Effectiveness of Essentials for College Math as a High School Transitional Course

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EFFECTIVENESS OF Essentials for College Math AS A HIGH SCHOOL TRANSITIONAL COURSE

A dissertation Submitted to
the Graduate College of
Marshall University
In partial fulfillment of the
requirements for the degree of
Doctor of Education
in
Educational Leadership
By
Jennifer S. Riggleman
Approved by
Dr. Tom Hisiro, Committee Chairperson
Dr. Cynthia Kolsun
Dr. Lisa A. Heaton
Dr. Mary Ann DeLuca

Marshall University
August 2017
SIGNATURE PAGE

I hereby affirm that the following project meets the high academic standards for original scholarship and creative work established by my discipline, college, and the Graduate College of Marshall University. With my signature, I approve the manuscript for publication.

Effectiveness of Essentials for College Math as a High School Transitional Course

Project Title:

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Department: Leadership Studies

College: Marshall University

Committee Chairperson

07/24/2017 Date
DEDICATION

Proverbs 16:3- “Commit your works to the Lord and your plans will be established.”

To my heavenly Father, I committed this process to you from the beginning. Thank you for being true to Your word and being faithful to see me through to completion.

To my loving and wonderful husband Phil, you told me in the beginning of this program you had my back, and you have done just that. You have loved and encouraged me when I needed it most. I love you with all of my heart!

To my children Catie, Isaac, Caleb, Adam, and Susan, who have put up with my absence at events, many nights typing late, and have supported me all the way through – thank you. You are very special children and I have been bountifully blessed to be called your mom.

To my committee, I cannot thank you enough. Dr. Tom Hisiro, when I first met you at a conference, I knew you would be a source of support throughout this entire process and you have been just that. Dr. Lisa Heaton, and Dr. Cindy Kolsun, you have been great and solid instructors to give quality feedback, and point me in the right direction so that I could complete my goal. Dr. Mary Ann DeLuca, you have been not only supportive, but a mentor to me for many years now and I am more grateful than I can tell you for your influence in my life on multiple levels.

To the two men in administration at Davis and Elkins who gave me a nudge to start the process toward this goal, thank you.
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ABSTRACT
Statistics on the number of students who leave high school underprepared for postsecondary education, and have to take remedial coursework upon entrance to college vary, but, unfortunately, for at least the last 10 years, these statistics have remained high. This study examined the effectiveness of one transitional high school math curriculum called Essentials for College Math and its impact on 887 students in the state of North Carolina for the 2014-2015 academic year. The results of the study showed that there was a statistically significant improvement seen in pre- and post-test scores of students that completed the course. There was also a statistically significant difference that existed on post-test scores depending on where students scored on a pre-test. A statistically significant improvement, additionally, was seen among students who achieved the proficiency level following the Essentials for College Math course compared to those who were already at the proficiency level prior to taking the course. This study will add to an emerging body of literature surrounding the topic of effectiveness of transitional coursework in high schools.
CHAPTER 1: INTRODUCTION

The number of incoming college freshmen who need to take remedial or preparatory coursework prior to being admitted to a standard college math or English course is as high as 40% of all students according to Attewell, Lavin, Domina, and Levey (2006). They further assert that this percentage is even higher among non-traditional students returning to the classroom. Mangan (2012) states the number of incoming freshmen taking remedial coursework is as high as 50% of all undergraduates and is as high as 70% of students entering community colleges nationwide. The results of these remedial courses leading to successful degree completion are mixed. Magnan (2012) further explains results in his “Core Principles for Transforming Remedial Education: A Joint Statement,” which is comprised of findings from four different national higher education groups. The findings of this group, as presented in its report, are that fewer students should be placed in remedial courses, and should instead be placed in actual courses for college credit with support built-in to the coursework. When these courses are designed and carried out properly with the correct support structure in place, students are more likely to be successful not just in these courses, but are also more likely to complete a degree when they are not discouraged in the beginning of the process. City College in California has found that 90% of its new students who take the placement test are underprepared for traditional college English courses, and 70% are underprepared in math (Pogash, 2010). In his New York Times article Pogash (2010) quotes Katie Hern, an English instructor at Chabot College who concurs with the Joint Statement previously discussed: students who take her intensive one semester remediation course pass college
level English at twice the rate of those who spread the remedial coursework out over two semesters.

The importance of success in college cannot be overstated. The Georgetown University Center on Education and the Workforce claims that by 2018, 22 million jobs requiring college degrees will be needed, but the number of available people holding those degrees will fall short by 3 million. In addition, there will be a need for 4.7 million new workers with postsecondary degrees. Carnevale, Smith, and Strohl (2010), authors of the Georgetown report, state that this lack of graduates amounts to a deficit of 300,000 graduates every year between 2008 and 2018. The need for increasing levels of education in the U.S. culture is evident. Twenty-eight percent of jobs required the worker to have postsecondary education in 1973 compared to 59% in 2008. Carnevale et. al. (2010) predicted that by 2018 this percentage will continue to increase to 63%. Similarly, in 1973 there were 25 million jobs available to people with at least some college training, and that number skyrocketed to 91 million in 2007.

Success in post-secondary education is a requirement in order to meet the changing needs of the workforce in the United States. The increase in the number of students across the U.S. needing remedial coursework upon entering college makes accomplishing the task of acquiring a bachelor’s degree more difficult. However, the U.S. Department of Education National Center for Educational Statistics (2014), report titled, “Remedial Coursetaking at U.S. Public 2- and 4-year Institutions: Scope, Experience, and Outcomes Statistical Analysis Report,” shows a continued increase in average reading scale scores when comparing these statistics for years 1990, 2011, and 2013 among all ethnicities. The same report shows several other relevant facts including an increase from only 62% of
students in fourth-eighth grade being at or above basic in reading scores in 1992 compared to 78% at or above basic in 2013. The US Department of Education report shows a decrease in students below the basic level in English starting at 38% in 1992, and dropping to 22% in 2013. In the area of mathematics, the US Department of Education reported a similar decline, just as it did with English in the number of students below basic dropping from 50% in 1990 to 26% in 2013. It also showed an increase in average mathematics scale scores from 1990 through 2013 across all ethnicities.

These statistics suggest that students are being better prepared in high school, although their success rate in college remedial coursework indicates the opposite. The need for these better prepared high school graduates in the areas of math and English is clear. The focus of this research will be on the high school math curriculum that the Southern Regional Education Board (SREB) created specifically to prepare students for college level math. SREB is a nonpartisan and non-profit organization that has been in existence for 67 years with the desire to improve public education in the 16 states who are associated with the Board. The 16 states include Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. The organization receives funding from the continued support of the member states and from grants and contracts at the local, state, and federal levels (About SREB, 2015).

SREB recognized the need for improving high school graduation rates and for increasing the number of students who were prepared for college level work upon graduation from high school. SREB utilized a six-step model action agenda to develop policies relating to transitional coursework in order to achieve these goals:
1. Implement statewide college and career readiness standards.

2. Assess high school students for college readiness no later than the junior year.

3. Develop a high school curriculum of transitional courses to assist juniors and seniors who are underprepared for credit-bearing, college-level work.

4. Provide targeted teacher development for teachers in these transitional courses.

5. Ensure that postsecondary education recognizes and applies the state readiness standards to placement tests (not college acceptance).

6. Adjust school and college accountability systems to include meeting measures that prove an increase in student’s college readiness.

Not only are a large percentage of students underprepared for college-level credit-bearing classes, but many are also lacking reading, writing, and math skills required to be successful in entry-level jobs (Essential Elements, 2013). The Bill and Melinda Gates Foundation (2016), recognized the need for remedial coursework and a change in curriculum for high school students. The Gates Foundation seeks to support K-12 schools in the U.S. to ensure high school graduates are adequately prepared for college. The Gates Foundation also works to increase the number of students who have the opportunity to obtain post-secondary education. In order to move these objectives forward, the Gates Foundation desires to better align K-12 standards with those in higher education. One part of the Gates Foundation effort to achieve these goals in education is to collaborate with existing organizations and schools designing programs toward the same outcome. One group they chose to collaborate with was SREB. This partnership identified the eagerness of the Gates Foundation to design remedial programs to identify gaps in high school education for students in states involved with SREB. The Gates
Foundation partnered with SREB to further this initiative as it aligned their standards and desired to improve education for all students in the U.S.

**Statement of the Problem**

The tremendous number of students who need to begin college by taking remedial coursework suggests a need for scrutiny of the high school curricula. Adams (2014) presents statistics from the State of Tennessee on the issue of high school transitional courses. Adams (2014) declares that 70% of students attending college after high school require remedial coursework in college, and of those who enter the remedial pathway in college, only 5% are graduating from community colleges in a 3-year time span according to Tennessee Board of Regents. This statistic shows the need for transitional coursework prior to entrance into college. Many states are looking into this type of structure for those students who seek a post-secondary degree at institutions of higher education. Adams (2014) states that there are many ways to combat the problem, and the Southern Regional Education Board (SREB) has developed one such curriculum. This new curriculum developed by SREB has been piloted in seven states in 20 different schools. SREB is aiming to close the “readiness gap” and states that over 50% of students admitted to 2-year public colleges require remedial coursework in math, English, or both (Essential Elements, 2013).

**Purpose of the Study**

SREB has created a transitional high school course for literacy and for math called Literacy Ready and Math Ready respectively. SREB identified the issue of high school students needing remedial classes in math and English and realized those numbers would continue to increase. They believed this readiness gap would continue to widen with more
stringent standards coming from new assessments, such as Common Core Standards. SREB developed new curricula in both areas to be used as a transitional course in a student’s junior or senior year in high school. These programs have been designed to specifically target the lack of preparation for college level courses in math and English. These courses were field tested in seven different states in 2014, and since then have been piloted in four states in the 2015-2016 academic year. The piloted states include North Carolina, West Virginia, Arkansas, and Mississippi. North Carolina is only piloting Math Ready at this time. The programs have been adopted in these four states, although in West Virginia, transitional coursework must be offered, and the SREB curriculum is just one of the options the counties or individual schools could choose to implement in their classrooms (Math Ready, 2015). This study will examine the results of the Math Ready pilot in the state of North Carolina. The study is significant because of the staggering statistics of remedial coursework needed by high school students when they enter college, while showing a need for curricular change at the high school level.

**Research Questions**

The overarching question for this study is: Does a transitional math curricula exist that will decrease a student’s need for remedial coursework in college? In order to answer that question, data were collected by the North Carolina Early Mathematics Placement Testing program (NC EMPT) based on the implementation of SREB’s Math Ready transitional course in the state of North Carolina in 2014-2015 academic year. These data were analyzed to evaluate the significance of the program in better preparing students for college level math. Research questions for this study include:
1. What difference, if any, exists in pre and post-test NC EMPT scores of students taking the transitional Math course called Essentials for College Math?

2. What relationship, if any, exists in post-testing levels for students who have completed the Essentials for College Math course compared to the level students tested during the pre-test?

3. What difference, if any, exists between the percentage of students who were at the proficiency level as identified in the NC EMPT pre-test (not needing remedial coursework upon entrance to college), compared to the percentage of students at the proficiency level following the Essentials for College Math on the post-test?

Definition of Terms

Career readiness – Effectively navigating pathways that connect education and employment to achieve a fulfilling, financially secure and successful career (Career Readiness Partner Council, 2012).

Classroom rigor - learning environments that are not intended to be harsh, rigid, or overly prescriptive, but that are stimulating, engaging, and supportive (Glossary of Educational Reform, 2014).

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

Common Core Standards- is a set of high-quality academic standards in mathematics and English language arts/literacy (ELA). These learning goals outline what a student
should know and be able to do at the end of each grade (Common Core State Standards Initiative, 2017).

