TEACHERS’ PERCEPTIONS REGARDING AN INTEGRATED MATHEMATICS CURRICULUM

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Abstract

Limited research is available regarding best practices associated with an integrated mathematics curriculum. This qualitative study was conducted with teachers in a rural high school in upper East Tennessee. The study focused on teachers’ perceptions of best practices regarding a regular and honors integrated mathematics curriculum, as well as, the similarities and differences that exist within the curriculum. Through questionnaires, interviews, and a focus group, participants expressed their opinions of best practices related to an integrated mathematics curriculum and how similar and different a regular integrated mathematics classroom would be compared to an honors integrated mathematics classroom. Through open, axial, and selective coding, the study revealed that educator expertise and effective, relevant instructional strategies are perceived as best integrated mathematics practices. The study also revealed that similar instructional strategies and different rigor expectations exist regarding regular and honors integrated mathematics courses. The information gained from this study will help school districts determine effective instructional strategies and best practices that can be implemented in an integrated mathematics curriculum.
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Dedication

This dissertation is dedicated first and foremost to my Savior, Jesus Christ. Without Him, I would not be where I am today.

This study is also dedicated to my family. Thank you, mom and dad. Without your support and love, I would have given up. You always wanted to know if I “had that big paper finished….” Well guess what, I finally do! You will never know what you mean to me. You both have always pushed me to dream big, and I will never stop doing just that.

To my brothers, sister-in-law, and nieces. I love you all and thank you for always worrying if I had a life. You mean the world to me, and I cannot thank you enough for your support.

To all of my friends. I can finally go out to eat again! I love you all!
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Chapter 1: Introduction

Introduction

For many years, educators and researchers have debated what actually influences student achievement in schools (Darling-Hammond, 2000). Schools, once institutions for learning life skills, are now test preparation factories, where state assessments are the main focus (Walker, 2014). As new standards for learning have been implemented across the states, school districts are now faced with a changing curriculum to include real-world applications, problem-solving skills, and critical thinking skills to improve student achievement on state assessments.

The professional literature review and study emphasize the impact curriculum has on student achievement and how an integrated mathematics curriculum can influence the students’ understanding of previously learned content. It is imperative that school leaders and curriculum directors have clear goals and ensure every stakeholder in the school is aware of the vision of the school. School leaders must provide and implement a viable curriculum in order for students to obtain their goals and become college and career ready (Alexander & Cook, 1982). Therefore, school leaders must examine the current curriculum and ensure it is meeting the needs of the students to prepare them for post-secondary educational opportunities.

Background

American students have lagged behind their worldwide counterparts in the field of mathematics for many years. Studies have shown students in America rank only an astonishing 25th out of 34 countries in mathematics achievement. Educators, policy-makers, politicians, and parents have struggled with this disparity and how to correct it for years (Tarr, Grouws, Chavez, Soria, 2013). Research has shown a direct correlation between using an integrated mathematics curriculum and high achievement scores by secondary school students on standardized
Advocates of the integrated mathematics curriculum note the vast majority of countries other than the United States employ integrated approaches to mathematics instruction, and many of these countries outperform the United States on international achievement tests (Schmidt, 2004). The international curricula design integrates algebra, geometry, probability, statistics, and discrete mathematics to provide an integrated program rather than the compartmentalized structure of traditional programs (Strauss, 2013).

For many years, the mathematics course sequence of Algebra 1, geometry, and Algebra 2 has been a staple of the United States curriculum. This traditional mathematics curriculum is facing a challenge as schools’ transition to the Common Core Standards (Will, 2014). Due to the Common Core Standards and new state standards, school districts across the country are transitioning to an integrated mathematics approach. This type of curriculum is meant to bridge the gap in mathematics and aid in the students’ understanding of mathematical relationships. Secondary-level integrated math combines content from algebra, geometry, and statistics into a three-course sequence (Hanover, 2015). Previously, integrated mathematics was taught at the University of Chicago in laboratory schools. It later appeared again during the School Mathematics Study Group curriculum of the 1960s, and is often experimented within the standards-based reform curricula which began in the late 1980s (Araujo, Jacobson, Singletary, et al, 2013). Although integrated mathematics curriculum has been in use intermittently since the 1990s (Will, 2014), many states understand the need for this shift and are leaving the decision to school districts when deciding to use a traditional mathematics curriculum or an integrated mathematics curriculum. Although either approach to mathematics instruction is acceptable, the California State Board of Education suggests the integrated pathway presents higher
mathematics as a connected subject (Hanover, 2015). Common Core Standards and other state standards call for more rigorous content to be taught in the curriculum. Real-world applications, problem-solving skills, and critical thinking skills are now at the forefront of state assessments, providing more in-depth questioning to assess student knowledge and to ensure mastery of the content that was taught. By integrating these subjects, students will be able to recognize the relationships between mathematical topics, see their use in real-world situations, and gain repeated exposure to key topics in the math courses that follow, rather than learning them one time and moving on. This allows for the students to master mathematical content and achieve proficiency on state assessments.

**Research Problem**

State assessment scores are important in the evaluations of educators. With new mathematical standards and a push for higher test scores in education, districts are implementing new instructional strategies and curricula. It is no longer acceptable or appropriate to “teach to the test” due to higher order expectations and therefore, many school districts have decided to implement an integrated mathematics curriculum to aid in improving high-stakes assessment scores. High-stakes assessments seem to affect school practice; in particular, the implementation of these assessments have been followed by attempts to improve the quality of curriculum and instruction (Center on Education Policy, 2006; Goertz, 2007; Hamilton, 2003; Hamilton et al., 2007; Lane et al., 2002; Stecher, 2002).

**Purpose of the Study**

The purpose of the study was to determine the perceptions of educators’ regarding an integrated mathematics curriculum. In order to understand the educators’ views on the topic, the study was designed to determine teachers’ perceptions of best practices in integrated
mathematics instruction and the differences and similarities in honors and regular mathematics courses.

**Significance of the Study**

The significance of the study was the ability to determine an effective mathematics curriculum for a high school. Curriculum is a description of what, why, how, and when students should learn (Stabback, 2016). Throughout the Every Student Succeeds Act (ESSA) signed by President Barack Obama in 2015, the focus of evidence-based practice and evidence that curriculum matters are prevalent and therefore, states and local school districts must make decisions on curricular choices that will have a positive impact on student learning and achievement. Dr. David Steiner, executive director at Johns Hopkins Institute for Education Policy (2017), stated education has seen many waves of large-scale federal, state, and local reform initiatives that aim to improve student performance and therefore curriculum should be a top priority in education reform to see greater student achievement.

**Research Questions**

The study is designed to determine educators’ perceptions regarding an integrated mathematics curriculum.

1. What are educators’ perceptions regarding best practice integrated mathematics instruction for honors and regular math high school courses?
2. What similarities and differences exist in mathematics instruction in honors and regular math high school courses?

**Rationale of the Study**

The study focuses on understanding the perceptions of educators regarding an integrated mathematics curriculum. Research focusing on an integrated mathematics curriculum offers
mixed results. Some studies argued an integrated mathematics curriculum has a positive effect for student academic achievement; other studies have argued it has no impact on student achievement and therefore, the schools have chosen to return to a traditional mathematics curriculum. Through a questionnaire, in-depth interviews with teachers, and a focus group, the study investigated educators’ views regarding implementing an integrated mathematics curriculum. Research has identified how an integrated mathematics curriculum can aid in greater student achievement, but research has yet to understand the perceptions of educators.

**Researcher Positionality Statement**

The researcher, who has a B.A. in Mathematics Education, a M.A. in Curriculum and Instruction, and an Ed.S. in Administration and Supervision, has 14 years of experience in classroom instruction at the high school level. The work experience as a teacher in the mathematics classroom and as a teacher leader, has provided many opportunities to observe the effects of different mathematics curricula. The researcher’s role in the study included evaluation of an integrated mathematics curriculum.

**Theoretical Foundation**

Constructivism was the theoretical foundation for the study. Constructivism involves an individual’s prior knowledge and experiences and how it shapes their perceptions on new knowledge. The constructivist theory drives an integrated mathematics curriculum. Students must work collaboratively, apply problem-solving and critical thinking skills, and form cognitive relationships between mathematical content. Teachers must also collaborate with other colleagues and develop an aligned mathematics curriculum to ensure students are making connections within mathematical standards. Teachers must also engage in learning opportunities to help successfully implement and transition to an integrated mathematics curriculum. The
research also focused on building a theory which is known as Grounded Theory. Grounded Theory is a qualitative research approach and was developed by Glaser and Strauss in the 1960s. The purpose of this theory is to develop a self-defined theory that is of interest to the researcher. Research using the grounded theory starts with generic questions that guide the research. As data is gathered, theoretical concepts can be identified and links can be made from the data.

The conceptual framework for this study involved the use of best practices. Through PLCs and professional learning opportunities, teachers were able to understand what an integrated mathematics curriculum looked like, why it was important for student academic achievement, and how to successfully transition from a traditional mathematics curriculum to an integrated mathematics curriculum in the future. The data in this study provided information regarding educators’ perceptions and use of best practices, which will help identify if educators think an integrated mathematics curriculum is suitable for their school.

Limitations and Delimitations

There have been integrated mathematics curriculum studies conducted across the country. However, there is a lack of research which examines teachers’ perceptions. Most research conducted involved student achievement and textbook implementation.

The data was limited because only those teachers who are directly involved with teaching Algebra 1, Geometry, and Algebra 2 were able to participate due to integrated mathematics only including these subject areas. This minimizes interview responses and focus group where participants may or may not be comfortable expressing their true opinion regarding an integrated mathematics curriculum. Surveys were also used to understand the educators’ perceptions regarding an integrated mathematics curriculum. Surveys are dependent upon valid self-reporting and may limit the research due to insufficient information.
Definition of Terms

**Integrated mathematics.** Integrated math curricula incorporate content from across mathematical disciplines into a single course. Secondary-level integrated math combines content from algebra, geometry, and statistics into a three-course sequence. This sequence of Math I, Math II, and Math III replaces the traditional course sequence of Algebra I, Geometry, and Algebra II (Hanover Research, 2015).

**TNReady assessment.** As part of the Tennessee Comprehensive Assessment Program (TCAP), the TNReady assessment is designed to assess a students’ true understanding of material instead of just merely the memorization of mathematics. This assessment will be used to assess what students know and what they need to know in order for them to be college and career ready (Tennessee Department of Education, 2018).

**Academic achievement.** Academic achievement represents performance implications that indicate the extent to which an individual has achieved specific goals that were the focus of activities in instructional environments. School systems mostly define rational goals that either apply across multiple subject areas (e.g., critical thinking) or include the addition of knowledge and understanding in a specific intellectual domain. Therefore, academic achievement should be considered to be an all-around structure that consists of different domains of learning (Steinmayr, 2017).

**Perceptions.** Perception involves the way one sees the world (McDonald, 2012).

Organize of the Document

This study was organized into five chapters. The first chapter specified the background of the study, the statement of the problem, and the significance of the research. Additionally, in chapter one, a description of the theoretical framework and the list of research questions were
included. Chapter one also contained limitations and delimitations of the study as well as the definition of terms. Chapter two was a comprehensive review of literature related to the topic. The literature review incorporated information on the following: definition and history of integrated mathematics curriculum, political framework, Common Core State Standards, curriculum development, constructivist theory and summary. The third chapter was devoted exclusively to the methodology of the proposed research. Results of the collected data were reported in the fourth chapter while specific conclusions, implications, and recommendations based on the results of the study comprised chapter five.

**Summary**

The purpose of this qualitative study is to determine teachers’ perceptions regarding best practices in integrated mathematics instruction. While there are very few studies regarding the impact of an integrated mathematics curriculum, very little research is available regarding the perceptions of teachers. The researcher hypothesized that learning the perceptions of teachers in this area would be beneficial for student achievement and teacher best practices.
Chapter 2: Review of Literature

Introduction

The purpose of this study was to understand the perceptions of educators regarding the best practices of an integrated mathematics curriculum and the similarities and differences that exist in a regular integrated mathematics courses compared to an honors integrated mathematics course. Currently, in the school where the study took place, a traditional mathematics curriculum is in place with consideration of moving toward an integrated mathematics curriculum. When looking at how the curriculum has changed over the years, it is essential to understand the history of mathematics curricula in the United States and how the changes which have occurred have shaped what is now the current curriculum. With the implementation of Common Core State Standards in Mathematics, districts across the country have made changes to their curriculum with hopes of greater student achievement on standardized assessments and ultimately a deeper understanding of the mathematical concepts being studied for the students. Understanding curriculum development is essential for the success of the school, teachers, and most importantly, the students. With appropriate professional development, teachers can collaborate and discuss new instructional strategies and best practices to aid in the implementation of an integrated mathematics curriculum. This learning could take place in a professional learning community where teachers communicate with other colleagues about student work, instructional practices, and what methods of teaching can aid in greater student achievement. Often, teachers are reluctant to collaborate with colleagues due to conflicting planning periods or due to a desire to work independently versus as a group. However, it is essential that teachers work together to ensure not only their students, but the school as a whole, improve together.
Better problem-solving techniques and critical thinking skills are essential in understanding and retaining mathematical concepts and relating the various topics together. The quest to find a curriculum that best meets the learning needs of all students is a widely-debated topic throughout the United States. For many years, students have been enrolled in a traditional mathematics curriculum (Algebra I, Geometry, and Algebra II), but recent studies have identified other mathematical pathways which may be more efficient in providing students with proficiency in mathematics. With an integrated mathematics curriculum, students are asked to learn through real-world tasks where they discover different aspects of the mathematical concepts. Understanding different points of view are vital to this study as well as the instructional materials and best practices that can be incorporated into the integrated curriculum. This integrated mathematics approach is grounded in the constructivist theory of learning where students learn from developing their own ideas and using those new ideas to foster a greater understanding of the mathematics concepts.

**History of Mathematics Curriculum in the United States**

Over the years, the mathematics curriculum has changed dramatically in the United States. In the 1960s, the School Mathematics Study Group, supported by the National Science Foundation, was the first to support a curriculum that would integrate mathematical topics into the same course, such as combining algebra with trigonometry (Usiskin, 2003). This model was named “New Math” and focused on skills instruction and understanding. With the many successes during the New Math Period, little consideration was given to basic mathematical skills, making the curriculum too formal (Klein, 2003). By the 1970s, New Math was dead and had brought about an increased public support to return to a more traditional mathematics curriculum. However, the poor results by students in the United States on the National
Assessment of Educational Progress (NAEP) in 1972 prompted the opinion that basic mathematics was not enough and students needed more critical-thinking and problem-solving skills (Senk & Thompson, 2003). In the early 1980s, math and science education was experiencing widespread deterioration in rigor and conceptual understanding. Due to the decline in K-12 education during this time, two important reports came about in hopes of improving the curriculum in the United States. An Agenda for Action: Recommendations for School Mathematics of the 80s, was the first report on improving and strengthening the school mathematics curriculum and teaching by implementing eight recommendations.

The second report was A Nation at Risk, which was released by the National Commission on Excellence in Education. The National Council of Teachers of Mathematics (NCTM) released An Agenda for Action in 1980. The report called for a new direction in mathematics education with a recommendation of implementing national standards. The report recommended eight actions to improve school mathematics curricula. Specifically, the report made the following recommendations: school mathematics curricula focus on problem solving, basic mathematics skills be reinforced, mathematics curricula take full advantage of technology in the form of computers and graphing calculators, rigorous standards be implemented into the mathematics courses, and the success of students and the mathematics programs will be measured in various ways other than state assessments. The report also recommended teachers encourage students to study mathematics while providing a curriculum that meets the needs of all students, ensured that mathematics teachers provide themselves with a high level of professionalism, and communicated the importance for mathematics instruction to the public (NCTM, 1980). The report stated that it is essential for students to learn problem-solving skills even if their basic mathematical skills have not been mastered (NCTM, 1980). It’s important to
note these recommendations came at a time when America was at odds over whether to teach basic mathematics facts or implement technology usage and problem-solving skills in the mathematics classroom. Despite the enthusiasm of NCTM, the report received little widespread attention due to the fact it was overshadowed by the 1983 report *A Nation at Risk*. This report was commissioned by the United States Secretary of Education, Terrell Bell. He warned that the nation was at risk and suggested our educational system and its curriculum focused on mediocrity and was threatening the future of the United States (U.S. Department of Education, 1983). Most notably, the report maintained that if a foreign entity had tried to implement a dreary, uninspiring curriculum to the United States, it would have been viewed as an assault on American education (NCEE, 1983). This report addressed specific shortcomings in mathematics education and a wide variety of issues in American classrooms. One of the most important issues addressed was student assessment. The report stated:

Standardized tests of achievement (not to be confused with aptitude tests) should be administered at major transition points from one level of schooling to another and particularly from high school to college or work. The purposes of these tests would be to: (a) certify the student's credentials; (b) identify the need for remedial intervention; and (c) identify the opportunity for advanced or accelerated work. The tests should be administered as part of a nationwide (but not Federal) system of State and local standardized tests. This system should include other diagnostic procedures that assist teachers and students to evaluate student progress (NCEE, 1983, p.28).

