the perceptions of the mathematics educators. The recommendations for further research were also provided.

The current study was done to collect, describe, recognize, and interpret the lived experience of mathematical educators on how to improve mathematical skill in high school students. After speaking with the participants, it is obvious that the mathematics educators that participated in the study make every effort to improve themselves, create a more comfortable learning environment, and work to the best of their ability to help their students become better mathematics learners. It is hoped is that mathematics educators will find value in this study and will use the information to better themselves and their instructional techniques. Doing so will greatly improve the chances that students will succeed in mathematics and open a door they once thought was closed.

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Appendix A

Teacher Consent Form

Dear Teacher

My name is Michael Haskins. I am a graduate student in the Educational Leadership program at Minnesota State University, Mankato. I would like to conduct research in your school under the supervision of my advisor from the Department of Educational Leadership, Dr. Scott Wurdinger. The purpose of my study is to collect the perceptions of mathematics educators on how to improve mathematical skill in high school students.

If you agree to participate, I would like to interview you to understand your perceptions on how to improve mathematical skill in high school students. This interview will take about 30-45 minutes. The interviews will be recorded using an audio recording device. If you choose not to be recorded then I will record your answers to the questions using pen and paper. Files and any information containing answers to questions will be deleted when the research is finished, which would be around August 2018. The results will be used to help me develop a better understanding on the perceptions of mathematics educators on how to improve mathematical skill in high school students.

Your participation is totally voluntary. If at any time during the interview you decide that you would prefer not to answer a question or discontinue the study completely you are free to do so. Discontinuing the study will not affect your relationship with Minnesota State University, Mankato. You can stop participating by telling the researcher you no longer want to be in the study.

A possible benefit of this research is society and educators will have a better understanding on how educators are preparing themselves to become better educators and how they are improving the skill of high school students. By the end of the study, I hope to have a collection of the best techniques and methods that increase mathematical skill in high school students.

The only identified risk associated with your involvement is the possibility of discomfort in answering the questions.

All your answers will be kept confidential. Your name will not be recorded on any of the materials in this study. Instead, your identity will be recorded as the “Teacher X with x being a whole number. All consent forms will be kept in a locked filing cabinet in a secured office at Minnesota State University by Dr. Wurdinger.

If you have any questions please feel free to contact me, Michael Haskins, at Michael.Haskins@mnsu.edu or (507) 389-5891. You may also contact my advisor, Dr. Wurdinger, at Scott.Wurdinger@mnsu.edu or (507) 389-2919. If you have any questions about the rights of research participants please contact Dr. Barry Ries, Administrator of the Institutional Review Board, at (507) 389-1242 or Barry.Ries@mnsu.edu.

Enclosed is a copy of this letter for you to keep. If you are willing to participate in our study please sign this page of this letter and return it to me. Your signature indicates that you have read and understand the information above and willingly agree to participate. Thank you for your consideration.

Your Name (printed) _____ Initial if you are over 18 yrs _____

Your Signature _____ Date _____

MSU IRBNet LOG # 1138633

Date of MSU IRB approval: 10/17/18

Appendix B

Interview Protocol and Questions

Introduction:

Thank you for agreeing to speak with me about your experiences as a mathematics educator and your perceptions how to improve high school mathematical skills.

For the next 30-45 minutes, I will be talking with you about your experience as a mathematics educator, and your perceptions on how to improve high school mathematical skill in high school students.

I believe you will find the interview a worthwhile experience. **Just as a reminder: Your Informed Consent Form will be kept separately in a secure location away from any transcripts or notes from our conversation.** Additionally, I will use pseudonyms and remove any potentially identifying information in any write-ups or presentations of our conversation to protect your privacy and confidentiality.

I want to emphasize that if you do not want to answer a question or want to end the interview for any reason at all, I will honor your request. Your choice to participate or not in this interview will not result in any negative consequences.

Are you ready to begin?

Interview Questions:

1. How many years of experience do you have teaching mathematics?
2. What is the highest degree that you hold?
3. In your perspective, what are the main challenges students experience in learning mathematics?

4. What are your perceptions on how prepared high school students are for college mathematics?
5. What do you think is the relationship with math anxiety and success in mathematics?
6. What are your thoughts on requiring mathematics for all four years of high school versus three in Minnesota?
7. What do you do in the classroom to challenge your students?
8. What do you do to assess your students?
9. What are your perceptions of a successful mathematics student?
10. What characteristic to you feel define a successful mathematics teacher?
11. What do you do to improve yourself and your instruction?
12. What are your perceptions of the instructional techniques and/or delivery methods that are most effective in your classes?
    a. What methods are not effective?