**Remedial coursework** - Remedial education courses are defined as courses in reading, writing, or mathematics for college-level students lacking the skills to perform work at the level required by the institution (Basmat & Lewis, 2003).

**Transitional coursework** - Called transition courses, they are designed to help students avoid postsecondary remediation in math and English and become better prepared for the challenges of college (Barnett, Fay, & Pheatt, 2016).

**Significance of the Study**

This study seeks to increase the knowledge base of those involved in administering high school curricula for math, including teachers and administrators at the county and state level, and for those involved in designing and carrying out college level credit bearing courses in math at institutions of higher learning. Barnett, Fay, and Pheatt (2016) state that transitional coursework in high school has the potential to reshape a student’s transition to college, which could increase their likelihood of completing a degree, and could also teach nonacademic aspects of college further promoting a positive transition to secondary education.

Statistics vary in the exact number of students currently requiring remedial coursework at the time they enter college, but each one contributes to a compelling narrative about the current state of high school students from an academic perspective. The workforce continues to need college graduates for existing careers with a trend toward increasing those numbers. This study guaged the effective preparation of high school students in the category of math for entrance to college by the SREB Math Ready course. The findings from this study can facilitate and support future research.
Additional parties who may gain insight from this study include organizations such as SREB, the Gates Foundation, and colleges who are designing and implementing similar high school programs.

**Method**

This study was a quantitative analysis of NC EMPT data conducted electronically using Excel and SPSS programming for three assessments of the information. The first analysis included a t-test comparing pre- and post-test data on students enrolled in the Essentials of College Math course. In North Carolina, by way of an agreement between NC EMPT and the NC Department of Public Instruction, the SREB Math Ready course was renamed with a more descriptive title, Essentials for College Math. The second analysis included a Chi Square, comparing post-testing scores dependent on the initial pre-test scores of subjects. The third analysis was a Chi-Square for pre- and post-testing to assess students using the scores for the number of students initially at the proficiency level compared to those who had completed the course being at the proficiency level.

**Limitations**

There were several limitations to this study. The researcher received guidance from experts in the field of statistical research in order to minimize these limitations. The findings are limited to 26 high schools all located in the state of North Carolina. The study was limited by its focus on only one transitional math course. This study utilized the data set from the 2014-2015 academic year collected by NC EMPT. The data set does not include demographic information on students, population of the school, or setting for each of the 26 schools. Limitations to the statistical analysis include how students were assigned to the group taking the course and those that were not assigned to
take the course. The pedagogical style of the teachers was unknown. Due to these limitations, it is difficult to generalize the findings.

**Delimitations**

The purpose of this study was to examine the effectiveness of the SREB Math Ready curriculum utilizing NC EMPT’s data from its implementation during the 2014-2015 academic year. This study did not intend to cover the other primary category for transitional coursework in the high school curricula which is English. It is not directly relevant to this study. This study was limited to 26 high schools in North Carolina and did not take into consideration the other states where SREB piloted their Math Ready program.

**Summary**

This chapter serves as an introduction to the problem among high school graduates entering college not being prepared for college level, credit-bearing courses in the area of math. Chapter 2 examines the current literature including lack of preparation, which reviews rigor in the classroom, college readiness and transitional coursework in other states, curricular content organization, collegiate approach to the issue, workplace readiness, and college remediation. Chapter 3 describes the research method and procedures utilized in examining the data. Chapter 4 discusses the results of the data analysis. Chapter 5 includes the conclusion and discussion of the findings from the study, and offer recommendations for further research.
CHAPTER 2: LITERATURE REVIEW

According to the ACT, *Condition of College and Career Readiness Report* (2015), 31% of students taking the ACT failed to meet any of the benchmarks in English, math, reading, or science. Eighty-six percent of those who took the test stated they were aspiring to seek post-secondary education. The ACT identified the following areas as being important factors that contribute to student success for future educational pursuits in addition to academic benchmarks. These factors include:

1. Core academic skills – in the areas of math, English and science.
2. Crosscutting capabilities – performing essential tasks across academic disciplines.
3. Behavior skills – behaviors important for adapting and successful performance in a variety of settings.
4. Educational and career navigational skills – making informed decisions that are personally relevant and achievable.

Only 42% of students that took the ACT benchmark in 2015, met the math benchmark. Accordingly, during that time, 28% of students met the benchmark in all four areas. ACT’s *The Forgotten middle: Ensuring that all students are on target for college and career readiness before high school* (2008) states that students who are not on the path to college readiness in eighth grade will very likely never be ready for college level courses. Royster, Gross, and Hochbein (2015) found in their study that students were in fact able to be successful in college level courses even if they had not met these benchmarks in eighth grade. However, Royster et.al. emphasizes that students must be
guided into rigorous college preparatory work from eighth grade through high school. Guidance counselors are key to this process and must encourage and guide students’ aspirations, encourage enrollment in rigorous coursework, and make support services available, as needed.

This review of the literature examined preparation of each student in order to be adequately prepared for college level courses prior to their entrance to college. Attewall, Lavin, Domina, and Levey (2006) state 40% of all incoming freshman must take a remedial math or English course. Mangan (2012) states the number of incoming freshman taking remedial courses is as high as 50% and for students entering community colleges, the percentage is as high as 70%. These statistics are staggering and attempts to reduce these numbers need to be included in the body of research.

**Rigor**

Sparks (2013) found varying levels of rigor in high schools’ college readiness math classes such as algebra 1 and geometry. Sparks discussed the National Assessment of Educational Progress (NAEP) report of 2005, and stated that more students than ever before are taking an average of 3.8 math credits while in high school. This has helped to close the gap between racial and ethnic groups. However, the rigor involved in those courses varied greatly. Twenty-one percent of black and 17% of Hispanic students were in rigorous math courses compared to 37% of their white counterparts taking similar courses. Sparks (2013) quoted J. Michael Shaughnessy who cautions readers to examine the study because it failed to take into consideration teacher pedagogy, supplemental materials used, or implementation of textbook content. Shaughnessy is a math professor at Portland State University and former President of the National Council of Teachers of Mathematics.
Sparks (2013) pointed out that in a federal study, the National Assessment of Educational Progress, released by the National Center for Educational Statistics, the drive to get all high school students to take gateway courses such as algebra I and geometry has been successful, with most of the graduating class completing algebra I. The findings of this study indicate large gaps in the amount of rigor for these courses as depicted in their course materials. Less than one in four of these students studied topics rigorous enough to prepare them for college-level courses. Sparks quoted J. Michael Shaughnessy, “That’s really one of the goals put out by the Common Core Standards, to balance across states the mathematical experience that students will get.” The study did not take into consideration how teachers teach the material, how materials are being used, or how faithfully materials are being followed. Sparks (2013) gave statistics from The National Assessment of Educational Progress that found 32% of graduates who had completed algebra I had rigorous coursework, and 14% had beginner-level material. In geometry, 21% had vigorous coursework and 12% covered beginner-level material. The study identified a need for teachers to have more instructional support in order to properly teach new Common Core Standards, and recognized that they are harder to teach. Embedded in rigorous algebra I and geometry classes, students must learn to problem-solve and make sense of problems. The study did not take into consideration students who completed algebra I in middle school even though 20% of all 2005 graduates took the course as a middle school student, which was not a focus population of the study.

In addition to the encouragement from Sparks (2013) for students to take academically rigorous courses, Shernoff and Hoogstra (2001) claimed that intrinsic motivation and enjoyment of high school math and particularly science courses, can help predict college
success even two years after high school. This was true even when other factors were taken into account such as student life experiences, and high school grades. Students who reported low engagement were concerned with performance and grades. Students reporting low engagement were not underachieving or indifferent according to Shernoff and Hoogstra (2001), they were actually highly ambitious and concerned with their performance.

Padilla-Vigil and Mieliwocki (2015) stated that in today’s culture of rigor, students should have learning experiences that address Bloom’s taxonomy to the creation and sharing level. Students will be able to do this better when they can make connections between content and real-world applications. Padilla-Vigil and Mieliwocki (2015) explain the “Genius Hour” as education’s adaptation of an idea implemented by Google, where 20% of the developer’s workday at Google is used to pursue any project of interest to the employee, as long as it could benefit the company. Teachers adopting this process have modified the thinking behind it and have implemented the Genius Hour into their classrooms. These teachers allowed students this time of exploration and separated it into three phases of learning while the students selected a topic of interest that included the following:

- Phase 1 – Posing a Research Question
- Phase 2 – The Knowledge Quest
- Phase 3 – Sharing Knowledge

As students engaged in their quest for this knowledge, teachers became facilitators and guides. In order to guide students through such an assignment, teachers
must show creativity and innovation, which increased rigor in the classroom, and ultimately better prepared them for the real world.

The Center for Public Education report titled, *Is High School Tough Enough*, by O’Brien and Dervarcis (2012) states that high schools should prepare students for college and career readiness by offering a rigorous curriculum. The report cites several key criteria to developing this rigorous curriculum including:

1. High school core courses focused on essential knowledge and skills essential to post-secondary education.
2. Demanding curriculum that encourages critical thinking and content.
3. Students in rigorous courses should think, reason, and problem-solve.
4. Rigorous curriculum is focused, coherent, and appropriately challenging.

The report stated that almost 40% of high school graduates are not adequately prepared for entry-level jobs or college-level courses, and some low income schools lack rigorous coursework, and do not have course offerings for college-preparatory work.

Four examples of rigorous coursework are noted in the report. The first is Advanced Placement (AP) courses. O’Brien and Devarcis (2012) asserted that students taking AP courses are twice as likely to graduate from college in five years compared to those not taking AP courses. The second example of rigor for students is dual credit courses. Dual credit options happen when colleges collaborate with high schools to offer courses that count as college credit. AP and dual credit courses are not, unfortunately, offered at every high school nationwide. Students taking dual credit courses in high school have more academic success in college than those who do not take them (O’Brien & Devarcis, 2012). The third option of rigorous coursework high school students can take are early
college programs. Early college programs offer high school students an opportunity to take college coursework while in high school. Students enrolling in early college programs have higher graduation rates than students not enrolled. The fourth option mentioned in the report for rigor in high school is high-level math. They specifically define high-level math as math beyond algebra II. When students take high-level math, it doubles the students’ odds of completing a bachelor’s degree. All the strategies proposed in the report focus on high school courses that have a rigorous curriculum (O’Brien & Devarcis, 2012).

A study done by Speilhagen (2006) on the effects of placing students into algebra in the eighth grade compared to ninth grade yielded the following results. The school district that participated in the study had a desire to move its students from simply having basic proficiency in mathematics, to more rigorous coursework. Standards prior to the study dictated that only students who qualified would take algebra in the eighth grade. The qualifications included three criteria:

1. Prior performance in seventh grade math class
2. Scores on the Stanford 9 Mathematics test administered in the seventh grade
3. Teacher nomination

Spielhagen (2006) found a group of students who qualified to take algebra in eighth grade according to their grades, but were not placed in the eighth grade algebra class. She classified the group as the overlap group. Forty-five percent of the students in the study completed algebra in the eighth grade and 54% completed algebra in the ninth grade. Demographically, more girls than boys took eighth grade algebra. Caucasians took eighth grade algebra at substantially higher percentages than any other ethnic group, and
students qualifying for free and reduced lunch took algebra at a lower percentage than those students who did not qualify for free and reduced lunch. Speilhagen (2006) found that students who took eighth grade algebra stayed in the math “pipeline” longer and took higher-level math courses than those students who took algebra in ninth grade. Those same students in eighth grade algebra also attended college at higher rates than those in ninth grade algebra. The group who qualified to take algebra in the eighth grade but did not, also fell behind in college attendance when compared to those taking algebra in the eighth grade. The rigorous experiences this particular school district desired, according to this study, suggests that the increased rigor of placing students into eighth grade algebra has the potential to increase math literacy, which will increase the number of math courses taken by students and could positively impact their attendance in college.