With the release of *A Nation at Risk*, many states created a task force to aid in improving education and focus on basic skills and higher standards. In 1986, the NCTM established the Commission on Standards for School Mathematics, which were later referred to as the NCTM
Standards. These standards were created by teacher education professors and instructors from various universities, none of whom were mathematicians. The standards of the National Council of Teachers of Mathematics (NCTM) called for increased attention to many aspects of the mathematics curriculum. Specifically, NCTM called for additional attention to operation sense and meanings of operations, and mental calculation. Moreover, NCTM wanted increased consideration regarding the use of calculators for complex computation as well as the collection and organization of data. Finally, NCTM stated more concentration was needed in the mathematics curriculum on pattern recognition, manipulative use, and collaboration opportunities between students. The NCTM Standards reinforced a progressive education by advocating student-centered, discovery learning. NCTM favored this progressive movement, which was called “constructivism,” and the NCTM Standards were promoted under this term (Bosse, 1995). With writings from Jean Piaget about the developmental stages of learning and Lev Semenovich Vygotsky’s Zone of Proximal Development, the child-centered, cooperative learning approaches were favored by colleges of education. In the fall of 1989, President George H. W. Bush asked the nation’s governors to attend a summit and called for national standards to be implemented (Klein, 2003). The goal was to make American students first in the world by the year 2000. By 1997, many states had adopted and closely aligned their standards to the NCTM (Raimi, 2001).

During the 1990s, United States public schools’ mathematics programs were the most controversial they had ever been (Klein, 2003). In January of 1998, United States Secretary of Education Richard Riley called for an end to the “math wars.” These “wars” were brought about because of the introduction of new math textbooks with decreased rigorous mathematical content and an increased focus on basic skills. At this same time, NCTM also issued Mathematics
Standards for Schools. This document incorporated standards for mathematics teaching and learning, pre-service teacher education, and testing. The National Assessment of Educational Progress (NAEP) developed an addition to the extensive NAEP reporting to also include information on a state-by-state basis of the mathematical achievement of students (Dossey, McCrone, and Halvorsen, 2016). While this period witnessed the enactment of the NCTM Standards within the states, the preferred standards coordination across the states at grade levels was a miserable failure. In 2002, NCTM released *Principles and Standards for School Mathematics*. This publication blended earlier curriculum standards with more intricate standards. Following the release of *Principles and Standards for School Mathematics*, some individuals complained the United States mathematics curriculum was “a mile wide and an inch deep” (Schmidt, 2000). The National Science Foundation (NSF) was also very instrumental in the implementation of the NCTM Standards. The NSF assisted in making changes in the way students were taught mathematics and science. Education is a matter of local control, and it is essential that state governments align their standards with national standards to ensure the success of all American students. NCTM (2000) stated curriculum must be well articulated across grade levels and must be focused on important mathematics. Educators must connect the curriculum and understand the relationships between standards. This connectivity will aid in student comprehension of previously learned concepts, increase knowledge of problem-solving techniques and promote student success.

The role of the United States Department of Education is to set mathematical standards and provide special programs with federal funding. In 2001, Congress passed and implemented the No Child Left Behind Act (NCLB). Since that time, the role of the federal government in education has increased dramatically (Dossey, MCrone, and Halvorsen, 2016). NCLB
commissioned the United States Department of Education to supervise a program that would provide financial incentives for schools with outstanding performance and impose penalties for schools where performance was lackluster (U.S. Department of Education, 2008). NCLB consisted of four main driving factors: data-driven accountability for states, school districts, and schools; school choice for parents and students, in particular for those students attending low-performing schools; flexibility for states and local education agencies; and a stronger emphasis on reading (Dossey, McCrone, Halvorsen, 2016). NCLB also decreed that all students, including students with disabilities, receive a quality mathematics education. The Obama administration released a blueprint in March 2010 that was designed to reform the Elementary and Secondary Education Act (ESEA), the so-called No Child Left Behind Act of 2001 enacted under the Bush administration. The Obama administration’s blueprint reverted to the original name of the sweeping education act originally created under the Johnson administration in 1965 (Duncan, 2010). The blueprint recommended that states implement different assessments, develop best practices technology usage in the classroom, and ensure students will be able to write and speak adequately. Other goals from the blueprint included the ability for students to conduct research, use technology, and develop problem-solving skills.

In December 2015, President Barack Obama signed the Every Student Succeeds Act, otherwise known as the ESSA, which replaced No Child Left Behind, as the nation’s major law governing public schools. Led by former Secretary of Education, Senator Lamar Alexander (R-TN), Congress reauthorized No Child Left Behind by passing the Every Student Succeeds Act in December by a vote of 85-12 in the Senate and 359-64 in the House (Education Trust 2016; Klein 2016). ESSA requires that states test all students in reading and math in grades three through eight and once in high school. States are also required to align those assessments with
college-and-career-readiness standards (Brown, Boser, and Marchitello, 2016). Many states have adopted their own plans for success. Tennessee adopted a plan in October 2015 called *Tennessee Succeeds*. Since 2007, Tennessee has made rapid change in education (Tennessee Department of Education, 2017). Through standard revisions and higher expectations, the change in the state assessment is being made to provide better information to meet the needs of students. Tennessee has set four goals to work through to see success and an increase in student achievement. The first goal is for Tennessee to rank in the top half of the nation on the National Assessment of Educational Progress (NAEP) by 2019. Tennessee established the Read to be Ready initiative in order to accomplish the reading goal. That goal is for 75% of third graders to be proficient in reading by 2025. For high school students in Tennessee, the current average ACT composite score is at 19.4. By the year 2020, Tennessee wants to achieve an average ACT composite score of a 21. This goal will ensure that students at the high school level will be college and career ready and will provide greater opportunities for success in postsecondary endeavors (TDOE, 2017). The last goal in *Tennessee Succeeds* is for all high school graduates from the class of 2020 to earn a postsecondary certificate, diploma, or degree. While these goals are ambitious, they are attainable. The Every Student Succeeds Act was viewed by Tennessee as an opportunity to build on its successes and achievement gains in education. The Act also supported larger state goals and its implementation was framed around *Tennessee Succeeds* (TDOE, 2017). The funding and provisions under the Every Student Succeeds Act and initiatives within Tennessee’s plan are integral to the work and success of Tennessee students (TDOE, 2017).
Common Core State Standards

Currently, national focus in mathematics curriculum has shifted to the Common Core State Standards for Mathematics (CCSSM). These standards were presented in 2010 and encompassed a vision of a national set of standards supported by governors and superintendents of public education (Dossey, McCrone, and Halvorsen, 2016). The CCSSM were developed based on the curricular framework, standards provided by states, international frameworks, and research regarding mathematics instruction. In December 2008, Benchmarking for Success: Ensuring U.S. Students Receive a World-Class Education was released by the National Governors Association (NGA), the Council of Chief State School Officers, and Achieve. This document provided insight on international curriculum and was used as an example for connecting the state standards together to ensure equality of educational opportunities for students in any state. These standards were designed to provide guidance for curricula in the traditional pathway and integrated pathway (NGA and CCSO 2010). The CCSSM Standards for Mathematical Practice relate to the content domains and standards by describing practices which students should do when solving any mathematical task and the expectations that mathematics programs should hold for students. They are: make sense of problems and persevere in solving them, reason abstractly and quantitatively, construct viable arguments and critique the reasoning of others, model with mathematics, use appropriate tools strategically, attend to precision, look for and make use of structure, look for and express regularity in repeated reasoning. (CCSO, 2010). These mathematical standards are based around the NCTM Process Standards. The Standards for Mathematical Practice address what students should be able to do mathematically (Dossey, McCrone, and Halvorsen, 2016). The goal of the CCSSM was to prepare students to be college and career ready. The CCSSM were developed and adopted as the set of standards to be
used by the individual states. Theoretically it allowed students equal opportunity to similar instructional practices (Dossey, McCrone, and Halvorsen, 2016). As of 2016, the CCSSM recommendations were adopted and implemented by 43 states and includes the District of Columbia (Academic Benchmarks, 2015). Some states adopted the standards verbatim; however, many states faced difficulties in adopting standards with the CCSSM label. These states, however, were able to pass a modified version of the standards.

In July 2009, the United States Department of Education announced a program called “Race to the Top.” This program awarded grants to states if they would in turn adopt national standards that would prepare students for college and success in the workforce and national assessments that would measure the effectiveness of the standards and their implementation. If the states participated in “Race to the Top” and adopted CCSSM, the states would receive extra funding. Some state governments viewed this as high jacking the Common Core Standards. These standards were constructed around mathematical practices and specific mathematics content, and focused on developing greater mathematical understanding by students (Dossey, McCrone, and Halvorsen, 2016). CCSSM became a political problem when complaints were voiced about the lack of classroom materials, professional development, parental concerns, and the inability to distinguish CCSSM from Race to the Top. Due to this controversy, some states have legislation that allows parents to excuse their child from taking the state assessments. Much of the concern of CCSSM was due to the state assessments, which were not part of the Common Core State Standards. According to Michael Shaughnessy, President of the National Council of Teachers of Mathematics, the Common Core State Standards for Mathematics can be thought of as an opportunity for rethinking potential mathematical pathways, particularly in secondary mathematics (Shaughnessy, 2011).
In 2011-12 school year, Tennessee implemented the Common Core Standards in English language arts and math standards for kindergarten, first grade, and second grade. The following year, most districts began the implementation of math for grades three through eight and the total implementation of Common Core Standards in both math and English began in the 2013-14 school year. Over the years, Tennessee teachers have voiced their opinions, viewing the standards as a federal invasion into local decision-making and a change that emphasizes the reading of non-fiction over fiction (Pepper, Burns, Kelly, and Warach, 2013). In the 2013 First to the Top Survey, teachers’ perceptions of the Common Core Standards were assessed. All participants were asked to complete seven questions regarding the impact of Common Core Standards. Findings included teachers (70%) would have to change the way they teach, while 53% stated that the move to Common Core would improve the quality of their teaching (Pepper, Burns, Kelly, and Warach, 2013). In April 2015, Governor Bill Haslam signed a bill to review and replace the Common Core State Standards due to their controversial implementation. Months of review and revisions followed and the State Board of Education approved the new Academic Standards in 2016. Though there were some changes made, the changes in the standards were not as drastic as in 2011 with the implementation of the Common Core Standards. A committee of educators were appointed to revise the standards, and they used the Common Core Standards as a basis rather than starting from scratch (Aldrich, 2017). The committee made word adjustments for clarity and changes in instructional presentation to ensure the standards were easily understood for educators. For the sake of transition and manageability, some standards were moved to different grades and courses (Aldrich, 2017).

Standards are a big part of the foundation of education because they provide the learning goals on which all other educational decisions around curriculum and testing are made. Even
simple word changes can be significant concerning standards, such as the word *know*. If it is changed to *explain*, the standard changes from students having to memorize a formula or definition to having to be able to provide contextual evidence and mathematical properties to support their solutions. One of the most critical aspects of this implementation is teacher preparedness. Tennessee encourages districts to provide teacher training on the new standards each year. Training and professional development are essential to the successful implementation of any new curriculum and the academic success of students. Tennessee developed rigorous state standards and focused on the alignment of those standards to new assessments in math, English language arts, science, and social studies. The assessments were created to ensure all students were being presented and developing problem-solving and critical-thinking skills. Thus, Tennessee established a firm educational foundation for students in order to prepare them for college and a career (TDOE, 2017). The Tennessee Academic Standards establish learning objectives and appropriate grade-level or course outcomes for students. The curriculum provides students with the ability to obtain these objectives and outcomes using a specific instructional design (TDOE, 2017). Particularly in mathematics, districts can decide which pathway, traditional or integrated, they wish to use to serve their students best. In a 2014 report for Brookings, Tom Loveless stated:

> By treating both approaches as if they have equal standing—regardless of the overwhelming relative popularity of the traditional sequence—the Common Core State Standards cannot help but be regarded as prying open a window for integrated mathematics courses. Neutrality, in this case, is a tacit endorsement (Loveless, 2008).
Developing Mathematical Thinking

With the adoption of the Common Core State Standards or other similar standards in mathematics, conversations about the best means to fully prepare high school students for success in high school and in their postsecondary decisions have become a topic of great debate. The push for students to be college and career ready is essential and requires students to have academic knowledge, critical thinking and problem solving skills, communication and collaboration skills, grit, and community involvement (CCRS, 2014). These skills, along with the eight Standards for Mathematical Practice, are essential to producing students who are mathematically prepared for life and careers in the 21st century (Delvin, 2014). Mathematical thinking is more than just being able to add or subtract; it is making sense of patterns while understanding numerical and logical events (Delvin, 2011). In order to develop mathematical thinkers, teachers need to focus less on computational skills and procedures and focus more on helping students understand how to apply their learning to real-world situations. The use of technological resources is greatly encouraged to allow students to handle and solve more complex problems without being consumed with the tedious computational aspects of the task. Recent developments in mathematics suggest mathematical thinking occurs when learning is highly interactive rather than a set of rules to memorize (Wallace, 2003). The ability to problem-solve, collaborate within a team, adapt old methods in new situations, and see mathematics in new ways produces a greater understanding of mathematics which is essential in the 21st century (Delvin, 2011). Students must be invested and interested in the learning of mathematics for it to make sense to them. With an integrated mathematics curriculum, students will be able to collaborate with other students and make connections within mathematics courses that will in turn provide them with a better understanding of the relationships between mathematical
concepts. Students will be more likely to see appropriate applications if they can apply prior knowledge that they have learned to real-life events (Hiebert, Carpenter, Fennema, Fuson, Human, et al, 1996). Often, real-world math problems incorporate concepts from multiple subjects; integrated mathematics courses teach students to think about math in an applied, interconnected manner versus the traditional pathway that leads students to believe the concepts in the various courses are simply disjoint pieces of information (Hanover Research, 2015).

Mathematical understanding is essential for all students to be college and career ready.

**Traditional Mathematics Pathway**

In previous years, high schools only required students to complete at least two years of mathematics courses to graduate. With more rigorous standards in place, high schools are requiring students to complete more mathematics courses to be considered a qualified candidate for graduation (Reys et al., 2007). This requirement poses new questions regarding mathematics courses for schools, teachers, students, and parents. With the implementation of the Common Core State Standards, the new curriculum allows for school districts to offer both traditional and integrated mathematics courses. It is up to school districts to decide which curriculum best meets the needs of their schools and most importantly, their students. The traditional mathematics pathway has been utilized in school districts across the country for years. This three-course sequence of Algebra 1, Geometry and Algebra 2 is familiar to students and parents and provides emphasis on the study of advanced mathematical topics. Although this topic is widely debatable, the subject sequence that occurs in some high schools also occurs at the college level. The subject-based emphasis on algebraic techniques may benefit some students who intend to study higher-level mathematics in high school or college. For more than 20 years, the number of students taking advanced mathematics courses at the college level has been
decreasing (Steen, 2007). The reason for this decrease is that students dislike the subjects and view them as a set of courses that follow rigid sets of rules with seemingly no relevance in the real world (Lesh and Zawojewski, 2007). Others will argue that the traditional pathway has prepared students for college; however, there is a steady increase of remedial mathematics courses at the college level (Reys and Reys, 2009). According to the Higher Education Research Institute Faculty Survey, many students lack the basic skills required to perform successfully and fully understand college level mathematics (Lindholm et al., 2005). Some schools choose to keep the traditional pathway because it will require fewer instructional and curricular changes (Hanover Research, 2017). A pressing matter for some school districts is the lack of instructional supplies and materials needed to implement the integrated pathway. High-achieving districts may not wish to implement the integrated pathway because they already have students pursuing post-secondary opportunities (Harlow, 2015). While maintaining a traditional mathematics pathway can minimize the need for new instructional materials, teachers will still need to adapt the traditional pathway and the order they teach concepts to include new standards (Hanover Research, 2017). Therefore, it is essential that teachers be trained on the new standards in order to fully understand and incorporate new material and instructional practices into their teaching. The Common Core State Standards cite key shifts, which could require changes in the ways teachers instruct and develop their curriculum. Educators must focus on teaching fewer topics and on linking those concepts across grade levels to ensure conceptual understanding and mastery (CCSS, 2018).