A different perspective on rigor comes from Dunn (2008), who stated her fear of focusing solely on rigor in the classroom at the expense of vigor, or experiential learning in the classroom. Dunn (2008) maintained that as scholarship of teaching and learning encourages scientific learning, based on data and verifiable results, the potential exists for creativity and encouraging student engagement to decrease, and education would then lose an entire form of pedagogy. Dunn agreed with empirically driven validation of pedagogical processes, but also saw that proving validity of a pedagogical style is not always possible or necessary. She discussed four reasons why barriers exist in the validation process and why classroom demonstrations can still be effective. The first is that a particular classroom teacher’s class is not randomly assigned. Secondly, there is no control group unless two classrooms are treated differently and have students sign an informed consent. The informed consent would need to state that participation is
voluntary, with the use of institutional review board approval. The third criterion is class size, where the statistical significance has been lacking with a small sample size. Dunn’s fourth argument is spontaneous pedagogy, meaning a teacher may take a particular moment in time of teaching to do a simple demonstration where data collection would not be possible. Dunn further stated that there should be a forum in scientific journals for publication of these demonstration techniques, which may be useful to others in the profession. Dunn suggested vigor and rigor are not either-or propositions, but they both exist along an empirical continuum.

According to the Rennie Center for Education Research and Policy (2009) 43% of community college incoming freshman and 30% of incoming freshman at 4-year institutions are enrolled in remedial coursework. Sixty-three percent of students enrolled in remedial coursework do not earn a 2-year or a 4-year degree and only 3 or 4 out of 10 even complete their remedial sequence. In the current math pathway in Massachusetts, the push for more rigor in the classroom has become a push for “further, faster,” through this pathway. The Rennie Center suggests a new pathway through high school math is needed to better “motivate, educate, and prepare students as they master mathematics through the level of Algebra II and beyond” (p. 3).

The Rennie Center for Education Research and Policy (2009) discusses the ACCUPLACER test and its hopeful administration in Massachusetts. The ACCUPLACER test is administered in 1,300 high schools nationwide and in 30 countries. It is a computer-based test given to high school students to show areas of strengths and weaknesses for college preparation. Once students receive tests results,
they have time to effectively prepare before having to take a remedial math course in college.

Five states and their approaches to reducing the need for remedial coursework in college are given by the Rennie Center for Education Research and Policy (2009) as examples. The first of these states is California. California administers the Early Assessment Program (EAP) test. Students take this test to see if they can score well enough to take credit-bearing courses in college. Those who pass can automatically take a credit-bearing course at any Cal State campus. Students who do not pass can take courses to better prepare them for college in their junior and senior year. The second state example given was Florida. Florida is seeking to offer the ACCUPLACER test to more high school juniors who are interested in attending college. Students that score above a certain cut-score can take a dual-credit course in high school. Texas is the third state used as an example in the Rennie report. Texas is looking to develop a course to follow Algebra II that is rigorous and relevant. This course will be designed for non Science, Technology, Engineering, and Math (STEM) students or for workforce training programs to improve student skills. Washington state is the last of five states used as an example. Washington is beginning their Transition Math Project (TMP). The TMP is helping students identify math skills that high school graduates need in order to meet minimum requirements for college enrollment.

Massachusetts is adopting a five step approach toward the goal of reducing the need for remediation according the Rennie Center for Education Research and Policy (2009). The five steps include:

1. Ensure mastery of arithmetic by the end of seventh grade.
2. Focus on mastery and application of algebraic concepts.
3. Offer ACCUPLACER test to high school juniors.
4. Provide guidance based on Elementary Algebra ACCUPLACER score.
5. Encourage all students to take mathematics during their first college semester (pp. 7-10).

Even with the total cost of implementation of these five steps to reduce remediation, there is still a savings to students. This savings came in direct tuition cost as well as a reduction in cost and fees for students if there is a 30% reduction in remediation necessary for the state of Massachusetts.

Loveless (2013) discussed the weakening of integrity and rigor in Algebra II courses nationwide. He stated that students have been pushed to take more advanced coursework for several decades in the U.S. and this push has increased enrollment in advanced courses in middle school and high school. In 1986, 44% of 17 year-olds had completed Algebra II and that number has increased to roughly two-thirds of 17 year-olds taking Algebra II. In 1986 the rate of 17 year-olds taking Algebra II for black and Hispanic students was less than one-third and now that ethnic disparity gap has narrowed significantly. However, even as more students took advanced courses, test scores went down. One possibility given by Loveless for this phenomenon is that students are underprepared for these advanced courses. Loveless (2013) stated that there is nothing in the research that indicated a decline in the quality of Algebra II textbooks or quality of teachers from 1986-2012. More unprepared students are being placed into Algebra I in middle school. Loveless discussed a finding from California where students who took Algebra I as ninth graders instead of eighth graders were 69% more likely to pass the
algebra end-of-the-course exam than their ninth grade peers who took the course for the second time after failing the end-of-the-course exam in eighth grade. Loveless stated that these advanced math classes have lost their credentialing power as a result of pushing unprepared students into advanced courses. Students are taking the courses and making good grades but do not know the advanced subject matter they should. The evidence of this lack of preparedness shows up in the transition to college. One example given for the state of California was that 30% of incoming freshman had to take remedial classes despite having a high school GPA of 3.15. Loveless suggested that legitimacy needs to be restored to advanced high school math courses so students who pass these courses have learned what they think they have and what they are supposed to.

Kim, Kim, DesJardins, and McCall (2015) attested to the fact that the U.S. continues to rank low among Organization for Economic Cooperation and Development (OECD) countries for math literacy. This has placed the high school curriculum under scrutiny. The No Child Left Behind (NCLB) Act of 2001 requirements prompted many states to increase the number and type of math that students must complete to graduate. Kim et. al. (2015) looked at whether or not completion of Algebra II predicted college success. This study found that for students graduating from Florida high schools in 1996-1997 and 2001-2002, completion of Algebra II only mattered for 2-year college attendance, and not 4-year college attendance and degree completion. The level of rigor in different school systems is not guaranteed even though requirements are the same. For this reason, the impact of Algebra II is diminishing. Kim et. al. (2015) also found that African Americans, Hispanics, and students with low socio-economic status tend to be localized in schools with lower levels of resources. In these schools, even when students
complete the required coursework, the level of knowledge they obtain from the class may be less overall than students who attend schools with more resources.

**College Readiness**

**SAILS Program.**

Squires (2013) stated that in May 2012, Chattanooga State Community College received funding from the Tennessee Board of Regents for the Seamless Alignment and Learning Support (SAILS) program. This program is a bridge math course for seniors in high school who are identified as being at high risk of having to take remedial math in college. The program uses Pearson Education, MyMathLab, software that was donated by Pearson to the program. Teachers provided individual instruction and students access online material at their own pace.

Squires (2013) stated that 200 high school students enrolled in SAILS in the fall of 2012. Eighty percent of these students completed at least half of the developmental math program and 20% took advantage of enrolling in a college level math course. These data put 20% of students at least one semester ahead of their peers, with the possibility of taking two college level math courses while in high school. Squires further stated that by introducing this program to high school seniors, it gave these students a chance to start their college career before graduating from high school.

Miller (2014) stated that when John Squires was a math instructor at Cleveland State Community College and used Pearson’s MyMathLab, remedial students’ success rates increased from 50-69%. Squires (2013) moved to Chattanooga State Community College and used MyMathLab where remedial student success rates rose from 48-65%. Squires (2013) desired to take this success to the high schools and developed the SAILS program for students scoring below 19 in math on the ACT test. SAILS uses
MyMathLab in a blended learning format where students complete modules at their own pace. Squires and others at Chattanooga State presented a proposal to the Tennessee Higher Education Commission about the SAILS program. The proposal was approved and funded to be implemented in the fall of 2013. The original pilot of one classroom was expanded to 200 students. Eighty-three percent of those students who had used MyMathLab were deemed college-ready at the time of graduation. Twenty-five percent of those students completed a bridge math class and were able to take a college level math class in the spring of their senior year to be able to enter college with a completed math credit. Bill Haslam, Governor of Tennessee, committed state funds to the SAILS program for his “Drive to 55” initiative. The “Drive to 55” initiative is an attempt to raise the rate of Tennessee residents with post-secondary credentials to 55% by 2025 (Squires, 2013).

Chattanooga State Community College developed and implemented a program in 2013 designed to help high school students save money by not having to enroll in remedial math courses in college (Jett, 2013). Students who scored lower than a 19 in math on the ACT as juniors were identified as being on track to take remedial math in college. Chattanooga State involved three other community colleges during the 2012-2013 academic year and worked with 500 students to administer a course to them while in high school to allow them to begin college without needing a remedial math course. Eighty-two percent of those students completed the course. Chattanooga State cooperated with 200 of the 500 students by offering a rigorous course, and 50% of those 200 completed the high school course in one semester and were able to take a college-level, credit-bearing math class in the spring of their senior year. This placed them a
semester ahead of other incoming college freshman. Jett said the SAILS program was being supported by the state with $117,000 in taxpayer money initially being allocated to the program. The SAILS program creates a different learning environment for students. The instructor teaches for approximately 30 minutes then students work on computers to practice the lesson. Students cannot move to the next unit until they receive an 85% pass score. Students work at their own pace. The value of a program like SAILS cannot be overstated. Jett cited the Chattanooga State Institutional Research Department as finding that, of students taking remedial math as freshman, only 5% earn their associates degree within 3 years, and about half of them do not even return for their sophomore year.

Governor Bill Haslam designated $1.1 million dollars in 2013 for the SAILS program. These finances have enabled 6,500 high school students at 114 high schools and all 13 community colleges in the state to participate in a transitional math class while in high school. These students were identified as being on track to need remedial coursework after high school according to Fain (2013). Fain stated that remediation is the largest barrier to improving college graduation rates across the country.

Two other states have implemented new legislation addressing remediation in different ways according to Fain. Connecticut eliminated remedial courses and instead encouraged a co-requisite model of remedial students receiving extra help while working alongside students deemed college-ready. In Florida, community colleges were given the option to have students skip remediation even if an advisor or placement tests showed that the student had remedial needs. In addition, Florida has stated that all high school graduates are college-ready and do not have to take a placement exam when they enroll in college. The effectiveness of these initiatives in Connecticut and Florida have yet to
be seen. Mangan (2015) stated that pass rates in some introductory courses in Florida have declined, as students are unprepared for college level courses. Mangan (2015) further stated that there are concerning misconceptions taking hold nationwide about remedial education and the reform taking place in the area. The National Association for Developmental Education (NADE) addresses some of these myths in Mangan’s article. The first is the belief that if a student graduates from high school you are ready for college. For some students this is true, according to the NADE, but for others, this false-belief only serves to create frustration. Another myth according to Mangan (2015) is that co-requisite courses are the viable option for all students. Mangan (2015) quotes Robin Ozz, who has been teaching co-requisite courses for seven years. According to Ozz, these co-requisite courses do not work well for the students with the greatest need. These students falsely believe they will complete a course in one semester, and when they are unable to do that they lose their motivation and often drop out.

In Tennessee, the commitment to offset the remediation is real. The SAILS program began with high school math teacher, Deborah Weiss at Red Bank High School. Fain (2013) stated that Weiss implemented Pearson’s MyMathLab online software in one classroom. There were no lectures used in this system and students worked at their own pace to master content with teachers providing one-on-one feedback and instruction. This approach showed very promising results and was then implemented with other high schools and community colleges. The community colleges provided field coordinators to visit high schools and assist high school teachers where necessary.