Many people consider the subject-specific sequence of algebra, geometry, and algebra sacred; they believe that it is the only way mathematics can be organized for effective and high-quality instruction (Reys and Reys, 2009). The National Education Association began this
subject-specific approach in the late 19th century (NEA, 1894). During this era, very few students completed high school. Therefore, it was considered appropriate only to offer subject-specific courses. For more than 30 years, research of secondary school students in the United States suggests that students have scored well below those in other countries on international assessments (McKnight, Crosswhite, and Dossey, 1989; Schmidt et al., 1999). Under the traditional pathway, states may need to consider other opportunities for acceleration in middle school (Hanover Research, 2017). In addition to an accelerated pathway that compacts Algebra I into Grades 7 and 8, districts can offer modified courses at the high school level for advanced students to give students who have higher academic achievement an opportunity for advancement and extension (Hanover, 2017). The California Department of Education (CDE) has accelerated options for students on the traditional pathway in their state. Schools in California allow students to double-up in math courses during the same year, allow students in school with block scheduling to take two mathematics courses in both semesters of an academic year, offer summer school classes provide the same material and expectations, create other mathematics courses by compressing four years of high school content into three years, create an Algebra II/Pre-Calculus course that will allow student to go into Calculus in grade 12, and pull out standards that focus on trigonometry or statistics and have students take those courses alongside the traditional or integrated courses (CDE, 2014). These suggestions are excellent for school districts to consider when deciding which pathway they will offer to their students. When schools are faced with the question of whether to use an integrated approach versus a traditional approach to learning mathematics, there is not a right or wrong answer. To accommodate both approaches, some high schools have chosen to develop and implement dual curriculum paths, i.e. both a subject-specific pathway as well as an integrated pathway. This unique solution
highlights the very essence of education: the ability of educators to understand students’ needs and continue to improve and strengthen mathematics programs to meet those needs (Reys and Reys, 2009).

**Integrated Mathematics Pathway**

According to Usiskin (2003), integration is “the simultaneous consideration of different aspects of knowledge” (p.13). Incorporating different concepts of mathematics into multiple courses was not a new idea. Integrated math curricula combine content from across mathematical specialties into a single course. Integrated mathematics courses at the secondary level combine content from algebra, geometry, and statistics into a three-course sequence (Hanover Research, 2015). This sequence, Math I, Math II, and Math III, replaces the traditional course descriptions of Algebra I, Geometry, and Algebra II. Most of the world’s countries currently organize their mathematics curriculum as an integrated curriculum. The United States, on the other hand, continues to be one of the few countries still utilizing the traditional curriculum (Loveless, 2014). Advocates of the integrated pathway argue it is academically more effective and in line with how secondary math is taught in foreign countries where students are performing at a higher level than in the United States (Harlow, 2015). Under integrated math pathways, students learn to blend mathematical concepts and make connections across fields and gradually deepen their understanding and skills (Tatter, 2015). The National Assessment of Educational Progress (NAEP) stated only 2% of twelfth graders in the United States reported taking integrated Math IV. Of that group, 3% took integrated Math III in the eleventh grade and 4% took integrated Math 2 as a tenth grader (Loveless, 2014). Georgia, New York, North Carolina, Utah, and West Virginia use an integrated mathematics curriculum statewide. The College Board (2007), released the *College Board Standards for College Success – Mathematics*
and Statistics, which included a similar version of mathematical standards adapted for integrated mathematics programs. This document illustrates how content might be arranged if taught in an integrated mathematics setting. In a study of more than 3,000 high school students from around the country, Tarr and Grouws found a significant difference in student achievement levels for each curriculum approach. Their study found students who studied from an integrated mathematics program scored higher on standardized achievement tests than those who studied from a traditional mathematics program (University of Missouri-Columbia, 2013). Sutton and Krueger specified some considerations teachers must understand regarding instruction in an integrated mathematics curriculum. They suggest student engagement does not guarantee student learning. Students might be engaged in a topic that is being taught, but that does not mean they are learning new material. They also suggest using problem-solving techniques is not the same as solving a mathematics word problem. Students need to struggle with problems they do not know how to solve and be able to incorporate prior knowledge to aid in solving the new mathematics problems. Allowing students to struggle enhances learning; integration can only be purposeful when the instructor understands how ideas relate to each other and the many ways that concepts can be built upon (Sutton and Krueger, 2002). The switch to this curriculum has not gone as smoothly as they would have liked. Switching to an integrated mathematics curriculum has it challenges and plenty of faults that must be considered (Will, 2014). In 2011, the president of the NCTM referred to traditional high school math sequencing as an out-of-date way to teach math and advocated for an integrated approach to better prepare students for college (Shaughnessy, 2011). In 2008, the United States Department of Education's National Mathematics Advisory Panel stated that a review of the literature failed to produce enough studies to establish whether an integrated approach or a traditional approach was more effective.
in teaching mathematics (U.S Department of Education, 2008). While there is no sufficient data to prove that an integrated curriculum is a better option for student achievement over a traditional curriculum, educators are discussing the option of moving toward an integrated pathway to ensure greater student achievement. Which mathematical curriculum works best is uncertain (Reys and Reys, 2009); it will depend on parents, students, administrators, teachers, and other stakeholders working together to improve and enhance the curriculum and instruction for all students. The continuation of adapting and refining mathematics programs is what education is all about and should always be encouraged.

Studies Examining Integrated Mathematics

Several studies have examined the effects of integrated mathematics curricula. In 2012, Finkelstein studied over 24,000 students in California. This study provided information about the reform needed in California’s secondary math sequence. The study showed that only 34% of Grade 11 students in the state tested proficient in Algebra I, although over half of the students took Algebra I for the first time in Grade 8 and approximately 20% took Algebra I for the first time in Grade 9 (Finkelstein et al., 2012). The analysis that was presented showed that some students continue to excel in math throughout high school, regardless of when they take Algebra I. It also showed that students who moved quickly through Algebra I in middle school (before they were fully prepared), never reach the level of Proficient on the Algebra I end of course assessment. Therefore, the report suggested that student readiness for Algebra I is more important than the grade in which students take the course (Hanover Research, 2015). The authors of the study recommend that schools encourage students to take more time to develop the foundational concepts and skills prior to taking Algebra 1 rather than taking Algebra I earlier with the potential to repeat it in later grades (Finkelstein et al., 2012).
Integrated mathematics curricula are becoming very popular with the release of the Common Core State Standards. Schoen and Hirsch conducted a study on the Core-Plus Mathematics curriculum in 2002. Core-Plus Mathematics is a four-year curriculum that follows an integrated math sequence. The curriculum consists of strands of algebra, statistics, probability, geometry and trigonometry (Schoen and Hirsch, 2002). This constructive and social constructivism curriculum centers around collaborative learning of problem situations and teacher-led whole-class instruction (Core-Plus Mathematics, 2010). The study was conducted across 11 high schools and examined achievement outcomes for 1,050 students who were in either a Core-Plus Mathematics classroom or a traditional classroom (Schoen and Hirsch, 2002). For students using the Core-Plus curriculum, they reported positive effects on SAT math scores, the Iowa end of course assessment for Grade 9, and subtests for Core-Plus Mathematics. The What Works Clearinghouse (WWC) calculated an average improvement of 15 percentile points using this curriculum (Core-Plus Mathematics, 2010).

In 2002, 120 students from the Derby School District in Derby, Kansas, were randomly assigned to either a traditional math curriculum or a Core-Plus Mathematics curriculum. The study found that students enrolled in the integrated mathematics curriculum were more likely to score proficient or higher on the Grade 10 Kansas State Mathematics Assessment than were their peers in the traditional math class (Core-Plus Mathematics, 2010). In addition, 79.1% of students in the Core-Plus Mathematics group enrolled in a fourth-year elective college preparatory mathematics class, compared to 46.5% of students in the traditional group (Tauer, 2002).

In the Comparing Options in Secondary Mathematics: Investigating Curriculum (COSMIC) project, researchers studied 11 different high schools in five states. The project
evaluated secondary school mathematics by comparing students enrolled in a traditional math curriculum and an integrated math curriculum (Tarr, Ross, et al., 2010). A total of 100 teachers and 5,800 students participated in the study where student learning and achievement were measured over a three-year period. In the first phase of the COSMIC project, 2,161 students in 10 schools were studied. The students were tested using common objectives, problem-solving and reasoning tests, and a standardized achievement test. The study found students enrolled in integrated mathematics curriculum courses scored significantly higher on achievement tests than their counterparts enrolled in a traditional curriculum course (Grouws, 2013).

In the second phase of the COSMIC project, students were studied after the second year of the secondary math sequence. In 2013, the study of more than 3,000 high school students nationwide found that students enrolled in the integrated mathematics course scored significantly higher on standardized tests administered to all participating students (Hurst, 2013). The study examined end-of-year outcomes for students enrolled in integrated Math II or Geometry. The study also found that students with a history of high academic achievement benefitted more from the integrated mathematics program than students who studied from the traditional curriculum (Hurst, 2013).

The authors of the COSMIC project conducted a precursor to the studies described above. Published in 2010, this study involved 2,621 secondary school students across five states. Students in integrated and subject-specific math courses were analyzed using the National Assessment of Educational Progress (NAEP) scores (Hanover Research, 2015). The curriculum types were significantly correlated with student scores on project-development assessments as well as the Iowa Test of Educational Development for mathematics when controlling for percentage free and reduced-price lunch eligibility, with students in integrated curricula showing
greater gains than students enrolled in traditional math courses (Tarr, Ross, et al., 2010). The students in the subject-specific curricula used textbooks from Holt, Prentice Hall, Glencoe, McDougal Littell, and HRW in Algebra 1, Geometry, and Algebra II. The students in the integrated curricula used the Core-Plus curriculum for Math I, Math II, and Math III (Hanover Research, 2015). Subject-specific lessons typically included teacher-led, whole-class discussions, whereas integrated subject lessons typically incorporated small-group work (Tarr, Ross, et al., 2010).

Another curriculum developed through the National Science Foundation was MATH Connections. This curriculum was designed to help link a student’s knowledge of mathematics to the business world. MATH Connections consisted of three mathematics courses that combined the topics of a traditional curriculum with contextual applications imbedded in each course. The students were required to complete experiments and understand mathematical situations in the real-world application problems. Teachers received professional development in MATH Connections curriculum before it was implemented. Researchers compared matched groups of student scores on the Connecticut Academic Performance Test, PSAT, and the SAT. The study found that there was no significant difference on the mean scores of the test. When a further study was conducted based on the mathematics ability of the students entering college, there was significant evidence that the MATH Connections curriculum made a difference on student achievement (Cichon and Ellis, 2003).

Senk and Thompson (2003) shared that an integrated mathematics curriculum has increased advantages that could increase student achievement across the United States. Integrated mathematics curriculum can help students understand the relationship within strands of mathematics and aid in a student’s ability to understand real-world applications. Because of
the continuous learning of mathematical content throughout a student’s mathematical career, there is less of a chance to forget important information. Additionally, the learning styles of students differ, making the integrated mathematics approach more appealing to a wider variety of students (Senk and Thompson, 2003).

While any adoption of new standards and instructional materials is challenging, under an integrated approach, secondary math teachers may need to provide instruction in new or less familiar domains (Hanover Research, 2017). For example, teachers who taught Algebra I in a traditional mathematics sequence would need to incorporate aspects of geometry into their curriculum and instruction; conversely, teachers that taught Geometry would need to provide instruction in algebra. Geometry, Algebra I, and II teachers with significant experience teaching under a traditional approach may require additional supports, in comparison with teachers who previously taught both algebra and geometry focused courses (Clark, 2015). The Common Core State Standards for Mathematics are more rigorous than previous standards and require teachers to scaffold instruction to address skill and knowledge gaps as students transition in the new content standards and expectations (Dilger, 2017). Changing the mathematics curriculum of a school or district can be a lengthy, complex, and complicated process. In order for the change to succeed, it is essential to garner teacher support for integrated mathematics before implementing the curriculum. This can be accomplished by building trust with teachers and other stakeholders in the early stages of the proposed change, establishing a clear vision and purpose for the change, and sustained support of personnel throughout the implementation of the change. It is not inconceivable for districts to provide professional development across multiple years to ensure the success of both the program and the students (Dilger, 2017). This will provide students who
are on the traditional mathematics an option to continue on that pathway and provide incoming students with a fresh start into the integrated mathematics pathway.

**Curriculum Development**

Curriculum development is defined as a planned, progressive, and systematic approach in making improvements in education (Alvior, 2014). For any curriculum to be effective, the educational program should encompass the goals, objectives, instructional resources, and assessments that are involved in the implementation of the curriculum (Alsubaie, 2016). The curriculum can be subject specific or a general overview of the expectations of the class. The curriculum must be usable with strategies and materials available for the teacher and student to be successful. All successful curricula that are being developed must undergo a stringent review and revision in order to continually ensure effectiveness (Johnson, 2001). Curriculum development is challenging; therefore, the development must include stakeholders and those involved directly with student instruction (Johnson, 2001). The most important person in curriculum development and implementation is the teacher. Their knowledge, expertise, and experiences are central to any effort regarding curriculum development. Without the teacher’s ideas and involvement in developing a curriculum, it will not be successful. The curriculum development team must always consider all stakeholders in education that can make a difference (Carl, 2009). Another important aspect of curriculum development is professional development of teachers (Handler, 2010). In order to contribute to curriculum development effectively, teachers must be provided with the appropriate knowledge and skills needed to make informed decisions about the development. Therefore, teachers need training and professional development that are directly tailored to their needs and aid in their understanding of the critical role they play in the development and implementation process (Carl, 2009).
Many studies support the empowerment of teachers in the curriculum development process. Fullan (1991) found that if teachers are involved in the process of curriculum development and implementation, the level of achievement of educational reform will have a significant impact. In other words, the teacher is the most important individual regarding the success of the curriculum. Teachers and supervisors should gather data, have collaborative communication, and make informed decisions together. Instructional leadership is shared with teachers; therefore, they must investigate and reflect on the decisions that will be made (Blasé, 1999). Therefore, schools must continuously assess themselves and have a goal that moves them toward success (Glickman, Gordon & Ross-Gordon, 2013). To develop an understanding of the learning that occurs using a curriculum, one must consider how the instructional materials are aligned. The National Research Council (2004) referred to curriculum alignment as “implementation fidelity” and describes it as the use of instructional strategies and materials and how well they are being implemented. George, Hall, and Uchiyama (2000) emphasize that assessing implementation is key to productively evaluating curriculum programs. Teachers must decide when the content is taught and they must implement the instructional materials that are available to them when they feel it is appropriate (Ben-Peretz, 1990; Clandinin & Connelly, 1992; Clarke, Clarke, & Sullivan, 1996; Remillard, 1999; Remillard and Bryans, 2004).

**Mathematics Curriculum Development**

For at least a decade, mathematics educators have asked for change in the curriculum and instructional practices in mathematics (NCTM, 1989). In the 1950s and 1960s, curriculum materials, such as textbooks and worksheets, were the primary vehicles used (Remillard, 1999). Curriculum reformers have been extremely cautious about student learning opportunities, giving little recognition to curriculum materials and instead focused on teacher development (Ball,
Nevertheless, curriculum guides and textbooks continue to be a mainstay in classrooms (Tyson-Bernstein and Woodard, 1991). According to Longe (1984), there are five stages of curriculum development that educators must go through to ensure success in the classroom. The first stage is goal determination. This process includes determining the general education goals and identifying the major objectives that will be used. This process serves as the basis for making informed decisions on how they school should be run and what instruction should occur ensuring that it does not dictate the practical details of the school (Longe, 1984). There are three basic factors that affect curriculum objectives: the learner, society, and the subject matter (Akangbon, 1984; Badmus, 2002).

The second phase of curriculum development is technical operations. Determining the general educational goals is essential to the curriculum development process. Once this occurs, teachers and administrators can start to place the goals into specific curriculum activities. In this phase, decisions are made regarding the objectives of the course of study, content, instruction, learning, and the curriculum team would develop instructional materials to be used in the class (Festus and Kurumeh, 2015). When selecting learning experiences, Badmus (2002), suggests five principles. The learning goals must be related to the objectives; they must provide satisfaction to the learner; the learner must be able to understand the objective; the learning goal must relate to a particular objective; and the learning goals must have several learning outcomes. Continuity, sequences, and integration are three major areas to focus on to have an effective organization (Badmus, 2002). Curriculum planners must determine the strategies that will be the most effective in the teaching and learning process. Some strategies that have been proven to work effectively are expository teaching, inquiry learning, small group teaching, individualized learning, mastery teaching, games, and programmed instruction.
The third phase in curriculum development is the application process. In this stage, the teachers try out and revise before they approve the curriculum. Often, educators are determined to implement a new curriculum and are unsure of its success. Therefore, it is imperative to observe teachers using the curriculum and look at data to understand student growth and proficiency. The curriculum team should encourage both teachers and students to provide feedback throughout the teaching and learning process (Festus and Kurumeh, 2015). According to Fullan and Pomfret (1977), personal contact and interaction among implementers, and between implementers and planners, is one of the most important aspects of implementing new innovations. Unfortunately, this interaction is often missing during the planning and implementation phases of new ideas and innovations.

The fourth phase of curriculum development is the implementation stage. During this stage, teachers should implement the proposed curriculum. During this time, professional development should be provided to teachers with strategies and instructional guidance. Jerry Patterson and Theodore Czajkowski (1979) suggest two areas of staff development. The first is re-education, which is described as the development of the skills necessary to implement the curriculum. During this time, educators can share lessons that have worked or discuss problems within the curriculum. Re-education is necessary for staff development. If teachers do not understand the instructional strategies they are asked to use, implementation cannot take place (Patterson and Czajkowski, 1979). The second component in curriculum development is resocialization. This is defined as the development and refinement of roles and role development. Fullan and Pomfret (1977) define role relationships as teachers being able to understand the behavioral alternatives available to them and change to meet those alternatives
accordingly. The success of any curricula depends on the understanding of instructional materials and school leaders’ and teachers’ preparedness (Kurumeh, 2015).

The final phase of curriculum development is the evaluation stage. This is the process of evaluating the educational objectives and determining if they are being met (Festus and Kurumeh, 2015). The methods and techniques that should be used when evaluating a curriculum include discussion, experiments, interviews with those involved in the curriculum implementation process, observation of the new curriculum, and questionnaires to understand the positives and negatives of the curriculum (Hussain, Dogar, Azeem, and Shakoor, 2011). This phase is also crucial in determining the level of student success and performance during the curriculum implementation. This should happen throughout the course and be discussed with educators to ensure the success of the program.

**Communication during Curriculum Development**

For teachers to be successful when implementing a new curriculum, the most essential aspect is communication with parents and community members. Anyikwa and Obidike (2012) state that parental involvement is essential if students are to get a good education. Parental involvement in a child’s education was of critical importance to the child’s academic performance at school (Morrison, 2007). Kindiki (2009) concurred and found a significant increase in a child’s academic achievement was evident when parental involvement was apparent. The collaboration between parents and schools gave children the realization that adults in their lives wanted to see them succeed both in school and beyond. According to the Interactive Mathematics Program (2012), parent communication is integral to successful curriculum adoption. The decision to implement an integrated mathematics curriculum should involve administrators, teachers, parents and most importantly, students. Open-house nights
provide an excellent time for administrators and teachers to begin the conversation regarding a need for change in the curriculum. Alternate methods of communication should also be in place for parents who may be unable to attend. Modern technology has made the communication process much easier, but school districts must be responsive to the needs and preferences of parents (Harper, 2017). Surveys can be sent via e-mail or through social media. Once the school has established the methods of communication, parents and educators can begin to have a discussion regarding the change in curriculum. The discussion can be based around the fact that in the changing world today, mathematical expectations in the 21st century will be different from what was required of their parents (Interactive Mathematics Program Resource Center, 2012). It is important for administrators and teachers to stress that the basic skills of mathematics will not be neglected, but rather go beyond memorization and provide students with a deeper understanding of the meaning and uses of mathematics. Sample lessons and materials can also be provided to parents as an example of what their student will be learning in the mathematics classroom. During the implementation of the integrated mathematics curriculum, The Sacramento City United School District requested feedback from teachers, school leaders, parents, students, and community members to aid in selecting the instructional materials for the new curriculum (Sacramento City USD, 2014). Parent workshops were also offered on effective use of the adopted instructional materials. Parent pushback will be inevitable when implementing any new curriculum. The Council of the Great City Schools (2013) advised educators to think of parents and community members as helpful communicators in their district. Therefore, educators must ensure that the public knows about what the district is doing with new standards and curriculum. Providing open forums to communicate with parents and gather parent feedback on the transition to an integrated mathematics course curriculum is beneficial for
school districts (Hanover Research, 2015). Through parent workshops, educators can introduce parents to content from the new curriculum and demonstrate how their students will be taught mathematics. By including parents, community members, and other stakeholders in the transition process, administrators may garner greater support for the change (Hanover Research, 2015).

**Professional Development Opportunities**

Professional development has been studied over the past decade, and a large part of the literature has been dedicated to its influence on teacher effectiveness, student learning and achievement. Through quality professional development, the academic success of students can be significantly affected due in part by the teachers’ participation in activities that can provide them with new instructional strategies to use in the classroom (Darling-Hammond, 1990; Guskey, 2002). Richard Elmore (2002) stated professional development was not only about the improvement of teachers. He maintained the most important result of professional development was the improvement of the school, as a whole. Joyce and Showers (2002) argued professional development activities that assisted teachers in learning new strategies to improve student achievement were simply not enough. They concluded administrators must also find effective ways to ensure those professional development activities actually have a positive impact on student learning. Hirsh (2003) stated professional development takes time and money, but it is the only way that teachers can benefit and improve student performance.

Professional development must meet the needs of the teacher and prepare them to use new instructional practices in their classrooms. Not all methods of professional development provide on-going learning for teachers. The goal of improving teaching and curriculum is best met when teachers understand that teaching is not an isolated event. For teaching to improve,
teachers must self-evaluate their practice and reflect on their performance (Heibert, Gallimore, and Stigler, 2004). While some teachers prefer a pedagogical style of learning, others may prefer an andragogic style where they themselves discover how to implement a new curriculum. According to Dean Fixsen of the National Implementation Research Network (2012), evidence-based practices cannot impact student achievement without effective implementation processes. Research suggests that highly effective professional development focuses on interaction over an extended period of time and relies on training activities specific to the teacher’s role (Altrichter, 2005). A number of school districts offer summer institutes and additional professional development to prepare secondary teachers for changes in the mathematics curriculum. In Tennessee, districts were asked to bring one team of up to six members to begin planning for standards roll-out in the 2017-2018 schools year. Districts were equipped with the necessary information about the revised standards to assess current systems and structures for alignment and plan support for schools and teachers (TDOE, 2018). The teams were composed of a diverse group of representatives including supervisors, superintendents, school administrators, and teachers. Their goal was to understand changes to the mathematics curriculum and return to their schools and present the new information to their colleagues. San Diego Unified School District also provided summer institutes and training for secondary mathematics teachers on new instructional materials, scope and sequences, pacing guides, assessments, and other instructional supports for the new integrated mathematics curriculum that was being implemented (San Diego USD, 2015). The Mathematics Program Resource Center emphasizes the importance of training school counselors on new curricula, given their direct interaction with students and parents during the transition. School counselors play a major role in informing students and parents about curricular changes. Therefore, it is essential that counselors at the high school and the
middle school levels be instructed on the new curricula in order to communicate to parents and students that the integrated mathematics curriculum is a mathematics class that consists of rigorous mathematical concepts designed for college bound students (Altricher, 2005).

This shift in teaching and learning mathematics can be a very daunting task for educators. According to Madeline Will (2014), the lack of instructional resources available for schools that are transitioning to an integrated mathematics curriculum is one of the biggest complainants that teachers and administrators have expressed. Educators in Utah launched an online, open-resource called Mathematics Vision Project to make up for the lack of resources available. This educator-driven initiative was created from the ground up to provide educators with applicable, appropriate professional development and curriculum resources. The framework on which the Mathematics Vision Project materials was based was constructed in accordance with research and grounded in a fundamental understanding of mathematics learning progressions. Thus, while the materials are research-based, they also incorporate key ideas for knowledge and are organized and generated within the discipline of mathematics (MVP, 2018). The professional development offered by MVP has options for educators that include understanding the sequence of mathematical topics, five practices for disseminating discourse, understanding the mathematics learning cycle, using the materials to plan for student learning, and facilitated lesson study (MVP, 2018).

**Professional Learning Communities**

Historically, teaching has been an isolated activity (Mindich and Lieberman, 2012). In some cases, many teachers would rather work on his or her own than plan with other colleagues due to conflicting schedules. A growing body of research has provided understanding about what effective professional learning communities enable educators to do. DuFour (2006) defines
professional learning communities (PLCs) as educators committed to working together using collaborative practices, problem solving strategies, and reflection upon their practice. Professional learning communities offer teachers a chance to collaborate and discuss successes within the classroom as well as develop a curriculum that will improve student achievement. The Professional Development Partnership (2008) shared a list of activities PLCs can use within the meeting. The activities include: examining data, evaluating and analyzing student work, determining effective instructional strategies, designing powerful lessons, and developing classroom-based common assessments to measure progress. Creating a true professional learning community takes more than just face time between teachers. According to Liebermann and Miller (2008), teachers must work to create a collegial culture in classrooms instead of a congenial culture. Many teachers want to have a classroom where students and teachers interact amiably and without real controversy. In a classroom with a collegial culture, however, bonds of trust are developed that allow for true and honest reflection and feedback. This environment allows and encourages disagreements and acceptance of responsibility without the mistake of assigning blame.

It is essential for teachers to work together to develop new curriculum ideas and make informed decisions while, at the same time, being constructively critical of each other’s opinions. Teachers need to integrate theory, as well as time and opportunities to explore new learning styles and how it could be implemented in the classroom (Darling-Hammond and McLaughlin, 1995). Therefore, school cultures must be conducive to critical enquiry and provide teachers with time to collaborate. The most useful professional development reiterates active teaching, common assessments, classroom observations, and most importantly, reflection rather than discussions (Darling-Hammond and McLaughlin, 1995).
After professional development takes place, teachers must commit to the implementation of the new curriculum. Mathematics teachers’ beliefs and opinions can either improve or hinder the transition of a new curriculum (Haynes, 1996; Jackson, 1986; Koehler and Grouws, 1992; Sosniak, Ethington, and Varelas, 1991). If teachers understand and hold similar beliefs regarding implementation of the new curriculum, they will be more likely to accept the change. According to Martin (1993), curriculum implementation approaches that do not take into consideration teachers’ thoughts and opinions will have a temporary life. The “top-down” approach is not effective, and educational reform experts, along with administrators, must ensure that all teachers support the new change. One major cause of failed curriculum reform is the disregard to consider teachers’ pedagogical knowledge and views (Knapp and Peterson, 1995). Many of these failed innovations were poorly implemented and had negative gains in student learning. Therefore, it is important that teachers believe that any new curriculum is possible and could have a great impact on student learning (Martin, 1993).

**Best Practices and Instructional Approaches**

The Learning Principle of the NCTM, *Principles and Standards for School Mathematics (PSSM)*, recommends that teachers include tasks that emphasize student engagement and deepen their understanding of mathematics and connect prior knowledge (NCTM, 2000). An integrated mathematics curriculum promotes the advancement of the associations between mathematical concepts. When mathematics is taught with real world connections, more students are able to connect these concepts and build a higher level of understanding (Sutton and Krueger, 2002). With these rich and realistic contexts, students are able to grow mathematically. Much debate around math course sequencing focuses on how and when to integrate algebra into the course sequence to appropriately challenge students as they prepare for more advanced math in the later
secondary grades (Senechal, 2014, p. 3). Many view Algebra I as the first course to take in high school. Many are advocating for “Algebra-for-All” policy where all students take Algebra I in middle school (United States Department of Education, 2008). While some educators advocate placing all students in Algebra I in grade 8, Robert Loveless argues against that strategy. He maintains placing all students in Algebra I in Grade 8 does a disservice to both displaced students who are several years behind in math education and also to well-prepared students. Teachers struggle to serve the needs of those students who are several grade levels behind while slighting the academic growth of students on grade level whose learning is stunted or stagnate (Loveless, 2008). Therefore, districts should provide modified pathways to allow high-achieving students the option to complete advanced math courses when they feel it is appropriate. Struggling students should be provided with explicit instruction and multiple forms of instructional examples. When teaching a new procedure or concept, teachers should think aloud while lead students in the problem-solving process (Hanover Research, 2017). It is imperative for students to verbalize the steps they took to get to the solution to a problem. Using heuristics can aid in the student’s ability to organize information. A heuristic is a method or strategy that explains the approach for solving a problem in basic terms so that all students can understand (Hanover Research, 2017).

Most mathematics teachers understand the importance of technology in the classroom. Some concepts included in the curriculum become more significant due to the effective use of technology required to better understand the concept. The effect of the strategic use of instructional technology on students and teachers is three-fold. Both groups gain much-needed insight into purposeful and challenging mathematics tasks, engage in mathematical ideas that involve active student participation, and build on prior knowledge that aids in the mathematics
learning process. This is true for both an integrated approach or a traditional approach (Sutton and Krueger, 2002). Instructional technology, such as calculators and computer software, aid in the student’s ability to make mathematical connections. Using technology in mathematics is essential in order for students to make mathematical connections and conjectures. Understanding how technology is incorporated into instruction is one of the most important decisions when teaching (Sutton and Krueger, 2002). When assessing students, the teacher can use computer-based programs, which will allow for teachers to use the data from the assessment to drive instruction. Edulastic is a web-based formative assessment platform that helps teachers prepare and deliver effective curricula by improving the assessment creation, assignment, and grading processes (ETR, 2014). This program provides real-time data and reports for districts and schools to use to enhance instruction. Data-driven decision making is the process in which teachers use the data from assessments to make informed decisions on instruction and student achievement (Mertler, 2014). Using and understanding data is one of the most beneficial aspects of teaching and the success of the students. Teachers should also provide peer tutoring to assist with the learning of students with disabilities. Peer tutoring has been used across academic subjects and has been found to be very beneficial for diverse learners (Greenwood and Delquadri, 1995). These strategies will aid in the improvement of struggling students in Algebra I or in an integrated mathematics curriculum.

**Constructivist Theory**

Constructivism is a term that describes the practice of individualized and discovery learning (Hirsch, 1996). This term implies that knowledge is found out from one’s self is truly integrated and understood. Jean Piaget was one of the first constructivist based on his view that knowledge was constructed in mind and related to how children acquire new knowledge
Piaget believed that knowledge is acquired through constructive processes and each new experience either supports or changes what the individual believes to be true. Because constructivism focuses on acquired knowledge, this theory is beneficial to anyone that is interested in teaching and learning. For instance, mathematics educators taking this position would argue that children would learn math more efficiently if mathematical knowledge was provided to them on the basis of what they already know, rather than have it presented by the teacher or another expert (Kallon, 2003).

Another contributor to constructivism was Lev Vygotsky. Vygotsky’s theory is assumed to be the origin of social constructivism. Social constructivism teaches that all knowledge through social interaction rather than an individual experience (Lynch, 2016). Learning occurs through creative activities. Educators should allow students to come up with their own questions, make their own assumptions, and test them for effectiveness (Lynch, 2016). Vygotsky (1978) stated every function of a child’s cultural development appears first on the social level and then, later, on the individual level. He also maintained this hierarchy of development applied equally to the formation of concepts, voluntary attention, and logical memory. Additionally he said all higher functions are formed as relationships between individuals.

The human brain is naturally curious, analyzing complex information and synthesizing simple facts into concepts (Sutton and Krueger, 2002). Therefore, teachers should aid in the students’ ability to link new instruction to prior knowledge by using multiple teaching strategies that draw on various techniques. Students must learn mathematics by actively building new knowledge from experience and prior knowledge (NCTM, 2000, p. 20). Effective mathematics teachers play a crucial role in helping students gain deeper knowledge and skills. Teachers
provide a constructivist approach by giving deeper explanations of how mathematics works using questions such as: How does this mathematical problem work?, What ideas and associations can you make from this mathematical situation?, What patterns or relationships apply to this problem (Sutton and Krueger, 2002)? Students control their own learning. Students will put more energy into classroom discussions and often study more on their own, when they are interested in topic (Brooks and Brooks, 1999). Five central beliefs of constructivism were identified by Grennon Brooks and Martin Brooks (1993). First, constructivist teachers value the point of view of the student and differentiate instruction based on the needs and interests of their students. Second, constructivist teachers challenge students. Learning occurs when an educator allows a student to construct knowledge that is challenging to that individual child. Third, the constructivist educator understands a topic will only make sense to a child when he or she sees relevance in lesson. A child’s interest in learning grows, once relevance is revealed to him or her. Finally, student learning is assessed daily in a constructivist classroom. Students demonstrate their knowledge every day in a variety of ways. These five ideas of constructivism can aid in educators’ implementation of an integrated mathematics curriculum. It is imperative that students understand and make connections on their own. Several studies have shown the effectiveness of the constructivist approach as opposed to the traditional drilling and rote memorization approach (Hmelo-Silver, Duncan and Chin, 2007; Steele, 1995). Steele (1995), stated that using constructivist learning strategies has positive impacts on student achievement. Constructivist learning strategies are exciting and aid in students learning mathematics. When students are excited about learning, it will increase their self-esteem, which in turn will help them think mathematically. While constructivism has gained support, two main criticisms have emerged. One critique of constructivism is that teachers often
forego their curriculum to pursue other interests of their students (Brooks and Brooks, 1999). The other critique of the constructivist approach to education is that it lacks rigor (Brooks and Brooks, 1999). Battista (1999) wrote this about mathematics education,

Many . . . conceive of constructivism as a pedagogical stance that entails a type of non-rigorous, intellectual anarchy that lets students pursue whatever interests them and invent and use any mathematical methods they wish, whether those methods are correct or not. Others take constructivism to be synonymous with "discovery learning" from the era of "new math," and still others see it as a way of teaching that focuses on using manipulatives or cooperative learning. None of these conceptions is correct. (P. 429)

In order to have a successful constructivist classroom, educators must plan carefully, and students must understand the goal of what is to take place. This will avoid off-topic discussion that does not relate to the material. Constructivist teachers also recognize the importance of prior experiences that students bring to the classroom. These prior experiences enable students to make connections with the lesson, a vital component of the constructivist classroom (Brooks and Brooks, 1999). According to Kallon (2003), most constructivists agree with these four characteristics. First, students develop knowledge through the process of active construction. In other words, students develop their own understanding from an outside source. Instead of students taking notes, they, in turn, should make sense of the material and relate it to what they already know. Second, constructivists suggest new learning depends on current understanding. New information must be related to old information. Third, constructivists agree that learning is facilitated by social interaction. Student interaction results in sharing, thinking, and decision making. Educators should provide opportunities for students to create learning communities in the classroom to promote learning. Finally, dialogue is crucial for students to learn. Educators
should encourage dialogue: student-student, teacher-teacher, and most importantly, teacher-student. Brooks and Brooks (1993) state that rather than saying "No" when a student does not answer the way the teacher wants, the constructivist teacher attempts to understand the students thought process about the topic being taught. Through questioning, the teacher leads the student to develop new understandings and acquire new skills that will enable them to be successful in future mathematics courses.