Squires (2014) stated there are four critical ideas that need to be considered in reforming developmental education. Squires, along with Angela Boatman, Assistant
Professor of public policy and higher education at Vanderbilt University developed the following criteria:

1. Focus on closing opportunity gaps for students.
2. Focus on closing achievement gaps for students.
3. Provide comprehensive examples and disaggregated data to show how proposed solutions will address gaps in opportunity and achievement.
4. Look for examples of other successful models.

Squires (2014) believed that by utilizing the SAILS program, with its disrupted lecture model, these four ideals will be achieved.

Roughly one in four high school graduates have to take remedial coursework in math or English upon entrance to community college according to Williams (2017). Forty percent of students in remedial courses drop out before graduation day due to frustration and lack of progress in the remedial sequence. Tennessee has implemented a possible solution to this problem by using self-paced learning programs, enhancing classroom support, and adding technology to aid students in high school classrooms. Tennessee created a bridge course so students would get dual credit for a course while also receiving the remedial help they require. The results of this approach in Tennessee and similar programs in Colorado, Indiana, and West Virginia have doubled student success rates in English and have improved math by up to six times the rate. This program in Tennessee started in 2012 with a partnership between Red Bank High School and Chattanooga State Community College and then the SAILS program began. Prior to the SAILS program, students would have had to complete up to three semesters of math to meet requirements to finally be eligible to take a credit-bearing course. Through this
new program, students can avoid the entire remedial process and the needs of students who were underprepared are then fully met (Williams, 2017).

**Mississippi.**

Fifteen community colleges in Mississippi are restructuring remedial coursework to help students graduate more quickly (Amy, 2014). Amy (2014) indicates that 27% of students entering community colleges in 2012 took at least one remedial course at a cost of $25 million to universities. This change in philosophy for these community colleges comes after studies found students taking remedial coursework fared no better than students taking a credit-bearing course. Students attending these 15 community colleges will now be required to take math and reading placement tests. Students who test into a remedial level math or English course will still potentially be placed in those or perhaps a credit-bearing course with an additional lab including computer programs and tutors. The goal is to assist students in being successful by removing the barrier of remedial education.

**Kentucky.**

The Kentucky Early Mathematics Testing Program (KEMTP) is similar to NC EMPT in set-up. The program was created after Bill 178 was passed by the General Assembly in Kentucky in 2000. It is a voluntary online or paper math test targeting high school sophomores and juniors in the state of Kentucky. The purpose of the test is to assess the student’s level of math preparation for college while still in high school, which is early enough to improve their math skills in order to avoid being placed in a remedial math course at the collegiate level. The KEMTP was designed by a statewide collaborative group (Kentucky Early Mathematics Testing Program, 2007).
In an attempt to improve overall education and specifically math education, the Developmental Educational Task Force and Science, Technology, Engineering, and Mathematics Task Force recommended several changes to education. To respond to those changes, the Council on Postsecondary Education (CPE) suggested an increase in ACT score from an 18 to a 19 in math to indicate readiness and 18 to 21 ACT score in reading starting in 2009. One other recommendation from CPE was to create a common online placement test to be given statewide in order to ultimately improve placement decision to increase student success. KEMTP is that test and encourages high school counselors, administrators, and math teachers to become familiar with college placement policies so they can better advise their students. Student feedback from the KEMTP testing comes in the form of a letter where students are given their score and the mathematical preparation for college based on that score. Students are placed into one of four categories.

2. Possible need for a remedial course in college: 13-16 answers correct.
3. Probable need for one, possibly two remedial courses: 9-12 answers correct.
4. Probable need for at least two remedial courses: 0-8 answers correct.

Students are told whether they answered correctly or incorrectly on a specific topic to be able to identify more specifically any problem areas (Kentucky Early Mathematics Testing Program, 2007).

**Wisconsin.**

The Early Mathematics Placement Testing Tool Program (EMPT) in Wisconsin is designed to improve math readiness for high school students who desire to continue their
education in college. EMPT testing motives include reducing the need for remedial college math classes by 50% for participants compared to non-participants, motivating students to take appropriate math classes as a senior, and increasing readiness for calculus by 10% for participants over non-participants. The EMPT program is a sponsored program of the University of Wisconsin Technical System and the Department of Public Instruction, as they collaborate with Wisconsin high schools. The program is funded by the state of Wisconsin, and offered free for all students. The test can be administered online or in paper and pencil format. Students receive a report informing them of their level of math placement at University of Wisconsin and the Wisconsin Technical Center campuses, and receive information about math requirements for various majors in the Wisconsin University System (Early Mathematics Placement Tool Program, 2011).

**West Virginia.**

The transitional Mathematics course for high school seniors in the state of West Virginia is designed to prepare students for entry-level credit-bearing courses at the post-secondary level. The transitions course is available as an option for a fourth math credit for all students. State policy 2510 states: “Transitions Mathematics for seniors focuses on a set of prioritized mathematics standards for students who have not met the college and career readiness benchmark on the West Virginia General Summative Assessment or a college admission assessment (e.g. SAT or ACT)” (C. Burke, personal communication June 14, 2017). This correlates to a 19 in Math on the ACT and a 460 on the quantitative portion of the SAT. There is no required or even suggested curriculum for teachers of transitional math in WV, although they are given access to free materials of the SREB Math Ready course online.
The West Virginia Department of Education (2016) released the *Mathematics in West Virginia Annual Review* report from 2015 and stated in the report that 17,020, 11th grade students in the state of West Virginia took the West Virginia General Summative Assessment (WVGSA). Students that scored at a proficiency level or higher accounted for 19% of these students taking the WVGSA who did not need to take a transitional math course or 3,341 students. Of those students that took the WVGSA, 5,708 took transitional math for seniors. This accounted for 33% of the total students who took the WVGSA entered a transitional math course. The other option for students is to take higher level math instead of transitional math, and 2,620 or 15% of students who took WVGSA took higher levels of math instead. Another 15% of students who did not score at the proficiency level took some other math course, not transitional or higher level math, but did take a math course. Eight percent of students who did not score high enough to be proficient on the WVGSA did not have a course entered into their schedule that held a math code (West Virginia Department of Education, 2016).

Pheatt, Trimble, and Barnett (2016), completed a study on the effectiveness of a transitions math course titled *Transition Mathematics for Seniors* which was implemented by the state of West Virginia in 2010. The study covered 2011-2013 implementation of the course. The course has since changed to a new format. Students in the study were administered the COMPASS college placement test at the end of the course. “The curriculum included five modules: the real and complex number system, algebra, functions, geometry, and statistics and probability” (p. 5). The greatest emphasis in the course was on algebra. Students were placed into the course if they scored lower than the “mastery” level on the state standardized WESTEST 2. Not all students in this
category, however, were placed into the transitions course. Students may have self-selected the course thinking it was less rigorous than other courses, or guidance counselors may have placed students into the course who they felt needed more help even if their WESTEST 2 score did not put them at a level requiring the transitions course.

Pheatt, et. al., (2016) state that their results showed that students in the transitions course were less academically successful and less advantaged than their average peers. The study also found that the transitions course did not improve academic outcomes for students in the course. Students in the course saw a 5% reduction in passing entry-level college math within the first year, and they fared worse in total credits earned and in enrollment of gatekeeper math courses. Pheatt, et. al. discussed possible reasons for the negative findings including students in the transitions courses were separated from their higher ability peers in higher-level math courses. Also, most students in West Virginia did not immediately attend college which may have limited the effectiveness of the transitions courses. Additionally, students who take higher level math may fare better than those in transitions math because they are grouped with higher-ability peers. The researchers state that more studies are needed on transitional courses and reiterate that the transitions course taught in West Virginia has already changed to a new format.

Content Organization

Algebra I is viewed by secondary students as a gateway to post-secondary success according to Laby, West, and Voloch (2015). Research is showing that many eighth and ninth graders that are required to take algebra I are underprepared. These underprepared students then require additional support because they did not grasp foundational concepts in the Algebra I course. Schools then have to remedy the lack of math skill for these
underprepared Algebra I students and teach a very tight high school math curriculum. Laby et. al. suggest a different approach called Accessing Algebra through Inquiry (a2i). This is a federally funded program to improve student achievement in Algebra I, geometry, and Algebra II. Accessing Algebra through Inquiry uses illustrative mathematics and provides opportunities for mathematical conversation with their teachers and peers. Accessing Algebra through Inquiry also provides in-school support and professional development for teachers. Laby et. al. also discussed piloting a program developed by the Education Development Center called Transition to Algebra. This course uses logic puzzles, problems, and explorations so teachers can aid student’s abilities to understand mathematical concepts. Combining algebraic thinking and non-traditional teaching methods offers the best resources to students who struggle with Algebra I and then often with more advanced math.

Tarr, Chavez, and Soria (2013) state that public awareness and scrutiny of school mathematics, will continue if the historical trend does not change where United States students underperform compared to their international counterparts in the category of math. Tarr et. al. reference the National Science Foundation (NSF) in the 1990s investing significant funding into high school math curricula redesign. This redesign changed the focus in mathematics from skills and symbol manipulation to problem-solving and mathematical thinking. The No Child Left Behind (NCLB) federal policy that was enacted in 2002 instructed schools to use scientific research-based programs such as the one designed by NSF.

In order to meet the NCLB criteria, some educational reformers believe a curriculum that is integrated provides a deeper, more meaningful understanding of
mathematics compared to traditional ways of teaching. Traditionalists believe a standards-based curriculum is too superficial and undermines classical mathematics values. Some school systems, in an attempt to appease both pathways of belief, have run a parallel curriculum offering an integrated and a traditional pathway. Tarr et. al. (2013) cite Designing High School Mathematics Courses Based on the Common Core State Standards as defining these two pathways as the following:

(1) An approach typically seen in the United States (Traditional) that consists of two algebra courses, and a geometry course, with some data, probability, and statistics included in each course; and (2) An approach typically seen internationally (Integrated) that consists of a sequence of three courses, each of which includes number, algebra, geometry, probability and statistics (p. 3)

Tarr et. al. (2013) based on these definitions, researched the discrepancy in differential mathematics learning effect when students study from a traditional subject-specific and an integrated textbook. They also researched the relationship between curriculum type, implementation, and student learning in a second-year high school mathematics course. In the study, they found that students did not learn more when studying math in the traditionally organized subject specific design. Students in the integrated pathway scored higher than students in the traditional pathway on a nationally normed test assessing problem solving and concepts. The study further determined that curriculum organization and implementation are key elements to increase students’ learning in first and second year high school math.
As stated by Will (2014), Common Core Standards are challenging the high school sequence in math of algebra I, geometry, and algebra II. Integrated math would combine topics from these three courses in an integrated sequence and teach students how to bridge connections among topics. Three states have instructed all school districts to teach integrated math: West Virginia, North Carolina, and Utah. Most other states have left the decision of teaching integrated math, or the traditional sequence up to the individual school districts. Georgia has been using integrated math since 2008, although now uses a hybrid approach of traditional and integrated math. Proponents of integrated math argue that real-world application of math is seen in combination, as taught by integrated math, not in “silos” as taught by tradition math sequence. Will stated 85% of Georgia teachers, however, say that they would prefer to teach math using the traditional method. One county superintendent stated that the integrated approach makes sense theoretically but teachers have not been adequately prepared for the transition from the traditional to the integrated method in order for implementation to be successful. Teachers also cite a lack of existing curricular resources to aid in the transition to integrated math. Another issue with integrated math is a lack of adequate assessment. State assessments are designed only to assess traditional math pathways. A few integrated math assessments do exist, but have been underutilized. A complete change in the curriculum design of mathematics in the United States does present challenges. Will (2002) states many educators believe the time has come for this change in the United States.

eighth grade students who were supposed to graduate in 1992. There were over 12,000 students in this cohort, and they were followed or tracked until 2000. The students who counted in the study graduated from high school and attended a post-secondary institution by the age of 26. Adelman’s (2006) focus was on student persistence to identify characteristics to explain completion of a bachelor’s degree. Adelman (2006) developed an academic intensity index based on the number of Carnegie units taken by students in high school. Adelman (2006) stated that the following are minimum requirements for the academic index to have a positive impact on bachelor’s degree completion. The academic index includes English-3.75 units, math-3.75 units with the highest being pre-calculus or trigonometry, science-2.5 units, foreign language-2.0 units, history and social studies-2.0 units, more than one AP (Advanced Placement) course, and no remedial math or English courses. The academic index Adelman (2006) found has the potential to increase bachelor’s degree completion among African-American students by 28%, Latino students by 18%, and white students by 10%.