Summary

For many years in the United States, teaching and learning has seen many changes regarding curriculum that seemingly are adapted based on where the political pendulum is at the time. Many reports and articles have been written to determine what the best method of teaching and learning should be for teachers and students to ensure American students are given the best opportunities available to be able to be competitive in a global job market. Curriculum development is an essential part of the schools and students’ success. Understanding curriculum design and its implementation are critical in the ever-changing educational world. The rigorous Common Core State Standards and local implementation of new standards have educators scrambling to improve their curricula to ensure the mathematics success of their students in the various postsecondary options. The new standards mandate enhanced problem-solving abilities on the part of students and a higher level of critical thinking skills. In the wake of the new, more demanding standards, school districts are faced with the decision of whether to continue with a traditional mathematics curriculum or to convert to an integrated mathematics curriculum. With proven research and facts regarding the integrated mathematics pathway, educators will be able to decide if this pathway best suits their students or if the traditional sequence of courses provides their students with the greatest opportunity to be successful.
How does one ensure the success of implementing an integrated mathematics curriculum? In order to ensure success, the issues that must be addressed are: all individuals have a clear vision of what is being implemented, professional development must be addressed, and best practices must be modeled for educators. As with any new venture, communication with parents, community members, and other stakeholders regarding the implementation of a new curriculum is paramount to its success. Therefore, a plan must be in place to ensure that all individuals involved understand the new curriculum, how it will be implemented into the classroom, and how it will be assessed to show the academic growth of the students. It is also essential that teachers receive the best professional development to ensure that the implementation of the new curriculum standards is seamless and top-notch. Through professional learning communities, teachers will be able to collaborate with other colleagues within the same discipline to learn and create new strategies that will aid in the success of their classroom instruction and ultimately their students. Without proper professional development, teachers may view this change as non-essential and remain conformed to their old methods of instruction. Therefore, best practice training and new teaching strategies, must be taught during the professional development to ensure the understanding of what the new curriculum entails and how it can be implemented into the daily instruction. Through this collaboration, teachers will be able to share ideas about best practices and what worked within their own classrooms as well as share struggles and concerns to find better ways to utilize and teach the new curriculum. Through modeling, teachers will be able to get a better picture of how a lesson should be structured and understand how specific activities work to meet the lesson’s objectives before implementation of the new standards.
The integrated mathematics curriculum is grounded in the constructivist theory. The theory suggests that students are able to construct their own knowledge by learning multiple strands of mathematics and problem solving techniques that relate to the overall concept that is being taught instead of learning the ideas, formulas, or methods as disjoint pieces of information. Through this type of curriculum, students are able to make connections to real-world situations and gain a deeper understanding of the mathematical process. With the push for students to be college and career ready, an integrated mathematics curriculum would not only help the composite ACT score, it would provide students a more holistic understanding of mathematical concepts that can be utilized in the workplace.

This study investigated the perceptions of teachers regarding best practices of an integrated mathematics curriculum and the similarities and differences that exist between a regular and honors integrated mathematics curriculum with hopes that the study will serve as additional information as revisions to the current curriculum are made. This chapter has reviewed the literature. In Chapter Three, the methodology of this study is described. In Chapter Four, the findings of the study are presented. A summary of the study, the implications, and recommendation of this study are presented in Chapter Five.
Chapter 3: Methodology

Introduction

The study was designed to determine the perceptions of teachers regarding best practices in integrated mathematics instruction. This specific study utilized a qualitative research approach to obtain teachers’ perceptions before choosing to implement this type of curriculum. The role of the researcher in qualitative research is to access the thoughts and viewpoints of study participants (Sutton, 2015). Due to the changing curriculum and implementation of the Common Core State Standards, the push for problem-solving and critical thinking skills are essential elements of instruction and must be addressed within the curriculum. For many years, students have been enrolled in a traditional mathematics curriculum (Algebra I, Geometry, and Algebra II), but recent studies have identified other mathematical pathways that may be more efficient in providing students with proficiency in mathematics. With an integrated mathematics curriculum, students are asked to use problem solving and critical thinking techniques and apply these to real-world situations. This type of curriculum offers students the mathematical ability to relate strands of algebra, geometry, trigonometry, and statistics together therefore, making the relationship between mathematics meaningful and relatable for future advanced topics in mathematics. With these strands interwoven within each course (Math I, Math II, and Math III), students are not only able to make important connections mathematically, they also have a greater ability of retaining mathematical concepts instead of forgetting from year to year.

Understanding the opinions of teachers are critical to this study as well as understanding the best practices that can be incorporated into the integrated curriculum. With the push for students to be college and career ready, it is imperative that students are provided with the
knowledge to function in the real world. This chapter will explain the research approach, population and setting, data collection procedures, and the data analysis process.

**Research Questions**

The study was designed to determine educators’ perceptions regarding an integrated mathematics curriculum.

1. What are educators' perceptions regarding best practice integrated mathematics instruction for honors and regular math high school courses?

2. What similarities and differences exist in mathematics instruction in honors and regular math high school courses?

**Description of Specific Research Approach**

Both grounded theory and constructivist theory were used as the qualitative research types for the study. Grounded theory is a form of qualitative research designs. Lincoln and Denzin (2005) viewed qualitative research as a practice of examining studied subjects and making sense of the studied subject through interpretation of gathered field notes, photographs, conversations, and other representations. The research focused on building a theory regarding an integrated mathematics curriculum and its implications. Grounded theory is applicable to generate a new theory or adjust an existing theory, giving a more explicit explanation to a studied process, and to discover a general perception of the interaction and actions among human beings (Creswell, 2012). The constructivist theory is a process in which the learner is building a personal experience. With the constructivist theory comes conceptual growth. Conceptual growth comes from the sharing of different perspectives and the changing of one’s internal representation in response to those perspectives as well as cumulative experience (Bednar, Cunnigham, Duffy, and Perry, 1995). The data collected provided information on best practices, which aided in
understanding if this type of curriculum was beneficial for understanding student success in secondary mathematics.

**Population and Setting**

This study was conducted at a rural high school in East Tennessee. The school was a 9-12th grade school composed of approximately 2300 students. The courses offered are rigorous: 19 Honors courses and 20 Advanced Placement courses. The study participants were faculty members directly involved in the mathematics curriculum. Of the 18-secondary high school mathematics educators (Algebra 1, Geometry, and Algebra 2 only) and seven administrators from the high school, eight were female and 17 were male. The gender categories of subjects taught were as follows: Algebra 1 – 5 females and 3 males; Geometry – 2 females and 3 males; Algebra 2 – 1 female and 4 males; Administrators – 2 females and 5 males. From this group of educators, 10 were randomly selected to participate in the study. These individuals were asked to fill out a questionnaire, and random teachers were selected from respondents for an interview to discuss their answers. Purposive sampling is used to produce a sample that can be logically assumed to be representative of the population (Lavrakas, 2008). Understanding the perceptions of teachers will be beneficial when deciding if an integrated mathematics curriculum is appropriate for future implementation.

**Data Collection Procedures**

Prior to beginning the study and the data collection process, permission was received from the Carson-Newman University Institutional Review Board. Permission from the school district was granted and requirements of the district were followed prior to beginning the study. Once the school district provided consent, the school administrator granted final approval.
Once approval was granted, a questionnaire was given to 20 Algebra 1, Geometry, and Algebra 2 teachers and seven administrators through Microsoft Forms via email that asked participants open-ended questions regarding their opinions about an integrated mathematics curriculum and best practices regarding the delivery of this curriculum. The open-ended questions were designed to encourage a full, meaningful answer using the responder’s own knowledge of an integrated mathematics curriculum. The most important benefit of open-ended questions is that they allow the researcher to find out more than what was anticipated (Farrell, 2016). The questionnaire responses were used as a foundation for questions asked during the individual interviews.

Individual interviews that are detailed give an understanding of teachers’ perceptions and opinions regarding an integrated mathematics curriculum. Using open-ended questioning, one can ask in-depth questions and glean the respondents’ true feelings about the topic. In this study, interviews were conducted with 10 teachers and administrators who currently teach Algebra 1, Geometry, or Algebra 2 and work directly with curriculum development. Open-ended questions were asked, allowing participants to explore his/her perceptions regarding an integrated mathematics curriculum as opposed to the traditional mathematics curriculum. While these questions were pre-determined, participants were allowed to discuss other opinions and ideas regarding the integrated mathematics curriculum. Each interview was audio recorded and then transcribed. The interviews occurred during the participants’ planning period and lasted between 30-45 minutes. Notes were made from the audio recording to provide a basis for the focus group’s meeting. A focus group was conducted with administrators and teachers. In this setting, a group discussion was facilitated between participants. With administrators and teachers in one
room, the participants provided conversation about their feelings regarding an integrated mathematics curriculum.

A focus group provides participants with an interactive group setting where they are free to talk with other group members about their feelings, beliefs, and opinions on a certain topic. Data was collected in a focus group by observing the communication and behaviors between participants. During this time, the group of participants were lead in discussion by asking questions that prompted the participants in an in-depth conversation. In this study, a focus group of 15 teachers was formed. The participants were interviewed to understand their opinions, possible best practices, and ideas on future implementation.

Data analysis was performed throughout the process of gathering data from questionnaires, interviews, and the focus group. As data were available, analysis occurred to best identify information that may affect subsequent questioning. This process adds fidelity to the grounded theory noted in this study. Transcripts were made of both notes and audio recordings taken during the interviews and focus group. Participants had access to the transcriptions to verify that their responses were correctly coded and interpreted. Throughout the data collection and analysis process, the findings were continuously discussed with a peer. Member checks were also conducted to ensure that the findings were valid.

**Ethical Considerations**

Researchers must keep in mind that participants are expecting full confidentiality with their personal information. Confidentiality is important in a qualitative study to ensure that the respondents information is kept totally private and any data that could identify them is thrown out.
Before the study began, permission was received from the Carson-Newman University Institutional Review Board. Following the University’s permission, approval was obtained from the school district, school administrator, and study participants. Participants were made aware that the study was voluntary and agreed to take part in the study. Consent forms were signed prior to the interviews and focus group. Stakeholders in education often prefer to keep their opinions to themselves in fear of others disagreeing with them. To avoid a lack of distrust, the school’s name and all participants’ names were kept anonymous.

**Data Analysis Procedures**

After the questionnaire, interviews, and focus group, data analysis occurred. Transcriptions were made of both the notes and audio recordings taken during the interviews and focus group. All participants were able to access the notes and recordings to ensure that their responses were interpreted and decoded correctly. Continuous discussions of the findings occurred throughout the data collection process with a peer debriefer. The role of the peer debriefer was to review the research for over emphasized points, vague descriptions, and detect bias or assumptions that could occur. The peer debriefer provided feedback to enhance credibility and validity.

Data coding is the process in which data is analyzed. Three types of coding were used in this study: open coding, axial coding, and selective coding. According to Miles and Huberman (1994, p.56), codes are tags and labels for assigning units of meaning to the descriptive or inferential information complied during a study. The first level of coding included open coding. In this process, the data was categorized into first level concepts, or master headings, and second-level categories, or subheadings.
Through a random sampling, 15 out of the 25 educators made up of Algebra 1, Geometry, Algebra 2, and administrators were selected to participate in the interview process. These participants were randomly assigned a number from one to 25. A number generator on a Texas Instruments calculator (TI-84 Plus edition) was used to generate 15 random numbers. From these numbers, participants were notified that they had been selected to participate in the interview and focus group process. Interviews were used to understand the participants’ viewpoints of integrated mathematics curriculum. Interviews were conducted using an electronic recording device. After the interviews took place, open coding was used to determine key words used by teachers, followed by axial coding, which helped determine commonalities among these terms. Finally, selective coding was used to indicate what opinions the stakeholders had regarding an integrated mathematics curriculum.

A focus group was conducted with the same 15 educators who completed the interview process and recorded using a smart phone device. Open coding was used to analyze the opinions the participants unveiled. Notes were made through axial coding to note any additional information from the participants. Finally, selective coding was used to determine patterns that occurred in the participants’ responses.

Throughout the entire process, findings were continuously discussed with a peer debriefer. According to Lincoln and Guba (1985), peer debriefers are important to researchers due to their ability to provide an external check of the data to ensure credibility. The role of the peer debriefer was to aid in reducing bias and to review transcriptions, the conclusions, and general methodology of the study. Another important aspect of qualitative studies is the use of member checks. Member checking is defined as a quality control process to improve the accuracy and validity of what has been recorded during the interview session (Barbour, 2001).
In this study, member checks were conducted to ensure that the findings of the study were accurate and valid. Data and results were returned to the participants to check for accuracy of their experiences.

Summary

To answer the research questions, a qualitative research study was conducted. Data were analyzed from questionnaires, interviews, and a focus group. Questionnaires were given to the teachers in the study to gain an understanding of their overall opinion of the current curriculum and their views of transitioning to an integrated mathematics curriculum. Individual interviews were held with participants to understand their opinions of an integrated mathematics curriculum. These questions provided a more in-depth understanding of the teacher’s opinions. A focus group comprised of the teachers and administrators was held to ask questions that were developed from the questionnaire.

From the results of the questionnaires, interviews, and focus group, data were coded, using open, axial, and selective coding, to determine patterns in relation to the research questions. The benefits of this research will aid in understanding teachers’ opinions regarding an integrated mathematics curriculum and will serve as a basis for future recommendation regarding implementation.
Chapter 4: Presentation of the Findings

Introduction

The purpose of the study was to determine the perceptions of educators’ regarding an integrated mathematics curriculum. In order to understand the educators’ views on the topic, the study was designed to determine teachers’ perceptions of best practices in integrated mathematics instruction and the differences and similarities in honors and regular mathematics courses. All research was completed during school hours. Teacher questionnaires were delivered via school email on Microsoft Forms; the interviews were recorded using an electronic device during teachers’ planning period. Additionally, the teacher focus group was conducted after school and recorded on an electronic device. Two research questions guided this study:

3. What are educators' perceptions regarding best practice integrated mathematics instruction for honors and regular math high school courses?

4. What similarities and differences exist in mathematics instruction in honors and regular math high school courses?

Description of Participants

This study was conducted at a rural high school in East Tennessee. The school was a 9-12th grade school composed of approximately 2300 students. The study participants were faculty members directly involved in the mathematics curriculum. Of the 18-secondary high school mathematics educators (Algebra 1, Geometry, and Algebra 2 only) and seven administrators from the high school, eight were female and 17 were male. The gender categories of subjects taught were as follows: Algebra 1 – 5 females and 3 males; Geometry – 2 females and 3 males; Algebra 2 – 1 female and 4 males; Administrators – 2 females and 5 males. From
this group of educators, 20 individuals responded to the questionnaire. From the 20, 10 were randomly selected to participate in the interview and focus group portion of the study.

**Table 4.1**

*Categorization of Participants by Subject*

<table>
<thead>
<tr>
<th>Subject</th>
<th>Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra 1</td>
<td>6</td>
</tr>
<tr>
<td>Geometry</td>
<td>3</td>
</tr>
<tr>
<td>Algebra 2</td>
<td>7</td>
</tr>
<tr>
<td>Administration</td>
<td>4</td>
</tr>
</tbody>
</table>

**Data Collection Process**

A questionnaire was distributed to each participant via an online Microsoft Forms document. The teachers chose to voluntarily participate with the understanding that the information was anonymous. A total of 20 teachers participated in the online questionnaire. Figure 4.1 details the number of teachers from each subject that participated. The purpose of the questionnaire was to identify teachers’ perceptions regarding an integrated mathematics curriculum and understand their general opinions on the topic.

Within these 20 teachers, 10 were randomly selected to participate in the interview process. During the interviews, teachers were asked to clarify their responses to the open-ended questions that were asked on the questionnaire. The interviews were audio-recorded for data collection and transcribed to better understand their perceptions of best practices regarding an integrated mathematics curriculum. This data were used to answer both research questions.
Using the same 10 teachers that participated in the interviews, a focus group was conducted. As a group, teachers were asked to delve into their responses and have a meaningful conversation of what they felt the best practices were in an integrated mathematics curriculum. They also discussed the differences and similarities among an honors integrated mathematics curriculum and a regular integrated mathematics curriculum.

**Description of the Questionnaire**

To determine the depth of knowledge of an integrated mathematics curriculum, data were collected through an online questionnaire that was sent to mathematics teachers and administrators. The questionnaire included questions that were Likert scale, ranking, and open-ended questions.

The questions included:

1. On a scale from 1 to 5, with 1 being not at all familiar and 5 being very familiar, how familiar are you with the integrated mathematics curriculum?

   Using Strongly Disagree to Strongly Agree, answer the following statements.

2. Integrated mathematics provides students with an opportunity to connect strands of mathematics together.

3. My teaching strategies would have to change to incorporate this type of curriculum.

4. Professional development would need to be implemented for me to understand this curriculum.

5. I am comfortable teaching strands of mathematics concepts (Algebra 1, Geometry, Algebra 2, Probability and Statistics, and Trigonometry).

6. An honors integrated mathematics curriculum should be distinctly different than a regular integrated mathematics curriculum.
Questions 7-10 were open-ended response questions with questions seven and 10 directly addressing the research questions of the study.

7. What best practices are associated with an integrated mathematics curriculum?

8. How can the best practices you listed above be incorporated into an integrated mathematics curriculum?

9. In your opinion, which type of curriculum (traditional or integrated) better meets the needs of the Tennessee Academic Standards?

10. Do you feel there are similarities and differences regarding best practices and instruction for an honors integrated mathematics curriculum versus a standard integrated mathematics curriculum?

**Questionnaire Findings**

Once the data were collected, a thorough analysis was conducted to understand teachers’ perceptions. When asking about the familiarity of an integrated mathematics curriculum in Question 1, the average familiarity was 2.9 out of 5. For Questions 2-6, a series of statements were given to determine teachers’ understanding in using best practices associated with an integrated mathematics curriculum. Figure 4.2 displays the total number of responses and percentages for each category.
Table 4.2

*Teachers’ Perceptions and Understanding of an Integrated Mathematics Curriculum*

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 2</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>3 (15)</td>
<td>16 (80)</td>
<td>1 (5)</td>
</tr>
<tr>
<td>Question 3</td>
<td>0 (0)</td>
<td>9 (45)</td>
<td>5 (25)</td>
<td>5 (25)</td>
<td>1 (5)</td>
</tr>
<tr>
<td>Question 4</td>
<td>0 (0)</td>
<td>2 (10)</td>
<td>2 (10)</td>
<td>9 (45)</td>
<td>7 (35)</td>
</tr>
<tr>
<td>Question 5</td>
<td>2 (10)</td>
<td>1 (5)</td>
<td>2 (20)</td>
<td>2 (20)</td>
<td>9 (45)</td>
</tr>
<tr>
<td>Question 6</td>
<td>1 (5)</td>
<td>1 (5)</td>
<td>2 (10)</td>
<td>7 (35)</td>
<td>9 (45)</td>
</tr>
</tbody>
</table>

Questionnaire Open-Ended Question One

The first open-ended question was, “What best practices are associated with an integrated mathematics curriculum?” Once the data were analyzed, several themes emerged related to this question. Below, Table 4.3 depicts that key findings of open-ended question one.

Table 4.3

*Key Findings of Open-Ended Question One*

<table>
<thead>
<tr>
<th>Key Findings</th>
<th>Number of Participants and Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linking Concepts through Real-world applications and Inquiry Based learning</td>
<td>8 (40)</td>
</tr>
<tr>
<td>Professional Development</td>
<td>4 (20)</td>
</tr>
<tr>
<td>Projects and Manipulatives</td>
<td>4 (20)</td>
</tr>
<tr>
<td>Planning and Scaffolding</td>
<td>2 (10)</td>
</tr>
<tr>
<td>Active Student Involvement</td>
<td>1 (5)</td>
</tr>
<tr>
<td>Technology use</td>
<td>1 (5)</td>
</tr>
</tbody>
</table>
Overwhelmingly, participants stated they felt different types of learning and teaching strategies could be utilized in an integrated mathematics curriculum. Participant 1 stated “discovery learning and deriving concepts” was an important best practice to implement into this type of curriculum. A seamless transition was also mentioned in the responses. Participant 4 stated a “seamless transition would help the students distinguish between the different content areas while comprehending how they are connected.”

Some participants suggested the flipped classroom approach, where students watch a video lesson at home and then come in the next day to practice problems related to that topic. Participant 8 stated “a flipped classroom, technology assisted, and individualized prescriptive teaching are strategies which would enhance any instructional practice.” Participants’ also felt that it would be beneficial for students to self-discover ways to link concepts to the real-world. Participants’ stated that real-world application problems would need to be an essential best practice to enhance the student learning and understand how the mathematics strands really connect. Through these types of problems, students will be able to use algebra, geometry, and other mathematics to solve one application.

Respondents’ to the survey also stated they would need adequate professional development in order to implement best practices into an integrated mathematics curriculum. Participant 10 mentioned that “high quality professional development” would be needed. This can be done through common planning times or through professional learning communities. The ability to work with other colleagues to understand new ways to teach a concept is essential when developing a new curriculum. Participants’ also stated that during the professional development, they would be able to plan together and create common assessments.
Open-Ended Question Two

Open-ended question two asked teachers to further examine how the best practices they listed in question one could be incorporated within an integrated mathematics curriculum. These provided a more in-depth look into the participants’ ideas of best practices. Figure 4.4 details the key findings of the responses.

Table 4.4

*Key findings of Open-Ended Question Two*

<table>
<thead>
<tr>
<th>Key Findings</th>
<th>Number of Participants and Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorporate activities/projects</td>
<td>6 (30)</td>
</tr>
<tr>
<td>Easy Transition due to Prior Knowledge</td>
<td>5 (25)</td>
</tr>
<tr>
<td>Planning and Professional Development</td>
<td>3 (15)</td>
</tr>
<tr>
<td>Incorporate technology</td>
<td>1 (5)</td>
</tr>
</tbody>
</table>

After analyzing the responses from open-ended question two, certain themes began to develop. Thirty percent of the participants responded that incorporating activities and project based learning would be ways they would incorporate the best practices into an integrated mathematics classroom. Participant 2 stated having “students’ complete projects that use the application of the skills learned” would need to be incorporated within the curriculum. Participant 12 stated “student projects should be incorporated where research (or review) is required would be essential for making the students see the connections. Implementing these projects would require disciplined students along with an instructor that would allow the students to struggle with the concepts taught.” Participant 11 stated teachers should “plan activities that
directly involve action on the part of students and are relevant to students. Teachers should also limit lecture and incorporate student activities within the lecture.”

Participants also felt that due to the fact that students will already have prior knowledge, transitioning from each concept would be easier. Participant 7 stated “when a concept is covered in Algebra 1, it can be directly used in a geometry situation without the need of re-teaching the skill.” This will allow teachers to move forward quickly without having to stop and review material that should have already been covered or that students forgot. Participant 19, an administrator, suggested that “linking concepts and standards to ones previously learned” would be a necessity in the classroom.

Planning and professional development are critical to the implementation of any curriculum but they are extremely important when implementing best practices into an integrated mathematics curriculum. Professional development will be needed to help teachers with new strategies and methods of instruction. Participant 4 stated “teachers will have to have a good grasp on the content and how to present it. This may be attained by professional development targeting these practices. The professional development should target each level of math individually, while also offering time for all levels to work together to increase fluency and coherency.” During the professional development or professional learning community, teachers should collaborate to make informed decisions about what best practices have actually worked in their classroom.

Only one participant on the questionnaire responded that technology should be incorporated into the classroom. During the focus group, all participants stated technology would play a vital role in their teaching practices. With technology, teachers will be able to provide students with online resources to aid in their learning.
Open-Ended Question Three

After analyzing the participants’ responses in open-ended questions one and two, the question of which type of curriculum would better meet the needs of the Tennessee Academic Standards was asked to gage an idea of the participants’ opinions. Figure 4.5 details the key findings on participants’ opinions of traditional mathematics curriculum or an integrated mathematics curriculum.

Table 4.5

<table>
<thead>
<tr>
<th>Key Findings/Curriculum Type</th>
<th>Number of Participants and Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Mathematics Curriculum</td>
<td>9 (45)</td>
</tr>
<tr>
<td>Integrated Mathematics Curriculum</td>
<td>6 (30)</td>
</tr>
<tr>
<td>Not sure</td>
<td>5 (25)</td>
</tr>
</tbody>
</table>

Each participant was asked their feelings about an integrated mathematics curriculum and a traditional mathematics curriculum with respect to the Tennessee Academic Standards. Out of the responses, 45% of the participants stated they feel a traditional mathematics curriculum best meets the needs of the Tennessee Academic Standards. Participant 12 had a very specific example of why the traditional mathematics curriculum best meet the needs of the standards. Participant 12 stated “the traditional curriculum is better at teaching pure mathematics. There are too many topics within math that do not have an immediate application (simplifying radicals for exact answers) that would be omitted in the integrated curriculum. When investigations and applications are utilized, students do not always go for the "math" way of solving a problem. As the standards currently exist, there are still topics from pure math (powers of i) that would
require a traditional approach to teach. The integrated approach would, however, contribute to creating better problem solvers if the curriculum is implemented properly. Some of the standards, such as persisting in problem solving, would be better addressed through an integrated approach. As the current standards are written, the best curriculum would be traditional with the inclusion of rigorous student projects (if time allowed, and the students had the work ethic).” Participant 9 stated the Tennessee Academic Standards would be best met with a “combination of the two.” Participants also stated if the school system decided to switch to an integrated mathematics curriculum, “it would be a nightmare” due in part to some students already being enrolled in the traditional curriculum. One participant even stated that transfer students from other states or counties might have a difficult time entering a district with an integrated curriculum. Participants understand the pros of an integrated mathematics curriculum, but prefer the traditional approach the best.

**Open-Ended Question Four**

Open-ended question four was designed to answer research question two. The question “Do you feel there are similarities and differences regarding best practices and instruction for an integrated mathematics curriculum versus a traditional mathematics curriculum?” was asked to determine if the curriculum should be different or similar. Figure 4.6 details the key findings from the responses of the participants.
Table 4.6

*Key Findings from Open-Ended Question Four*

<table>
<thead>
<tr>
<th>Key Findings</th>
<th>Number of Participants and Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honors courses should provide more rigor and higher</td>
<td>14 (70)</td>
</tr>
<tr>
<td>order-thinking skills</td>
<td></td>
</tr>
<tr>
<td>There should be similarities in activities</td>
<td>5 (25)</td>
</tr>
</tbody>
</table>

From the responses given in open-ended question four, 70% of the participants’ feel that honors courses should be different when it comes to the rigor and pacing of the course. While participants’ feel there should be some similarities in teaching strategies, the level of higher order thinking skills must be present in an honors course.

Overwhelmingly, 70% of the responses on open-ended question four stated the main difference between a traditional and honors integrated mathematics curriculum would be the rigor. The participants suggested that for an honors class to truly be on an honors level, the rigor and expectations must be at a greater pace than that of a traditional integrated mathematics class. Participant 3 stated “there are plenty of similarities between honors and standard, but there is one distinct difference: Rigor. I will expect my honors classroom to go a bit deeper, and push themselves harder with individual directed learning.” Participant 7 had the same opinion stating “Honors students must be held to higher standards and should be expected to meet those expectations. I have always initially presented the material in a similar manner, but in an honors class, I expect the students to work more on their own or in a group to solve problems and work through difficulties they may face. I do this much less in a standard classroom, where students need more scaffolding.”
Study Findings

After finalizing the preliminary phase of the data collection process, data were sorted through open, axial, and selective coding. From this data, common themes were narrowed to categories which express a clear understanding of teachers’ perceptions of best practices regarding an integrated mathematics curriculum. Through the initial open and axial coding, themes developed which support the categories in presenting pertinent information to answer the research questions. Selective coding permitted the data to be separated into two categories which address the two research questions. The study results have been divided into two categories with the themes to justify each. Table 4.6 and 4.7 illustrate the level of coding for the study.
Table 4.7
Data Sorted in Levels of Coding for Research Question One: What are educators’ perceptions regarding best practice integrated mathematics instruction for honors and regular math high school courses?

<table>
<thead>
<tr>
<th>Raw Data</th>
<th>Open Coding</th>
<th>Axial Coding</th>
<th>Selective Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Parent communication, high quality and professional development are essential best practices”</td>
<td>Professional Development</td>
<td>Professional growth and understanding</td>
<td>Educator expertise and effective, relevant instructional strategies are perceived as best integrated math practices</td>
</tr>
<tr>
<td>“The professional development should target each level of math individually, while also offering time for all levels to work together to increase fluency and coherency.”</td>
<td>Communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“It is essential that teachers are provided proper training on how to incorporate these practices”</td>
<td>Experienced Instructors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Inquiry and problem solving focused lessons. Critical thinking and knowledge application skills.”</td>
<td>Deriving concepts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Scaffolding will happen easily in an integrated math classroom. There should be a pretty natural flow to the instruction.”</td>
<td>Project based learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Plan activities that directly involve action on the part of students and are relevant to students.”</td>
<td>Scaffolding/Linking Concepts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“A flipped classroom, technology assisted, and individualized prescriptive teaching are strategies.”</td>
<td>Flipped classroom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Manipulatives and providing as many representations and chances at mastery as possible.</td>
<td>Discovery learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Real-world application problems can be given at the end of a lesson to assess all the skills students have learned.”</td>
<td>Blended learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Graphing activities are imperative. Activities matching graphs, equations, transformations, translations, and restrictions would be helpful.”</td>
<td>Critical thinking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“problem solving, test taking strategies, real life application of concepts, etc.”</td>
<td>Knowledge application skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chester education, high quality and professional development are essential best practices”</td>
<td>Test taking strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“The professional development should target each level of math individually, while also offering time for all levels to work together to increase fluency and coherency.”</td>
<td>Real-world examples</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“It is essential that teachers are provided proper training on how to incorporate these practices”</td>
<td>Use of manipulatives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Inquiry and problem solving focused lessons. Critical thinking and knowledge application skills.”</td>
<td>Graphing activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Scaffolding will happen easily in an integrated math classroom. There should be a pretty natural flow to the instruction.”</td>
<td>Use of technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Plan activities that directly involve action on the part of students and are relevant to students.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“A flipped classroom, technology assisted, and individualized prescriptive teaching are strategies.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Manipulatives and providing as many representations and chances at mastery as possible.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Real-world application problems can be given at the end of a lesson to assess all the skills students have learned.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Graphing activities are imperative. Activities matching graphs, equations, transformations, translations, and restrictions would be helpful.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“problem solving, test taking strategies, real life application of concepts, etc.”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.8
Data Sorted in Levels of Coding for Research Question Two: What similarities and differences exist in mathematics instruction in honors and regular math high school courses?

<table>
<thead>
<tr>
<th>Raw Data</th>
<th>Open Coding</th>
<th>Axial Coding</th>
<th>Selective Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I think the similarities would revolve around activities, duration of instruction assigned to specific topics, use of technology and use of manipulatives.”</td>
<td>Similar standards are taught in a regular course</td>
<td>Similar teaching and learning strategies</td>
<td>Similar instructional strategies and different rigor expectations exist regarding regular and honors integrated mathematics courses</td>
</tr>
<tr>
<td>“There must always be similarities in instruction simply due to content.”</td>
<td>Similar activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Similarities: same standards”</td>
<td>Similarities in instruction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“I have always initially presented the material in a similar manner.”</td>
<td>Classes should be uniform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“The practices could be used in both courses with the timing and elimination of topics in the honors course.”</td>
<td>Best practices can be used in both types</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“The honors class should need less scaffolding.”</td>
<td>Technology use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“honors should be more complex and demand higher-order thinking.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“there is one distinct difference: Rigor. I will expect my honors classroom to go a bit deeper, and push themselves harder with individual directed learning.”</td>
<td>Difficulty of problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Honors students must be held to higher standards and should be expected to meet those expectations.”</td>
<td>Amount of assistance on assignments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“honors classes should be geared to more hands-on application and real world modeling.”</td>
<td>Honors is Quality not Quantity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Provide critical thinking skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>More rigorous</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make assumptions of prior knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Demand higher order thinking skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Real-world modeling and self-discovery</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Analysis of the Participant Interview Data

Interviews were conducted with 10 participants from the study. Random numbers were given to participants. Purposeful sampling was conducted using a TI-84 calculator number generator. Random numbers were given to identify the individuals that would participate in the interview process. The teachers were asked to reflect on their current teaching practices when responding to the questions that were asked. All teachers were asked the same questions in a semi-structured interview. Member checks were conducted to ensure correct understanding of the responses that participants gave through follow-up questions and restatement of the participants’ thoughts. Sessions were recorded, then transcribed for each response. The questions asked were clarifying questions from the questionnaire to better understand each participants’ response. Participants’ were challenged to think deeper about their responses answered on the questionnaire.