Adelman (2006) also found twice as many students in the 1992 cohort anticipated earning at least a bachelor’s degree compared to the 1982 cohort. Statistically, he found the strongest correlation using a multivariate analysis, between high school curriculum and completion of a bachelor’s degree. This correlation was more significant than class rank, GPA, or test scores. Examining math curriculum, specifically students who completed at least algebra II showed that these students had stable bachelor’s degree attainment rates, but this rate declined for every level below algebra II. The first year of attendance in college Adelman (2006) stated is where student preparation is most sorely tested and that remediation stalls a student’s momentum toward success. Remedial
courses caused students to earn a bachelor’s degree at a 48.7% rate compared to 69.9% rate for those who did not have to take remedial courses. Adelman (2006) also found that students who successfully completed remedial coursework did gain energy toward degree completion. Adelman (2006) addressed the concept of rigor explaining, “Secondary schools must provide maximum opportunity to learn, by which we mean not merely course titles, but course substance” (p. 108). This study supports Adelman’s (2006) original research from *Answers in the Toolbox* (1999) and the Trusty and Niles (2003) study.

Trusty and Niles (2003) investigated the effects of background variables and high school math curricula on completion of a bachelor’s degree. Their study followed students for 12 years from eighth grade to eight years after high school. The math course variables Trusty and Niles (2003) counted were algebra II, trigonometry, pre-calculus, and calculus. They also looked at background variables of gender, socioeconomic status, racial/ethnic group and eighth grade cognitive ability. The variable most strongly related to bachelor’s degree completion was high school intensive math courses. Finishing one unit of algebra II, trigonometry, pre-calculus, or calculus more than doubled the odds of receiving a bachelor’s degree. Trusty and Niles (2003) asserted that this increase in likelihood of attaining a bachelor’s degree when taking higher level math courses in high school was independent of influences of eighth grade reading and math ability, gender, socioeconomic class, and racial/ethnic group. Their findings were in agreement with Adelman (1999). Trusty and Niles (2003) state five specific findings for teachers, students, parents, and counselors to guide course-taking decisions:
1. Students who earn credits in intensive high school math courses have a greater likelihood of finishing a bachelor’s degree than those who do not.

2. Each course – algebra II, trigonometry, pre-calculus, and calculus are all-important and the benefit of taking these courses is cumulative.

3. Planning and advising students individually is critically important to their success long-term.

4. School administrators, counselors, teachers, and parents should work to ensure intensive math courses and opportunities are offered to students.

5. School counselors should provide particular support for Latino, African-American, or low socioeconomic students who desire to complete a bachelor’s degree (pp. 11-12).

Lasilla, Rule, Lee, Driggs, Fulton, Skarda, and Torres (2009) examined how to improve students transitioning from high school to college in Iowa, and make that transition better, particularly in the area of science. This research was prompted somewhat due to reports from the Washington Post, New York Times, and USA Today stating that the U.S. was not producing enough scientists to fulfill economic needs for the future. In Iowa, only 29% of students taking the ACT in 2005 met all three of the college readiness benchmarks of science, math, and English. Lasilla et. al. (2009) quoted Kati Haycock, director of the Education Trust as saying, “Although scores in Iowa and scores nationally show students entering high school are better prepared than they were 20 years ago, they are leaving high school less ready for college and the workplace” (p. 10). Former Iowa governor Vilsack, in expressing his concern over the troubled educational system, said high schools needed to be more rigorous. Low teacher pay in Iowa also
contributes to the problem. In 2005, Iowa ranked 41st in teacher pay nationally, but the legislature approved a salary increase to bring teacher salaries to 25th by 2008.

Lasilla et. al. (2009) formed the “Transitions Team” to begin conversations on how to improve student success, particularly in the area of science. This included revision of high school, community college, and university math curricula. The “Transitions Team” brought together high school and college instructors and invited guest lecturers. The insight gained from this collaborative work concluded that the sequence of science courses taught in high school was outdated and needed to be revised. They further stated that math courses should be taught at the same time as the science courses with science applications introduced in the math courses so they tracked together throughout the semester. The hope is that this approach will improve student’s thinking and reasoning skills and see real-life applications of math, which are more important than simply memorization of the same topics.

Shaugnessy (2011), President of the National Teachers of Mathematics, asked two questions based on his concern of how students are being prepared for college in K-12 schools. The two questions he asked about secondary education included: are students getting an appropriate mathematics experience, and are the math options comprehensive enough to provide a smooth transition to college from high school? The approach of making the final high school math goal, calculus, is inappropriate and does not address the future needs of students. A different sequencing and pedagogical style to current math classes will better prepare students with mathematical competence. Shaugnessy (2011) describes a typical high school math sequence of Algebra I, Algebra II, and perhaps pre-calculus, then the student attends college and takes intermediate algebra,
college algebra, then perhaps pre-calculus again. He states that this series of endless algebra is unnecessary, produces high attrition rates, is out-of-date and repetitive, and does not improve students’ views toward math or their abilities. Providing students with other alternative pathways to transition from high school to college math will better aid students. Shaugnessy (2011) suggests that the currently flawed system be replaced with exciting 21st century mathematics alternatives that will produce a better math student who can actually apply principles learned to real-life situations.

Early, Rogge, and Deci (2014) state that teachers, since the passing of No Child Left Behind in 2002, are being held accountable for improving student test scores in their classrooms. As a result, there is an interest in assessing the quality of instruction happening in the classroom. Early et. al. (2014) investigated one method for assessing instruction called Engagement, Alignment, and Rigor (EAR) visit protocol. This tool was designed by the Institute for Research and Reform in Education. This protocol has been used in 100 elementary, middle, and high schools nationwide for more than 27,000 visits and can be used for all subject matters. The protocol requires 20 minutes of observation focusing on student experiences that result from what teachers do, not on teacher behaviors. For engagement in the classroom, students who are engaged, processing information, or communicating information tend to be more intrinsically motivated to perform in the class. Alignment is the extent to which a teacher is on track in providing appropriate content to students in a timely manner and according to state and local standards. Rigor for the EAR protocol is maintaining high expectations for adequately challenging students in order to move these students to a higher level of learning.
Findings from Early et. al. (2014) indicate that teachers who were assessed at a high level on the EAR evaluation were engaged, aligned, and provided rigor in their respective classrooms, had students showing improvement on standardized tests. The results also showed that when students perceived themselves as being engaged and having quality instruction, their performance improved.

**College Readiness**

Hoyt and Sorenson (2001) looked at success rates of high school students in English and math based on COMPASS or ACT testing to predict remedial placement for college courses. They stated that in 1998 in Georgia, 30% of students who graduated from high school taking college preparatory courses still had to take remedial courses in college. In comparison, during the same year, remediation rates in Maryland were 46% and in Florida, they were 60% in 1995. Hoyt and Sorenson (2001) stated that a metaphor “the chain of blame” is being used to discuss this remediation problem with institutions of higher education blaming high schools, high schools blaming middle schools who blame elementary schools for the lack of student preparation. The authors’ findings conclude that a set number of years in high school required math and English will not, by itself, solve the problem. One variable may be lax or inconsistent standards that vary from school to school and teacher to teacher. Another variable may be teachers awarding passing grades to students who have not grasped material adequately. Students may lack motivation to perform well on assignments as a result. Hoyt and Sorenson (2001) suggested more focus on the learning process and better communication between instructors of higher education and secondary schools would positively influence the remediation problem.
North Carolina Early Math Placement Testing, (NC EMPT), has been in existence for 18 years and is the longest running and largest EMPT in the nation. Their goal is providing accurate and non-threatening information to high school students who have college and career plans according to Hattingh and Hilgoe (2015). NC EMPT has served more than 680,000 students, whose participation in the program is voluntary. The NC EMPT service is being provided free-of-charge by the state of North Carolina and is housed at East Carolina University. NC EMPT provided up-to-date practice math placement testing and information about requirements and expectations for incoming students at 58 community colleges and 15 UNC institutions. The overarching goal of NC EMPT is to reduce the number of incoming college freshmen requiring remediation. During the 2014-2015 academic year, 39,000 students participated in NC EMPT testing. Essentials for College Math, the name given by North Carolina to SREB’s Math Ready course, was offered statewide during the 2014-2015 academic year. This course provided a perfect platform for NC EMPT to use when reaching out to teachers who had students in need of a bridge course in math after reviewing the student scores. Ellen Hilgoe, Associate Director for NC EMPT, was chosen to become one of the North Carolina writers of SREB’s Math Ready course along with writers from four other states. Math Ready consists of eight modules targeting math skills necessary for success in college. North Carolina, West Virginia, Arkansas, and Mississippi were implemented Math Ready statewide in 2015-2016.

The 2014-2015 NC EMPT test was created using objectives in the areas of number and operation, algebra, and geometry. Letters discussing student results are created and returned to students within one day of NC EMPT receiving their scores.
Hattingh and Hilgoe (2015) further state that schools were given two options for the NC EMPT testing for the 2014-2015 academic year. Most schools chose Option 2, giving a new version of the EMPT test later in the semester compared to Option 1, with the 2013-2014 version of the test was given earlier in the semester. There are 32 questions on the exam and students can score a level 1, 2, 3, or 4. The level 1 student has 0-11 correct answers, level 2 has 12-16 correct answers, level 3 has 17-24 correct answers, and level 4 has 25-32 correct answers. Students receiving level 3 or 4 scores are considered to be college-ready.

Yeager and Dweck (2012) examined resilience in college readiness, or how students respond to challenges and whether or not that response is positive or negative. They also looked at whether the response could be changed. Academic underachievement is one of the most important issues facing educators today according to the study. Student perceptions about their level of intelligence being fixed and not able to be changed affects their resilience level because when they encounter academic challenges they may think that they are dumb or perceive that they are viewed as dumb and therefore do not persist through a challenge. Even when students are taught academic skills to become more resilient, they often times do not apply those skills because they do not believe that they can improve academically. Yeager and Dweck (2017) define resilience as:
Any behavioral, attributional, or emotional response that is positive and beneficial for development (such as seeking new strategies, putting forth greater effort, or solving conflicts peacefully), and we refer to any response to a challenge that is negative or not beneficial for development (such as helplessness, giving up, cheating, or aggressive retaliation) as not resilient (p. 303).

Research on resilience looked into the high failure rate of community college students who were placed into remedial math. Often, placement into these remedial courses produced feelings that math was a concept they would never be able to obtain or understand. The researchers encouraged students in these classes, teaching them that brains were malleable and that they could be taught to use and apply new strategies, and that brains grow more when they learn something new. When these strategies were applied, fewer students withdrew from their developmental courses, and they earned better grades in the course than students who did not receive the interventions. This increase in resilience showed students viewed academic challenges differently than before the intervention. The challenges became for them a way to get smarter instead of making them feel dumb. Yeager and Dweck (2012) addressed educational reform that focused on increased rigor in curriculum and instruction, and stated that without addressing resilience, the reform will not see the improvements that it potentially could.