The interviews were conducted with 10 mathematics teachers on a one-on-one basis. These interviews took place in a school setting, and the interview questions were reviewed for possible misunderstanding by one secondary teacher that did not participate in the study. From these interviews, four themes became evident about best practices regarding an integrated mathematics curriculum; best practices for schools, best practices for curriculum development, best practices for students, and best practices for teachers. Table 4.8 details the respondents and subject area that they teach followed by a detailed narrative of the findings.
Table 4.9

*Subject Taught by Interview Participants*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Subject Area Taught</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 1</td>
<td>Algebra 1</td>
</tr>
<tr>
<td>Participant 2</td>
<td>Algebra 1</td>
</tr>
<tr>
<td>Participant 3</td>
<td>Geometry</td>
</tr>
<tr>
<td>Participant 4</td>
<td>Geometry</td>
</tr>
<tr>
<td>Participant 5</td>
<td>Algebra 2</td>
</tr>
<tr>
<td>Participant 6</td>
<td>Algebra 2</td>
</tr>
<tr>
<td>Participant 7</td>
<td>Algebra 2</td>
</tr>
<tr>
<td>Participant 8</td>
<td>Algebra 2</td>
</tr>
<tr>
<td>Participant 9</td>
<td>Algebra 2</td>
</tr>
<tr>
<td>Participant 10</td>
<td>Algebra 2</td>
</tr>
</tbody>
</table>

**Professional growth and understanding.**

Four of the 10 participants stated schools must provide the appropriate best practices for teachers in order for the curriculum to be successful.

Participant 3 stated specific modeling and professional development would be needed to understand the best ways to teach the curriculum and implement the best practices that are associated.

Participant 6 stated an experienced educator would be required due to the fact of incorporating multiple subjects. “If you're going to include trigonometry you need somebody that knows what is available in trig that can be included.” “Same thing with Statistics; you need
somebody that's taught enough statistics and has enough examples to include so that when you're in the middle of the binomial theorem for example they know hey this is the statistical application of the binomial theorem which we cover in the middle of polynomials.”

Participant 7 stated “Most teachers are typically used to teaching only one subject maybe so, in order to incorporate multiple subject areas into the same class, I think teachers would be more comfortable if there was quite a bit of professional development not only in how to pull the subjects together and teach them but maybe even refreshers in some of those other subject areas because myself if it's something I haven't ever taught.” Participant 7 also stated communication with parents and other stakeholders would need to be in place for everyone to understand “what the curriculum is and why we are moving toward it.”

Participant 10 stated “Just talking about the best ways to incorporate that new way of thinking is critical. I mean you've got to have new ways of teaching mathematics. You're going to have to teach things you haven’t taught before because there’s stuff in Geometry that I've not taught in….well ever.” Participant 10 expressed the need to have very specific professional development opportunities. Participant 10 also stated modeling of a lesson would be very helpful. “I think it would be nice to see our math specialist or someone with a little bit of experience or I would go and watch someone who is currently teaching integrated mathematics.”

**Effective instructional strategies.**

From the initial questionnaire, nearly all of the responses included real-world application or project-based learning. As with any new curriculum, understanding what instructional strategies to use in the classroom is essential. Curriculum development is essential when determining what is best for students.
Participant 4 stated “Students need to see the relevance to their own lives in order to be motivated in anything so problem-solving and real life applications allow them to see the need for the content being taught.”

Participant 5 stated “creative and applied concepts are when you start integrating multiple concepts together. It allows for a lot of creativity in the assignments.” Participant 5 suggested that instead of looking at a broad concept, integrating it makes the topic realistic and students would be able to take something from it that they can use in real life.” Participant 5 also stated inquiry-based learning would be beneficial because of the similarities it shares with an integrated curriculum.

Participant 6 stated projects must be incorporated into the curriculum. “When the Common Core was first introduced, it wasn't necessarily the standards that changed as much as how Tennessee trained all of us. The training was geared toward a pedagogy approach. They wanted task arcs where the students had to do several things, such as hands-on activities and investigations.”

Participant 8 stated “in-depth analysis” enables the student to answer the “why” questions and with the use of projects, students are able to answer those questions with complete understanding. This will enable the students to use higher-order thinking skills that are associated with an integrated mathematics curriculum.

Relevant activities to enhance student learning.

Specific strategies provided to students is imperative in any curriculum. In an integrated mathematics curriculum, knowing and understanding what will help students succeed is one of the most important aspects of the curriculum.
Participant 1 had many ideas on how to help students be successful in an integrated mathematics classroom. With the use of technology, students are able to use computer programs to aid in their retention and mastery of the material. “Delta math was created by an individual up in New York who created Delta math and he wanted to target secondary mathematics skills related to Common Core Standards.” These rigorous questions provide students with prescriptive feedback that will enable them to understand what areas of the curriculum they are lacking in. Individualized curricula are essential for all students. “Being able to work on skills with real-time analytics provides the student with immediate feedback.”

Participant 4 believes that blended learning would aid in student success in an integrated mathematics classroom. “Having students do a portion of new instruction at home such as watching videos or power point notes to be ready for the examples and practice when they get to school….”

Participant 9 stated active student involvement is an essential best practice. “Students learn better by doing rather than watching so I just think it's important for them to actively practice something and make their own mistakes. Really the more senses that they can engage from sensory to visual to hearing on a problem, the better that they're going to be able to make connections.”

Teachers hold the key to students’ learning. Through multiple strategies and techniques, teachers must engage and prepare students to pass standardized tests and master the subject material. From the study, participants stated many best practices that teachers could use in an integrated classroom for students to be successful.
Participant 4 stated one important best practice is test taking strategies. “Students need to understand the reason behind standardized testing and the benefits to themselves for doing their best to be prepared for these tests and the rewards for their efforts.”

Participant 8 suggested their needs to be a seamless transition from a traditional classroom to an integrated classroom. “I prefer traditional because that's what most schools around here use and so and in fact most schools across the Eastern region of the United States. So if you have transfer students who are coming in from another system or from another state it's easier for them to transition in to the traditional system as opposed to trying to transition into the integrated system.” Being able to provide incoming students with an appropriate transition is important in the students’ academic careers. This is one major downside of an integrated mathematics curriculum due to the fact that students could be missing important information during the process.

Participant 5 states that multiple representations is an important best practice in an integrated mathematics classroom. “an example of that would be you doing the quadratic formula and so you start integrating multiple steps. You have to know a b and c values, you have to know standard form, you got to know how to simplify radicals, you got to know how to sometimes take out of a greatest common factor. The students know all of those things. They might not necessarily know quadratic formula, but if you get them the building blocks then they can kind of take it and go with it because they already have the information that they need to do everything within that concept.” Being able to provide students with multiple representations will essentially equip them with a mathematical toolbox that can be used in more advanced mathematics classes.
Participants also noted that the use of technology in the classroom is a key best practice. Being able to prepare students for the real-world and college means that students must be fluent in technological skills. Therefore, the use of an online learning platform, online assessment programs, and basic computer skills will be essential in preparing students to be college and career ready.

**Analysis of the Similarities and Differences of an Integrated Mathematics Curriculum**

During the interview process, participants were asked what similarities and differences exist within an honors integrated mathematics curriculum and regular integrated mathematics curriculum.

**Similar teaching and learning strategies.**

Participants stated the standards would be the same for an honors integrated and a regular integrated mathematics curriculum. Participant 3 stated students in an honors integrated mathematics class would be able to “explore and find things out on their own” instead of leading them through the material.

Participant 5 stated “I think it would be the same thing as standard integrated would-it would be the same thing you would do an honors integrated-it would just be a whole lot faster and you would introduce stuff to those students at a quicker pace than you would a normal classroom.”

Participant 7 stated “Content-wise you're still doing the same thing so you still have to cover the same content.” Participant 1 agreed stating that in an integrated mathematics classroom, students “would be ability matched according to the students individualized needs.”
Participants also suggested that the use of technology and the similarities with instruction would be the same in any mathematics classroom. The way the teacher presents the material would be the same.

**Different expectations of work, rigor, and demands.**

Overwhelmingly, participants stated an honors integrated mathematics curriculum should be more rigorous than a regular integrated mathematics curriculum. This would include students using self-discovery to learn the concepts. Whether it is the difficulty of the problems that are given or the enrichment activities, all participants agreed that an honors curriculum is based on the idea of quality not quantity. In other words, what makes an honors course truly honors is not the amount of work given, but the quality of instruction, activities, and use of prior knowledge that make it rigorous. Participant 8 stated “Well the honors class, just because of the way we do it here, you have less time. You just have a semester so it has to be a quicker pace plus that type of kid would probably lose focus if you spent as much time as you have to doing it in a traditional or a standard class.”

Participant 9 stated “When you're in a standard class, you tend to just hit the highlights and kind of skim over topics. You don't really tend to do in-depth analysis types of questions, which are the higher order thinking skills just simply because you're trying to get them through the math part of it. So, I think one of the different ways you can differentiate between a standard class and an honors class is by having them do more in-depth projects or in-depth analysis and have them answer the why questions.”

**Analysis of the Focus Group**

A focus group was conducted with the 10 participants to see if their views and opinions changed from the questionnaire and the interview. This group met after school in a round table
discussion and addressed the research questions related to the study. During this time, participants were able to review their answers from the questionnaire and responses to the interview questions. The participants were involved in the focus group session and openly listened to the ideas of others through meaningful and respectful conversation. After a thorough analysis of the questionnaires, interviews, and focus group, it was found that the participant’s views had not changed. As a group, the participants stated the main best practice that is associated with an integrated mathematics curriculum was real-world application problems. They also conferred that the main similarity and difference that exists between a regular integrated mathematics curriculum and an honors integrated mathematics curriculum would be the rigor of the course. They stated the quality of the instruction and its rigor are what truly make any mathematics course an honors course. A complete transcription of the focus group can be found in the Appendix B.

Summary

Chapter 4 provides an analysis of demographic and interview data. The purpose of this study is to understand teachers’ perceptions of an integrated mathematics curriculum and understand what best practices are associated with an integrated mathematics curriculum. It also addresses the similarities and differences in a regular and honors integrated mathematics curriculum. Analysis of the data gathered occurred to assist in answering the following research questions:

1. What are educators' perceptions regarding best practice integrated mathematics instruction for honors and regular math high school courses?

2. What similarities and differences exist in mathematics instruction in honors and regular math high school courses?
Data were collected using questionnaires, semi-structured interviews, and a focus group. The data sources were analyzed, and common themes emerged. There are four themes that appear with the participants. From the participants, four themes became evident regarding the best practices that are associated with an integrated mathematics curriculum: best practices for schools, best practices for curriculum development, best practices for students, and best practices for teachers. Two themes emerged from the participants regarding the similarities and differences that exist in a regular integrated mathematics curriculum and an honors integrated mathematics curriculum. Chapter 5 details the qualitative research findings, conclusions, and inferences from these data, as well as recommendations for future research.
Chapter 5: Conclusions, Implications, and Recommendations

The fifth chapter is separated into four sections to examine the findings of this qualitative study. The study summary is examined first, followed by an analysis of the findings with discussion of the available literature. The third section details the implications of the study. The concluding section proposes recommendations for future research pertaining to secondary teachers’ perceptions of best practices regarding an integrated mathematics curriculum.

Summary of the Study

The implementation of an integrated mathematics curriculum has been researched in many studies. Frequently, related studies on the benefit of an integrated mathematics curriculum include an investigation of student achievement on standardized assessments, quality of textbooks, and the benefits of the different curricula available. The purpose of this qualitative study was to investigate teachers’ perceptions of best practices regarding an integrated mathematics curriculum and the similarities and differences of a regular and honors integrated mathematics curriculum. The qualitative study is comprised of data from semi-structured teacher interviews. In order to achieve triangulation and to inform the examination of the teacher interviews, data were collected from an online questionnaire and a focus group. A total of 20 secondary mathematics teachers and administrators, teaching either Algebra 1, Geometry, Algebra 2, or in administration directly involved with curriculum development, responded to the online questionnaire. The questionnaire asked for volunteers willing to be interviewed for the purpose of gaining further information on the perceptions of best practices regarding an integrated mathematics curriculum.

From the teachers who responded to the questionnaire and agreed to be interviewed, 10 participants were randomly selected using purposeful sampling. The analysis of the data from
this study offers a greater understanding of teachers’ perceptions of best practices regarding an integrated mathematics curriculum and the similarities and differences between a regular and honors integrated mathematics curriculum. This qualitative study was driven by the following research questions:

1. What are educators’ perceptions regarding best practice integrated mathematics instruction for honors and regular math high school courses?
2. What similarities and differences exist in mathematics instruction in honors and regular math high school courses?

Findings

All study participants work in a public secondary school in upper East Tennessee. A comprehensive analysis of data collected from the online questionnaire, semi-structured interviews, and focus group provide answers to the qualitative research questions. The findings of this study are formed on the triangulation of three separate sources: online questionnaires, teacher interviews, and a focus group. To increase the credibility of the study, triangulation, member checks, and peer debriefing were used during the research process. The following summary of the findings related to each individual research question and the themes that developed from the transcripts, online questionnaire, and focus group.

Research Question One

All participants who were interviewed agreed that best practices play a vital role in an integrated mathematics curriculum. Interviewed teachers’ explanations varied on what the best practices actually were, but three distinct themes developed from the data collected on the perceptions of best practices regarding an integrated mathematics curriculum. These themes are:
professional growth and understanding, effective instructional strategies, and relevant activities to enhance student learning.

It is important to understand what best practices are for the school, curriculum, students, and teachers. Not only is it essential to incorporate best practices within instruction, one must also develop an understanding of how it will affect these areas. Mathematics teachers are experts in their field and many have taught multiple mathematics subjects over the years. Four of the 10 participants stated that schools must provide the appropriate best practices for teachers in order for the curriculum to be successful. They stated this could be through professional development activities and communication with parents about what the curriculum actually is and how it will be implemented. Participant 3 stated that specific modeling and professional development would be needed to understand the best ways to teach the curriculum and implement the best practices that are associated. Without an understanding of the curriculum, students and teachers will not be successful.

It was also determined that effective instructional strategies and relevant activities to enhance student learning were important to participants. From the initial questionnaire, nearly all of the responses included that students should be asked to learn independently through self-discovery and that the curriculum should provide relative real-world applications so that students would be able to apply the concepts to their everyday lives. Participant 4 stated “Students need to see the relevance to their own lives in order to be motivated in anything so problem-solving and real life applications allow them to see the need for the content being taught.” Questionnaire responses indicated that 40% of the participants think that linking concepts through real-world applications and inquiry-based learning was important. After the interview and focus group, all teachers were of the opinion that real-world application to student lives was extremely important.
In the initial questionnaire, 5% of the participants felt that active student involvement was important. After the interviews and focus group, it was found all participants agreed that active student involvement was essential best practice for students themselves. Students must be motivated and interested in the topic to be totally involved in the lesson. Therefore, with the use of manipulatives and other best practices, students would be able to be engaged in their learning process. Participant 9 stated, “Students learn better by doing rather than watching so I just think it's important for them to actively practice something make their own mistakes. Really the more senses that they can engage from sensory to visual to hearing on a problem, the better that they're going to know what the better going to be able to make connections.” Through multiple strategies and techniques, teachers must engage and prepare students for assessments and post-secondary opportunities. From the data, test taking strategies, limited lecture, use of manipulatives, graphing activities, and use of technology were some of the best practices that can enhance instruction.

From the questionnaire, interviews, and focus group, the final consensus of the group was that educator expertise and effective, relevant instructional strategies are perceived as the most beneficial best practices to incorporate into an integrated mathematics curriculum. Being able to apply a concept to the lives of students and have them see that it holds relativity in their everyday life is important.

**Research Question Two**

The second research question that was addressed was the similarities and differences that exist in a regular and honors integrated mathematics classroom. After asking this question on the questionnaire, in the interviews, focus group, the two themes emerged. They were similar teaching and learning strategies and different expectations of work, rigor, and demands.
Similarities in Regular and Honors Integrated Mathematics Curriculum

Overwhelmingly, the participants stated that they felt the standards and instructional strategies would be the same due to the fact that all students are required to take the same state assessment and that the total curriculum must be taught. Participant 7 stated, “Content-wise you're still doing the same thing so you still have to cover the same content.” Participant 1 agreed stating that in an integrated mathematics classroom students “would be ability matched according to the students individualized needs.” In other words, instruction would be the same, but the pace and best practices would be different. One similarity that participants stated would be the same was technology. In a society where technology is used daily, schools are moving toward a one-to-one initiative to ensure that students get the appropriate training by using online learning platforms similar to those found at the college level. All participants felt that appropriate use of this technology is an important best practice to incorporate into any classroom.

Differences in Regular and Honors Integrated Mathematics Curriculum

The major finding of differences in a regular and honors integrated mathematics curriculum was rigor. From the questionnaire, 70% of the participants mentioned rigor in their response. Participants felt that a faster pace, more in-depth explanation of the mathematics, and project-based learning was essential for an honors integrated mathematics course. Participants also stated that honors is about quality not quantity. In other words, students should not be required to work 50 homework problems, but instead, receive instruction that goes beyond rote memorization. Participants also conferred that higher-order thinking skills are necessary in an honors class. This could be provided through independent learning opportunities or enrichment activities that provide students with these skills.
Implications

The findings in this study noted themes and ideas that teachers hold to be true when discussing best practices associated with an integrated mathematics curriculum and the similarities and differences of a regular and honors integrated mathematics curriculum. From these findings, four implications can be formulated: schools must provide professional development on best practices for an integrated mathematics curriculum before implementation, real-world examples must be the best practice used in an integrated mathematics curriculum to ensure students have relative meaning in their everyday lives, standards do not change, and therefore, integrated mathematics courses should be using the same best practices, and an honors integrated mathematics curriculum must be rigorous to ensure that students are receiving the in-depth knowledge needed to meet expectations in future advanced mathematics courses and prepare them to be college and career ready. All teachers interviewed stated different ways that the best practices of an integrated mathematics curriculum could be used and expressed their opinions on regular and honors integrated mathematics curriculum. With these best practices that were stated by the participants, school systems will be able to implement this type of curriculum in the future.