Combs, Slate, Moore, Bustamante, Onwuegbuzie, and Edmonson (2009) studied differences in college-ready performance between boys and girls for the 2006-2007 academic year in the state of Texas. In an attempt to improve high school standards, Texas legislators in 2006 required public reporting of six college-ready indicators for high schools including:
1. Dual Credit Enrollment Courses
2. Advanced Placement (AP) test scores
3. Completion of Advanced Coursework in Math, Science, and Foreign Language
4. Scores from State Assessments
5. SAT or ACT results
6. Percent of College-Ready Graduates

The Combs et. al. (2017) study found statistically significant differences in 9 of 11 comparisons completed. Girls had higher rates overall of preparedness compared to boys in both math and reading. More boys were college ready in math than girls. Boys SAT scores were also statistically significantly higher than girls in the study. The achievement gap between the genders has been decreasing possibly because schools are providing equal opportunities and girls are being encouraged in STEM (Science, Technology, Engineering, and Math). The findings from the study suggest schools should continue to monitor AP and other college preparatory coursework and increase program rigor.

**Collegiate Approach**

Harrell and Lazari (2014) compared students at Valdosta State University who took traditional coursework with those who took Supplemental Instruction (SI) coursework in the mathematics department. These SI courses were taught three times per week by an assigned professor, then met twice per week for 50 minutes with an assigned student leader. Students who were weaker in mathematics were encouraged to sign-up for the SI sections, but it was voluntary. Final grades for students in the SI sections and the traditional sections showed no statistical difference. A comparison of final grades
between the two groups showed the SI group had significantly lower SAT scores prior to the SI course, which ultimately showed they had greater improvement. The program proved to be valuable but it was voluntary and low percentages of at-risk students chose to take the course. Valdosta State then required at-risk students to take Extended Sections (ES) courses. This course was different from the SI course in that the assigned professor was responsible for holding mandatory class sessions and assisting students. Forty percent of incoming freshman at Valdosta State were at-risk of not being successful in college Algebra. The middle 50% of these at-risk students were placed into ES classes by the Registrar’s office. All at-risk students were taught using traditional methods, but the ES group also met the additional two days per week for lab classes taught by the assigned instructor instead of a student leader as it had been on the SI courses.

The results of the Harrell and Lazari (2014) study showed that the ES group had lower High School GPA, SAT Math and ACT Math scores than the control group who was in a traditional math course. The study concluded that there was no statistical difference between the traditional group and the ES group on the final exam. This shows that the ES group was successful because they started as statistically weaker math students than the control group taking traditional math, yet there was no statistical difference in their final exam scores.

In an attempt to encourage high school students to complete rigorous curricula, Kim (2008) cited policymakers in the nation as implementing various initiatives as part of secondary curricular reform. These initiatives included High Schools That Work, career academics and tech prep programs, and integrating academics and Career and Technical Education (CTE). Tech prep programs have focused nationwide on preparing
students in an academically rigorous curriculum to help students make the transition from high school to post-secondary education. Kim’s study examined the relationship between tech prep and dual credit. They controlled for the variables of gender, ethnicity, and high school percentile rank. The study used a *Community College and Beyond* existing data set selecting Florida and Oregon. These two states were selected because they offered dual credit enrollment data.

Kim (2008) found that in Florida that non-tech prep students had a higher average number of dual credit courses than students in tech prep. In Oregon career tech education (CTE) dual credit students who were tech prep showed higher than average scores in dual credit courses than non-participating students. Student readiness was found to have a positive correlation with student readiness in reading, writing, and math in Florida among students in academic dual credit courses, whether academic or CTE. This finding was particularly positive among students in academic dual credit and the effect on readiness in math. Kim findings suggest that if tech prep students are encouraged to take CTE dual credit, it may lead to these students staying in college longer and being better prepared for college.

Pang (2010) declared that retention of college students would improve if those students were successful in their classes. Pang (2010) teaches Physics and has found that roughly half of his students, according to a math background survey he administered in 2007, were unable to perform basic math functions such as order of operations, fractions, percentages, and multiples. Pang maintains that many institutions have tried to remedy this situation by establishing remedial courses for these students. These remedial courses only become an extra burden to students instead of encouraging them toward graduation.
Pang (2010) felt that students who do not score high enough on a placement test upon entrance to the college should be placed in the same course as students who do pass the placement test, but it should be a slower pace taught by the best math instructors. Pang (2010) further said the instructors that teach these courses should be rewarded with merit, reduced teaching loads, and teaching assistants. In order to improve retention and decrease drop-out rates, improving a student’s math background is an appropriate and useful place to start.

Blum (2007) discussed the approach to remedial coursework taken by Montgomery County Community College outside of Philadelphia. In the fall of 2005, only about half of students at the school who took remedial beginning Algebra passed the course. Twenty-five percent of students who took remedial beginning Algebra in the fall of 2000 had still not received a passing grade in the course four years later. Most of these students had dropped out or were still repeating the course four years later. Most colleges have two or three remedial courses in the remedial course sequence and these are typically pass-fail, not for credit, and are designed to provide a bridge to college-level work for underprepared students. Blum (2007) stated, “But what college officials and observers find so distressing is not so much the number of students who must take remedial math classes, but the number of students who fail them,” (p. 62). A program called Achieving the Dream began with 27 two-year institutions and is now at 83 institutions, that desire to improve graduation rates and Montgomery County Community College is one of them. Roughly 60% of students at Montgomery have to take remedial coursework. In order to work toward improving remedial course completion and graduation rates, Montgomery is now offering a two week refresher math course in the
summer where students can take a placement test following the two week course, and can then move right to beginning Algebra and skip remedial math. Montgomery is also offering peer tutoring where the peer tutors also go to the remedial courses with students and then hold weekly sessions containing specific information about current class content. Some of these peer tutors recently passed the remedial course and some are higher level math students. The instructors for the remedial course have made the content applicable and user-friendly with real-life examples students can relate to in hopes that this will improve pass rates for the course, and ultimately graduation.

Williams and Siwatu (2017) discuss Louisiana’s approach to remedial education and state that developmental education has become an integral part of postsecondary education with 76% of all postsecondary and 98% of all community colleges in 2000 offering at least one remedial course. The Louisiana Board of Regents in 2015 implemented a newly revised policy stating that only 2-year community colleges and historically black colleges were permitted to teach developmental math courses, although students could be accepted at some regional 4-year institutions if they needed remedial coursework. Williams and Siwatu’s (2017) study sought to examine if successful completion of college-level work could be predicted by the location of where students took their developmental courses. The study found that race, high school GPA, and location of developmental math were statistically significant predictors of successful completion of college algebra. Students who attended and took remedial coursework at community colleges performed better in college algebra than other students, particularly if their high school GPA was above a 2.5 on a 4.0 scale. Based on this finding, Williams and Siwatu (2017) suggested that if community colleges are the location for successful
remedial education, then better collaboration between high schools, community colleges, and 4-year institutions would benefit students needing remedial coursework.

Furthermore, Williams and Siwatu (2017) stated stronger articulation agreements needed to be in place between community colleges and 4-year institutions so transferring credits is a smooth process. These articulation agreements they said, may also improve retention of developmental learners who desire to complete a bachelor’s degree.

**Workplace Readiness**

The Conference Board (2006) report, “Are They Really Ready to Work” cites four important workplace skills necessary for incoming employees to be successful as designated by 400 employers surveyed nationwide.

1. Professionalism/Work Ethic
2. Oral and Written Communication
3. Teamwork/Collaboration
4. Critical Thinking/Problem Solving

The Conference Board (2006) report found that high school graduates are deficient in all four basic skills except teamwork/collaboration but only received an “adequate” score in that category. They found 2-year and 4-year college graduates to be deficient in leadership and reading and writing, but were overall better prepared than high school graduates for entry-level positions. The report further specifies that according to employers, 72% rate new employees that are high school graduates as deficient in writing in English, 53.5% as deficient in mathematics, 38.4% deficient in reading comprehension, 80.9% deficient in written communication, 70.3% deficient in professionalism/work ethic, and 69.9% deficient in critical thinking/problem solving (Conference Board Report, 2006).
Seventy-five percent of employers surveyed for the Conference Board Report (2006) believe that K-12 schools are responsible for providing these basic skills for their new employees. These employers also agreed that 2-year and 4-year institutions held some responsibility as well as the employees and their parents to encourage the importance of learning, work, and career.

According to Kirst and Venezia (2001), an ongoing disconnect between K-12 schools and institutions of higher education continues all across the U.S. They state that this disconnect between K-12 and higher education occurs in the following six areas:

1. Access to college preparatory course in core subjects.
2. Grade inflation and a reliance on grades as a predictor.
3. The need for remedial-level college work.
5. Special problems endemic to senior year of high school.
6. Lack of early and high-quality college counseling for many students (p. 92).

Kirst and Venezia (2001) have the belief that dialogue between secondary schools and institutions of higher learning are often started but not maintained through the long term with any structure.

**College Remediation**

The Bermuda Triangle of community colleges as stated by Bradley (2015) in the *Community College Week* article is the remedial math sequence – students go in but never come out. Six states: Texas, Ohio, Georgia, Indiana, Missouri, and Colorado, are redesigning these remedial pathways in order to have students complete this coursework in one year or less and to make the connection between the courses and students’ career
choices. Thirty-eight percent of students in 2011-2012 in the California Acceleration Project completed a college-level statistics course in one year, and only 12% of students not in the project completed in the same time frame. Similarly, 65% of students in the New Math Project in Texas in 2011-2012 completed their remedial requirements in one year and only 26% of students in a traditional remedial course completed the same requirements. Bradley (2015) cited the Dana Center at the University of Texas as saying that math placement tests are inaccurate because they do not take into consideration the differentiated content of new pathways and often do not align with high school curricula showing more of the disconnect between higher education and secondary schools. Therefore, math placement tests send too many students to remedial classes.

Bahr (2012) stated that the majority of students in community colleges who begin remedial sequencing in math and other subjects do not achieve competency in those subjects. This phenomenon is particularly true for those students who enter the remedial sequence at a lower level. Students require a minimum amount of time in remedial classes in order to be successful. This period is different for each student depending on their initial level of skill. Students who are unable to complete the remedial sequence are likely to drop out of college with no credentials. One of the implications of the research, as Bahr (2012) notes, is that there are problems with standard remedial pedagogy. There is little reference to use outside the classroom, so students are unable to see a connection between the content and the real world.

Bryk and Treisman (2010) asserted that math should be a gateway, not a gatekeeper to a successful college education. They suggested that college math coursework should be designed to be applicable to a student’s career choice. The
Carnegie Foundation for the Advancement of Teaching has organized a group to create a statistical pathway for students to replace the current remedial sequencing in math. This has been more appropriate for students pursuing careers outside of those dependent on algebra and pre-calculus such as engineering and science or technology. This new sequence of statistical courses has benefitted students in the social sciences, humanities, and business among other disciplines. Bryk and Treisman (2010) recommend colleges teach students how to be students and survive college as well as pass coursework. This will in turn create successful students in the classroom for math and beyond.

Trusty (2002), examined the course-taking behaviors of high school students in math and science and whether or not that translated to a choice of math or science major in college. This was a large study of over 5,000 people total from all across the United States. All subjects attended U.S. high schools, were working on a bachelor’s degree within two years of high school, and had a specific college major. The result of the study showed that 22% of females and 36% of males were in a science or math major. Socioeconomic status was not a significant impact on the choice of major for males or for females. African-American women were most likely to be in science and math majors, and white and Native-American women were least likely to be in science and math majors. Asian/Pacific-Islander men were most likely to be in science and math majors, and white men were slightly less likely to be in science and math majors. Among women, positive attitudes about school decreased the likelihood of selecting math and science as a major. Among men with higher eighth grade science scores, there was a 37% increased chance of them choosing a math or science major than those with lower eighth grade science scores. The degree of computer use while in high school had a
significantly positive impact on men and their choice of a major in science or math, but the same effect did not exist for women. The effect among men taking physics in high school and their choice of a major in science or math was positive. This same effect was seen among women, but it was with the three intensive math courses of trigonometry, pre-calculus, and calculus, instead of physics as it had been for men. The level of performance in math taken early among women, led to more positive course-taking while in high school, which lead to more majors in math and science. For men, their self-perceptions in math had a strong positive effect on majoring in math and science. The Trusty (2002) study showed a distinct correlation between the levels of coursework that students take in high school and the positive effect it has on their choice of major in math or science while working toward a bachelor’s degree.
CHAPTER 3: METHOD

Empirical evidence reports that high numbers of high school students entering college must take remedial coursework upon entrance to institutions of higher education. The National Center for Educational Statistics (2016) survey revealed that 29% of students at public 4-year institutions and 41% of students at public 2-year institutions report having taken a remedial course in college. The report further affirms that taking remedial coursework is not always beneficial, and when students are not successful in these courses, the likelihood of them receiving a bachelor’s degree declines. Transitional courses taken in high school can prepare students who are not yet college-ready, but desire to seek higher education, and avert the process of college remediation. Barnett, Fay, and Pheatt (2016) stated that 29 states currently offer transitional courses to high school students, but research on the effectiveness of these courses is in the early stages. Effective implementation of transitional courses is critical to increasing student success and entrance to college in a credit-bearing course instead of remedial coursework.

Essentials for College Math is a transitional math course for high school students designed by SREB. SREB named the course Math Ready, and North Carolina called the same course Essentials for College Math. The North Carolina Department of Public Instruction collaborated with SREB to offer the course during the 2014-2015 academic year. The design of the course was to prepare high school students identified as being under-prepared for college-level mathematics. Teachers who offered the course were strongly encouraged to attend a four-day workshop presented by math consultants through SREB. The course focused on real-world problems, improving math skills, and encouraged confidence in the content (Hattingh & Hilgoe, 2015). Essentials for College Math included eight modules:
1. Algebraic Expressions
2. Equations
3. Measurement and Proportional Reasoning
4. Linear Functions
5. Linear System of Equations
6. Quadratic Functions
7. Exponential Functions
8. Statistics

These modules helped in developing critical thinking skills for students and enabled them to apply these skills to their college courses and to use in their careers. The course emphasized mathematical concepts so students understood why they were doing math a particular way, and were not simply memorizing procedures (Math Ready, 2015).

**Research Questions**

The overarching question for this study is this: Does transitional math curriculum exist that will decrease a student’s need for remedial coursework in college? In order to answer that question, an analysis of data collected by the North Carolina Early Mathematics Placement Testing program (NC EMPT) based on the implementation of SREB’s *Math Ready* transitional course in the state of North Carolina in 2014-2015 academic year was assessed. These data were analyzed to evaluate the significance of the program in better preparing high school students for college level math.

Research questions for this study include:

1. What difference, if any, exists in pre and post-test NC EMPT scores of students taking the transitional math course called *Essentials for College Math*?
2. What relationship, if any, exists in post-testing levels for students who have completed the *Essentials for College Math* course compared to the level students tested during the pre-test?

3. What difference, if any, exists between the percentage of students who were at the proficiency level as identified in the NC EMPT pre-test (not needing remedial coursework upon entrance to college), compared to the percentage of students at the proficiency level following the *Essentials for College Math* on the post-test?

**Research Design**

The significance of success of the *Essentials for College Math* course was analyzed in three different ways. The first was by using a t-test for a paired sample. The t-test assessment tracked the same students for pre- and post-testing and utilized their pre- and post-test scores as the dependent variable. The independent variable was the *Essentials for College Math* course. A Chi-square statistical test evaluated the data, revealing any difference between student’s initial level of knowledge and subsequent post-test score and assigned level. Students were assigned a 1, 2, 3, or 4 according to their pre-test scores and that initial designation was then compared to the growth or decline on the post-test scores for the same students. A student was to be considered college-ready if they scored a level 3 or 4 on the NC EMPT test. The Chi-square test revealed where the significance, if any, had occurred as shown by the results of the test. A comparison of students already at the proficiency level as shown in a pre-test level and those who reached the level of proficiency following the independent variable administration as shown by post-test level was also calculated. The Statistical Package
for the Social Sciences (SPSS) software program was used for the analysis of the data utilizing IBM SPSS Statistics 24.

NC EMPT scored students with a 1, 2, 3, or 4 based on the number of correct answers the student had on the pre- or post-test on a 32 question test (See Table 1).

**Table 1 Assigns NC EMPT levels with corresponding number of correct answers**

<table>
<thead>
<tr>
<th>NC EMPT Level</th>
<th>Number of Correct Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0-11</td>
</tr>
<tr>
<td>2</td>
<td>12-16</td>
</tr>
<tr>
<td>3</td>
<td>17-24</td>
</tr>
<tr>
<td>4</td>
<td>25-32</td>
</tr>
</tbody>
</table>

The NC EMPT Advisory Board reviews the level interpretations each year. This Advisory Board represents the 15 University of North Carolina campuses and 58 North Carolina community colleges. The level interpretations (See Table 2) are as follows:
Table 2 Describes assigned levels through NC EMPT

<table>
<thead>
<tr>
<th>Level</th>
<th>Level Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Indicates a student is not ready for college-level math courses and must take remedial math.</td>
</tr>
<tr>
<td>Level 2</td>
<td>Indicates the student must take remedial math in some choices of majors</td>
</tr>
<tr>
<td>Level 3</td>
<td>Indicates the student is ready for beginning-level college mathematics courses. However, a Level 3 score may be considered borderline at some universities for students planning to major in math, science, or engineering.</td>
</tr>
<tr>
<td>Level 4</td>
<td>Indicates a solid high school preparation for college-level mathematics. Some universities allow a student scoring a Level 4 on their math placement test to skip the first college math course, depending on that student’s choice of major.</td>
</tr>
</tbody>
</table>

(Hattingh & Hilgoe, 2015)

Sample

The Southern Regional Education Board (SREB) granted permission to the researcher to examine data garnered by North Carolina Early Mathematics Placement Testing (NC EMPT) for the 2014-2015 academic year (See Appendix A). NC EMPT collected data from 26 high schools in North Carolina who implemented SREB’s Math Ready course, called Essentials for College Math to 887 students. These 887 students also pre-tested and post-tested with NC EMPT tests. During the 2014-2015 academic
year, a total of 253 high schools and 38,903 students participated in the NC EMPT program. The 887 students at 26 high schools are a subset of the larger group. NC EMPT is a voluntary program that offers information to high schools and their students that choose to participate in the pre and post-testing program. The purpose of NC EMPT is to give these students relevant college readiness information. Students who participate are given a report which includes their score, assigned level, what the level means in the North Carolina system of universities, and how they can improve their scores throughout the rest of their high school career. It is also the decision of each individual school to choose whether or not to participate in the Essentials for College Math transitional course. The 26 high schools in this study were the only ones that opted to take part in the training and the use of the Essentials for College Math course itself (Hilgoe, E., personal communication June 5, 2017). The findings of NC EMPT showed that 43% of students who were enrolled in and completed Essentials for College Math saw improvement in the pre- and post-test scores while only 4% of students saw declines in the pre- and post-test scores. There are 2 options of the NC EMPT test that can be administered. The first, or Option 1, is the version used the previous year, or the 2013-2014 academic year in this case. The second option, Option 2, which was used by the majority of schools involves using the newly created version for the 2014-2015 academic year. Seventy-eight percent of students were assessed at a baseline of Level 1 using the Option 1 scores which is the lowest level. Students who were at the Level 1 baseline saw 46% of them increase at least one level to Level 2 on the Option 2 test and 11% of these same students improved to Level 3 on the Option 2 test (Hattingh & Hilgoe, 2015).
Procedures

An email sent to the Director of High School to College Readiness at SREB sought permission to use the data set NC EMPT gathered for the 2014-2015 academic year (See Appendix A). Usage of the data set belonging to SREB for this study did not warrant approval from IRB. Analysis of the existing research prompted the research questions for this study. Examination of the data utilized the SPSS software program for data entry and analysis. The data was uploaded in SPSS and a t-test, and two different Chi-Square tests were administered on the data.

Summary

This chapter presented the method used in acquiring and analyzing a data set established by NC EMPT for use by SREB. Chapter 3 described the research method and procedures used to examine the issue of the significance of transitional coursework in preparing high school students for credit-bearing courses without the need for remedial coursework in college. Chapter 4 will explain the results garnered from the data set and Chapter 5 will discuss the results and conclusion of data in Chapter 4.
CHAPTER 4: RESULTS

Chapter 4 presents the data results and analysis of the NC EMPT information gathered during the 2014-2015 academic year assessing the effectiveness of the Essentials for College Math course. The data collected represented 887 students at 26 high schools who completed the Essentials for College Math course. This chapter is organized into the purpose statement, research questions, population, and analysis of the data set.

Purpose Statement

SREB has created a transitional high school course for literacy and for math called Literacy Ready and Math Ready respectively. SREB identified the issue of high school graduates needing remedial classes in math and English and realized those numbers would continue to increase. They believed this readiness gap would continue to widen with more stringent standards coming from new assessments, such as Common Core Standards. SREB developed new curricula in both areas to be used as a transitional course in a student’s junior or senior year in high school. These programs have been designed to specifically target the issue previously stated of the lack of preparation for college level courses in math and English. These courses were field tested in seven different states in 2014, and since then have been piloted in four states in the 2015-2016 academic year. The piloted states include North Carolina, West Virginia, Arkansas, and Mississippi. North Carolina is only piloting Math Ready at this time. The programs have been adopted in these four states, although in West Virginia, transitional coursework must be offered, and the SREB curriculum is just one of the options the counties or individual schools could choose to implement in their classrooms (Math Ready, 2015). This study examined the results of the Math Ready pilot in the state of North Carolina. The study has significance
because of the staggering statistics of remedial coursework needed by high school students when they enter college, while showing a need for curricular change at the high school level.

This study sought to increase the knowledge base of those involved in administering high school curricula for math, including teachers and administrators at the county and state level, and for those involved in designing and carrying out college level credit bearing courses in math at institutions of higher learning. Barnett, Fay, and Pheatt, (2016) stated that transitional coursework in high school has the potential to reshape a student’s transition to college, which could increase their likelihood of completing a degree, and could also teach nonacademic aspects of college further promoting a positive transition to secondary education.

Statistics vary in the exact number of students currently requiring remedial coursework at the time they enter college, but each one contributes to a compelling narrative about the current state of high school students from an academic perspective. The workforce continues to need college graduates for existing careers with a trend toward increasing those numbers. This study gauged the effective preparation of high school students in the category of math for entrance to college by SREB Math Ready course. The findings from this study would facilitate and support future research. Additional parties who may gain insight from this study include organizations such as SREB, the Gates Foundation, state departments of education as they seek programs to implement for their student population, and colleges who are designing and implementing similar high school programs.
Research Questions

The overarching question for this study is: Does a transitional math curriculum exist that will decrease a student’s need for remedial coursework in college? In order to answer that question, data collected by the North Carolina Early Mathematics Placement Testing program (NC EMPT) was collected based on the implementation of SREB’s Math Ready transitional course in the state of North Carolina in 2014-2015 academic year. These data were analyzed to evaluate the significance of the program in better preparing students for college level math.