Recommendations for Future Research

With the increase of state-mandated assessments and teacher accountability, the opportunity for future research is vast. This study focused on teachers’ perceptions of best practices regarding an integrated mathematics curriculum and the similarities and differences between a regular and honors integrated mathematics curriculum. Future recommendations would include broadening the region of data collection. This study utilized one school district in upper East Tennessee; therefore, broadening the region would provide a more representative
sample from which feedback could be obtained. Another recommendation would be to expand the research to understand its effect on the ACT assessment. Completing this research would answer the question of if an integrated mathematics curriculum would increase students ACT composite score earlier in their high school career due to the fact that the strands of mathematics would be taught together, letting students see the connection between concepts. Another study that would be beneficial would be student achievement in advanced mathematics courses and Advanced Placement courses. This comparison could determine if an integrated mathematics course enabled students to score higher in the advanced courses and could provide school districts with essential information.

Summary

The purpose of this qualitative study was to examine teachers’ perceptions of best practices regarding an integrated mathematics curriculum and the similarities and differences that exist between a regular and honors integrated mathematics curriculum. Through questionnaires, interviews, and a focus group, participants expressed their opinions of best practices related to an integrated mathematics curriculum and how similar and different a regular integrated mathematics classroom would be compared to an honors integrated mathematics classroom. Through open, axial, and selective coding, the study revealed that educator expertise and effective, relevant instructional strategies are perceived as best integrated mathematics practices. The study also revealed that similar instructional strategies and different rigor expectations exist regarding regular and honors integrated mathematics courses. All participants agreed that in order for this type of curriculum to be successful, all administrators, teachers, parents, students, other stakeholders must be involved in the decision-making process and understand the complications that exist with any change in curriculum. The information gained from this study will help school districts determine effective instructional strategies and best practices that can be implemented in an integrated
This study will also provide districts with the knowledge of teachers’ perceptions of the similarities and differences that are associated with a regular integrated mathematics curriculum and an honors integrated mathematics curriculum. This information will provide districts and teachers with the knowledge of the curriculum to ensure that students are college and career ready.
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## Appendix A

### Open-Ended Question One Responses

<table>
<thead>
<tr>
<th>Participant/Subject</th>
<th>Response</th>
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</thead>
<tbody>
<tr>
<td>P1/Algebra 1</td>
<td>discovery learning, deriving concepts</td>
</tr>
<tr>
<td>P2/Algebra 1</td>
<td>Inquiry and problem solving focused lessons. Critical thinking and knowledge application skills.</td>
</tr>
<tr>
<td>P3/Algebra 1</td>
<td>I believe scaffolding would be the best practice most associated with integrated mathematics.</td>
</tr>
<tr>
<td>P4/Algebra 1</td>
<td>Best practices include a seamless transition made between topics/subjects. Material should be presented in such a way that students can distinguish between the different content areas, while comprehending how they are connected. Struggling students would also need additional support.</td>
</tr>
<tr>
<td>P5/Algebra 1</td>
<td>Manipulatives and providing as many representations and chances at mastery as possible.</td>
</tr>
<tr>
<td>P6/Algebra 1</td>
<td>I would think the teaching best practices would be remarkably similar. Real-world applications and multiple representations of materials are essential.</td>
</tr>
<tr>
<td>P7/Geometry</td>
<td>Teachers and students are able to make connections across subjects more readily. Therefore, real-world applications are needed to ensure that students understand the connections.</td>
</tr>
<tr>
<td>P8/Geometry</td>
<td>Direct instruction for majority of learning activities is an essential component of the program. A flipped classroom, technology assisted, and individualized prescriptive teaching are strategies which would enhance any instructional practice.</td>
</tr>
<tr>
<td>P9/Geometry</td>
<td>Blended learning, problem solving, test taking strategies, real life application of concepts, etc.</td>
</tr>
<tr>
<td>P10/Algebra 2</td>
<td>Parent communication, high quality professional development, real-world application problems.</td>
</tr>
<tr>
<td>P11/Algebra 2</td>
<td>The same best practices associated with a traditional curriculum - i.e. active student</td>
</tr>
<tr>
<td>Page</td>
<td>Algebra 2</td>
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</tr>
<tr>
<td>113</td>
<td>involvement, limited lecture, statement of objectives, real-world applications, etc.</td>
</tr>
<tr>
<td></td>
<td>An integrated curriculum is more of a pedagogical approach to instruction rather than a distinct curriculum. The key component of an integrated approach is specific applications of concepts learned to the other stands of math such as geometry and probability &amp; statistics. The best practices would be: an experienced instructor, student projects, and the inclusion of student investigations related to real life.</td>
</tr>
<tr>
<td>P12</td>
<td>Transition is very important. Graphing activities are imperative. Activities matching graphs, equations, transformations, translations, and restrictions would be helpful. Linking the topics together and allowing the students to see the &quot;big picture&quot; would be a &quot;must do&quot;.</td>
</tr>
<tr>
<td>P13</td>
<td>I think anything that becomes integrated often provides opportunity for creative and applied concepts. These practices can often be fostered through inquiry-based type instruction.</td>
</tr>
<tr>
<td>P14</td>
<td>Making sure that concepts from multiple years of mathematics are used to enhance the course content.</td>
</tr>
<tr>
<td>P15</td>
<td>Connecting to real-world examples and being able to connect one topic to another. Students have to see the connection between the topics for the integrated curriculum to be successful.</td>
</tr>
<tr>
<td>P16</td>
<td>Teacher lecture</td>
</tr>
<tr>
<td>P17</td>
<td>Not sure</td>
</tr>
<tr>
<td>P18</td>
<td>Scaffolding</td>
</tr>
<tr>
<td>P19</td>
<td>Not familiar enough to reply</td>
</tr>
<tr>
<td>P20</td>
<td></td>
</tr>
</tbody>
</table>
**Open-Ended Question Two Responses**

<table>
<thead>
<tr>
<th>Participant/Subject</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1/Algebra 1</td>
<td>Strategic planning across content specialists.</td>
</tr>
<tr>
<td>P2/Algebra 1</td>
<td>Students completing projects that use application of the skills learned.</td>
</tr>
<tr>
<td>P3/Algebra 1</td>
<td>Scaffolding will happen easily in an integrated math classroom. There should be a pretty natural flow to the instruction.</td>
</tr>
<tr>
<td>P4/Algebra 1</td>
<td>Teachers will have to have a good grasp on the content and how to present it. This may be attained by professional development targeting these practices. The professional development should target each level of math individually, while also offering time for all levels to work together to increase fluency and coherency. Support for struggling learners may be incorporated by amending the course sequence; extending class time; and offering tutoring. Options for acceleration through the pathway should also be included.</td>
</tr>
<tr>
<td>P5/Algebra 1</td>
<td>They can be worked in as introductory type materials, as well as activities during class time.</td>
</tr>
<tr>
<td>P6/Algebra 1</td>
<td>Real-world application problems can be given at the end of a lesson to assess all the skills students have learned.</td>
</tr>
<tr>
<td>P7/Geometry</td>
<td>When a concept is covered in Algebra 1, it can be directly used in a geometry situation without the need of re-teaching the skill.</td>
</tr>
<tr>
<td>P8/Geometry</td>
<td>Capitalize upon using technology assisted devices to support the learning styles of the students, for example operating an individualized prescriptive pathway.</td>
</tr>
<tr>
<td>P9/Geometry</td>
<td>These best practices allow students to explore topics and see how the branches of math fit together... many are already happening in the regular curriculum. For example, students in geometry must use Algebra skills every day in order to solve geometry problems.</td>
</tr>
<tr>
<td>P10/Algebra 2</td>
<td>It is essential that teachers are provided proper training on how to incorporate these practices into their teaching. Without professional development, educators might not succeed in the integrated curriculum.</td>
</tr>
</tbody>
</table>
| P11/Algebra 2       | Write the objectives and state the objectives often during class. Plan activities that directly
<table>
<thead>
<tr>
<th>P12/Algebra 2</th>
<th>involve action on the part of students and are relevant to students. Limit lecture and incorporate student activities within the lecture.</th>
</tr>
</thead>
<tbody>
<tr>
<td>P13/Algebra 2</td>
<td>To implement an integrated curriculum, instructors that have experience in the various strands of math would be required to ensure that all standards are taught adequately. Many topics (such as the rules of exponents with multiple variables and degrees beyond 3rd) do not have an immediate application. Ensuring these standards are taught would require an experienced instructor. Student projects where research (or review) is required would be essential for making the students see the connections. Implementing these projects would require disciplined students along with an instructor that would allow the students to struggle with the concepts taught.</td>
</tr>
<tr>
<td>P14/Algebra 2</td>
<td>The activities would be useful as an everyday part of the class. Notes and activities will help with the integration.</td>
</tr>
<tr>
<td>P15/Algebra 2</td>
<td>Have students use previously learned concepts to create new knowledge as they think and solve problems.</td>
</tr>
<tr>
<td>P16/Algebra 2</td>
<td>Through bell-ringers, exit tickets, projects, activities, etc.</td>
</tr>
<tr>
<td>P17/Administrator</td>
<td>Pulling real-world examples into the class through researching connections would be helpful. High-level PD would be very beneficial.</td>
</tr>
<tr>
<td>P18/Administrator</td>
<td>Teach Daily</td>
</tr>
<tr>
<td>P19/Administrator</td>
<td>Not sure</td>
</tr>
<tr>
<td>P20/Administrator</td>
<td>By linking concepts and standards to ones learned previously.</td>
</tr>
<tr>
<td>P20/Administrator</td>
<td>Not familiar enough to reply</td>
</tr>
</tbody>
</table>

Open-Ended Question Three Responses
<table>
<thead>
<tr>
<th>Participant/Subject</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1/Algebra 1</td>
<td>Integrated, because it makes connections that students might not make on their own. This leads to deeper more fundamental understanding of material. However, it is my understanding that this is not how they are being tested during certain grade levels.</td>
</tr>
<tr>
<td>P2/Algebra 1</td>
<td>Integrated</td>
</tr>
<tr>
<td>P3/Algebra 1</td>
<td>Since I have never been in, nor have I taught an integrated math classroom, I do not feel informed enough to answer.</td>
</tr>
<tr>
<td>P4/Algebra 1</td>
<td>An integrated curriculum would more adequately fulfill the goals of common core standards. It would also bridge the disconnect many students experience between the various math courses.</td>
</tr>
<tr>
<td>P5/Algebra 1</td>
<td>Traditional</td>
</tr>
<tr>
<td>P6/Algebra 1</td>
<td>I think either curriculum could meet the needs of the Tennessee academic standards assuming teachers were properly supported on implementation.</td>
</tr>
<tr>
<td>P7/Geometry</td>
<td>I have not done enough study of the integrated curriculum to answer this.</td>
</tr>
<tr>
<td>P8/Geometry</td>
<td>Currently, state assessment testing is divided and specific to the disciplines of high school mathematics education. Through this division, a traditional curriculum path is defined and best utilized in preparing students in meeting the requirements of measurement on the end of course exams.</td>
</tr>
<tr>
<td>P9/Geometry</td>
<td>I think it is a combination of the two. Time restraints do not allow for a full integrated curriculum, being on semesters - it would be difficult to switch over.</td>
</tr>
<tr>
<td>P10/Algebra 2</td>
<td>Given the current structure of the TCAP system, where each subject is tested individually, I believe that a traditional curriculum better meets these needs.</td>
</tr>
<tr>
<td>P11/Algebra 2</td>
<td>Traditional</td>
</tr>
<tr>
<td>P12/Algebra 2</td>
<td>The traditional curriculum is better at teaching pure mathematics. There are too many topics within math that do not have an immediate application (simplifying radicals for exact answers) that would be omitted in the integrated curriculum. When investigations and applications are utilized,</td>
</tr>
</tbody>
</table>
students do not always for the "math" way of solving a problem. As the standards currently exist, there are still topics from pure math (powers of i) that would require a traditional approach to teach. The integrated approach would, however, contribute to creating better problem solvers if the curriculum is implemented properly. Some of the standards, such as persisting in problem solving, would be better addressed through an integrated approach. As the current standards are written, the best curriculum would be traditional with the inclusion of rigorous student projects (if time allowed, and the students had the work ethic).

<p>| P13/Algebra 2 | I prefer the traditional curriculum. I feel that I can focus on the topic at hand. |
| P14/Algebra 2 | As it currently is, traditional is best. For me Algebra 2 does not use concepts from Geometry or other curricular areas. |
| P15/Algebra 2 | Integrated. I believe that incorporating multiple concepts into a classroom help students reach a deeper and better understanding of the material. |
| P16/Algebra 2 | I like the idea of the integrated curriculum because students will be able to make better connections within the content. |
| P17/Administrator | Integrated |
| P18/Administrator | We as educators need to understand that things change over time, with the constant use of technology in today's world, students learning has changed and we need to adapt to those changes to give our students the best possible way to succeed. |
| P19/Administrator | Integrated, because it works better with prior learning, real-world relevance, and other academic areas. |
| P20/Administrator | Not familiar enough to reply. |</p>
<table>
<thead>
<tr>
<th>Participant/Subject</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1/Algebra 1</td>
<td>Yes, the same best practices should be used for both classes. The honors class should need less scaffolding.</td>
</tr>
<tr>
<td>P2/Algebra 1</td>
<td>Shouldn't be more workload, instead should be more rigorous content.</td>
</tr>
<tr>
<td>P3/Algebra 1</td>
<td>There are plenty of similarities between honors and standard, but there is one distinct difference: Rigor. I will expect my honors classroom to go a bit deeper, and push themselves harder with individual directed learning.</td>
</tr>
<tr>
<td>P4/Algebra 1</td>
<td>Best practices and instruction should be mostly uniform; however, the support, pacing, and rigor need to be customized to the honors vs. standard curriculum.</td>
</tr>
<tr>
<td>P5/Algebra 1</td>
<td>I think the similarities would revolve around activities, duration of instruction assigned to specific topics, use of technology and use of manipulatives.</td>
</tr>
<tr>
<td>P6/Algebra 1</td>
<td>I would think the differences for a standard and honors integrated mathematics curriculum would be similar to the differences for a standard and honors traditional mathematics curriculum. I do not know if the state requirements are different.</td>
</tr>
<tr>
<td>P7/Geometry</td>
<td>Honors students must be held to higher standards and should be expected to meet those expectations. I have always initially presented the material in a similar manner, but in an honors class, I expect the students to work more on their own or in a group to solve problems and work through difficulties they may face. I do this much less in a standard classroom, where students need more scaffolding.</td>
</tr>
<tr>
<td>P8/Geometry</td>
<td>Yes, there should be variances over best practice strategies and instruction for both an honors course and a regular course for integrated math. The strategies should be appropriately utilized in order to meet the learning styles and abilities of the students. Pacing and rigor would also be incorporated and unique to both leveled curriculum.</td>
</tr>
<tr>
<td>Page</td>
<td>Subject</td>
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<tr>
<td>P9/Geometry</td>
<td></td>
</tr>
<tr>
<td>P10/Algebra 2</td>
<td></td>
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<tr>
<td>P11/Algebra 2</td>
<td></td>
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<tr>
<td>P12/Algebra 2</td>
<td></td>
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<tr>
<td>P13/Algebra 2</td>
<td></td>
</tr>
<tr>
<td>P14/Algebra 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Students to reach deeper thinking and concepts pertaining to a particular standard.</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>P15/Algebra 2</td>
<td>Yes. I believe that both courses should incorporate an integrated mathematics curriculum. However, I believe that for an honors class these students should still be pushed harder than a standards class.</td>
</tr>
<tr>
<td>P16/Algebra 2</td>
<td>I feel that honors students would have a greater ability to make the connections between the different topics of Algebra and Geometry. Teachers would be able to do more with the honors students to extend the learning of the material.</td>
</tr>
<tr>
<td>P17/Administrator</td>
<td>Not sure</td>
</tr>
<tr>
<td>P18/Administrator</td>
<td>I believe that if a student decides to take a higher-level class, then yes, they should be taught differently, that could be a faster pace, less explaining and more self-discovery, etc. There could be a number of things done differently based on the level of your students and their desire to proceed.</td>
</tr>
<tr>
<td>P19/Administrator</td>
<td>Similarities: same standards. Differences: honors should be more complex and demand higher-order thinking.</td>
</tr>
<tr>
<td>P20/Administrator</td>
<td>Honors curriculum and coursework must be more rigorous.</td>
</tr>
</tbody>
</table>