Research questions for this study include:

1. What difference, if any, exists in pre and post-test NC EMPT scores of students taking the transitional Math course called Essentials for College Math?

2. What relationship, if any, exists in post-testing levels for students who have completed the Essentials for College Math course compared to the level students tested during the pre-test?

3. What difference, if any, exists between the percentage of students who were at the proficiency level as identified in the NC EMPT pre-test (not needing remedial coursework upon entrance to college), compared to the percentage of students at the proficiency level following the Essentials for College Math on the post-test?

Population

During the 2014-2015 academic year a total of 38,903 students were pre- and post-tested through the NC EMPT program. A subset of this larger population were pre- and post-tested and completed the Essentials for College Math course. This subset included 26 high schools and 887 students. These schools voluntarily sent teachers for
training and utilized the course as transitional work for their students. The data set that was analyzed included only this subset of students. No other schools used the *Essentials for College Math* course.

**Data Analysis Procedures**

**t-test for Paired Samples**

A t-test for paired samples was used to look for significance of change within a single group of the same subjects under two different conditions (Salkind, 2007). The mathematical equation for a t-test for paired samples was:

**Figure 1 Formula for t-test**

\[
t = \frac{\Sigma D}{\sqrt{\frac{n\Sigma D^2 - (\Sigma D)^2}{n-1}}}
\]

\(\Sigma D\) -is the sum of differences between groups

\(\Sigma D^2\) -is the sum of the differences between groups squared

n -is the number of pairs of an observation (Salkind, 2007).

To answer research question one, a t-test for paired samples was used:

1. What difference, if any, exists in pre and post-test NC EMPT levels of students taking the transitional Math course called *Essentials for College Math*?

The two conditions that were being observed were the pre- and post-test levels for students before and after taking the *Essentials for College Math* course. These data were analyzed using the SPSS software comparing these two observations using a paired samples t-test.
Table 3 Statistical table for mean of pre- and post-levels

<table>
<thead>
<tr>
<th>Value</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>t-score</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test Level</td>
<td>1.269</td>
<td>.5567</td>
<td>-19.334</td>
<td>.000</td>
</tr>
<tr>
<td>Post-Test Level</td>
<td>1.760</td>
<td>.7949</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The mean level achieved by students on the pre-test was 1.269 ($sd = .5567$) and the mean level achieved by students for the post-test was 1.760 ($sd = .7949$). This difference between means is equal to .491, which equates to an approximate 12.5% increase in post-test score compared to pre-test score. A significant increase from pre-test to post-test was found. The level of significance was $p < .000$ therefore indicating that there is a statistically significant difference between the level students scored on the pre-test before they took the Essentials for College Math course and level they achieved on the post-test. The standard deviation was large, but the total number set, only going from 1-4, was very small, therefore you would expect a larger standard deviation due to the small distance between numbers.

**Chi-Square Test**

A Chi-Square test was used to compare what is observed with what is expected by chance (Salkind, 2007). The formula for calculating Chi-Square is:

**Figure 2 Formula for Chi-Square**

$$X^2 = \sum \frac{(0 - \hat{E})^2}{E}$$

$X^2$ - is the chi-square

$\sum$ -is the sum
O - is the observed frequency
E - is the expected frequency

To answer research question 2 a Chi-Square analysis was done:

2. What relationship, if any, exists in post-testing levels for students who have completed the Essentials for College Math course compared to the level students tested during the pre-test?

The data were reviewed and each of the 887 students was assigned a value based on the increase or decrease in level from pre-test to post-test. The researcher created the following code as shown in Table 4 in order for SPSS to recognize the assigned levels of differences in range for the data set. Since the levels were already assigned to the numbers 1, 2, 3, and 4, the assigned group numbers by the researcher began at 101 and were therefore easily recognizable, with 16 different possibilities in levels of increase or decrease in pre- and post-test levels.
### Table 4 Assigned groups of change in level from pre- to post-test for recognition by SPSS

<table>
<thead>
<tr>
<th>Change in Level from Pre-test to Post-test</th>
<th>Assigned Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>101</td>
</tr>
<tr>
<td>1-3</td>
<td>102</td>
</tr>
<tr>
<td>1-2</td>
<td>103</td>
</tr>
<tr>
<td>2-3</td>
<td>104</td>
</tr>
<tr>
<td>2-4</td>
<td>105</td>
</tr>
<tr>
<td>3-4</td>
<td>106</td>
</tr>
<tr>
<td>4-3</td>
<td>107</td>
</tr>
<tr>
<td>4-2</td>
<td>108</td>
</tr>
<tr>
<td>4-1</td>
<td>109</td>
</tr>
<tr>
<td>3-2</td>
<td>110</td>
</tr>
<tr>
<td>3-1</td>
<td>111</td>
</tr>
<tr>
<td>2-1</td>
<td>112</td>
</tr>
<tr>
<td>1-1</td>
<td>113</td>
</tr>
<tr>
<td>2-2</td>
<td>114</td>
</tr>
<tr>
<td>3-3</td>
<td>115</td>
</tr>
<tr>
<td>4-4</td>
<td>116</td>
</tr>
</tbody>
</table>

A Chi-square test was run on the data to assess the differences between groups. A level of significant difference existed between the groups.
The groups showing the largest number of students was one with no change at all, group 113. Group 113 included students that scored a level 1 on the pre-test and again scored a level 1 on the post-test. Following group 113, was the assigned group 103, which showed improvement from a level 1 on the pre-test to a level 2 on the post-test. Assigned group 102 also showed improvement with students improving from a 1 on the pre-test to a 3 on the post-test, which is the beginning of the level of proficiency. A high number of students maintained their level of 2 on the pre and post-test as showed in assigned group 114. Other groups showed smaller levels of change particularly in students who scored a
level 3 or 4 on the pre-test. Those students did show some change but not as much as students scoring a 1 or 2 level on the pre-test.

Table 5 Frequency and percentage of change in each assigned group

<table>
<thead>
<tr>
<th>Assigned Group</th>
<th>Number of Actual Students in the Corresponding Group</th>
<th>Percent of Total Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>101(1-4)</td>
<td>1</td>
<td>0.1%</td>
</tr>
<tr>
<td>102(1-3)</td>
<td>86</td>
<td>9.7%</td>
</tr>
<tr>
<td>103(1-2)</td>
<td>238</td>
<td>26.8%</td>
</tr>
<tr>
<td>104(2-3)</td>
<td>59</td>
<td>6.7%</td>
</tr>
<tr>
<td>105(2-4)</td>
<td>3</td>
<td>0.3%</td>
</tr>
<tr>
<td>106(3-4)</td>
<td>4</td>
<td>0.5%</td>
</tr>
<tr>
<td>107(4-3)</td>
<td>2</td>
<td>0.2%</td>
</tr>
<tr>
<td>108(4-2)</td>
<td>1</td>
<td>0.1%</td>
</tr>
<tr>
<td>109(4-1)</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>110(3-2)</td>
<td>3</td>
<td>0.3%</td>
</tr>
<tr>
<td>111(3-1)</td>
<td>5</td>
<td>0.6%</td>
</tr>
<tr>
<td>112(2-1)</td>
<td>25</td>
<td>2.8%</td>
</tr>
<tr>
<td>113(1-1)</td>
<td>372</td>
<td>41.9%</td>
</tr>
<tr>
<td>114(2-2)</td>
<td>60</td>
<td>6.8%</td>
</tr>
<tr>
<td>115(3-3)</td>
<td>27</td>
<td>3%</td>
</tr>
<tr>
<td>116(4-4)</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>
Ultimately students getting to the proficiency level of 3 or 4 is the goal of the transitional math course. See Table 4 for classification of groups. Groups 101, 102, 104, 105, and 106 all had students improving in the level they achieved on the post-test to get to a proficiency level of 3 or 4. This is a total of 152 students or 17% of the 887 students tested that were able to achieve a proficiency level after taking the Essentials for College Math course. Three other students also maintained a proficiency level by staying at level 3 on both the pre- and post-test as shown in Group 115. Two students dropped in score in group 107 but were able to stay at a level 3 so still achieved a level of proficiency.

The goal of transitional math courses is to get students to a level of proficiency so they do not have to take a remedial math course when they enter college. NC EMPT designates a student to be at the level of proficiency when they reach a 3 or 4 level. Research question 3 states:

3. What difference, if any, exists between the percentage of students who were at the proficiency level as identified in the NC EMPT pre-test (not needing remedial coursework upon entrance to college), compared to the percentage of students at the proficiency level following the Essentials for College Math on the post-test?

A Chi-Square was used to compare the number of students who scored at the proficiency level on the pre-test compared with students that scored at the level of proficiency on the post-test following their completion of the Essentials for College Math course. The first part of the question was answered by assessing the frequency at which the students during the pre-test scored at the proficiency level of a 3 or 4 and assessing the frequency at which students in the post-test scored a level 3 or 4.
Table 6 Frequency and percentage of students at each pre-test level

<table>
<thead>
<tr>
<th>Level</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test Level 1</td>
<td>694</td>
<td>78%</td>
</tr>
<tr>
<td>Pre-Test Level 2</td>
<td>151</td>
<td>17%</td>
</tr>
<tr>
<td>Pre-Test Level 3</td>
<td>38</td>
<td>4.3%</td>
</tr>
<tr>
<td>Pre-Test Level 4</td>
<td>4</td>
<td>.5%</td>
</tr>
</tbody>
</table>

Table 7 Frequency and percentage of students at each post-test level

<table>
<thead>
<tr>
<th>Level</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-Test Level 1</td>
<td>403</td>
<td>45%</td>
</tr>
<tr>
<td>Post-Test Level 2</td>
<td>303</td>
<td>34%</td>
</tr>
<tr>
<td>Post-Test Level 3</td>
<td>172</td>
<td>19%</td>
</tr>
<tr>
<td>Post-Test Level 4</td>
<td>9</td>
<td>1%</td>
</tr>
</tbody>
</table>

The data were analyzed using SPSS which assigned a frequency level for the pre-test level and another for the post-test level. Evaluating the frequencies themselves, students scoring a level 1 on the pre-test and post-test dropped from 78% to 45%, with students who scored a level 2 improving from 17% on the pre-test to 34% on the post-test. The level of proficiency, levels 3 or 4 also improved with Level 3 increasing from 4.3% to 19% and Level 4 doubling from .5% to 1%. This improvement in level 4 was small but important.

A weighted Chi-Square was then used to compare the two frequencies. A level of significance was found, with a Chi-Square score of 86.6, and significance between the two
frequencies with \( p < 0.000 \). The pre-test group had 42 students that scored a level 3 or 4 and the post-test group had 181 students that scored a level 3 or 4. This difference was out of 887 total students that were pre- and post-tested. The pre-test group showed 4.7\% of students scored at the proficiency level. The post-test group had improved to 20\% of students scoring at the proficiency level.

**Conclusion**

The data analyzed from NC EMPT for the 2014-2015 academic year showed levels of significance in all three areas that were examined. There was a significant difference in pre- and post-test scores among participants. There was a significant difference in post-test levels achieved by participants depending on which level they achieved on the pre-test. There was also a significant difference in students who were able to achieve a level 3 or 4 showing proficiency on the post-test compared to students who were at the proficiency level on the pre-test.

This study successfully achieved its purpose which was to investigate the effectiveness of the *Essentials for College Math* course. Chapter 5 will examine in more detail these results and their meaning.
CHAPTER 5: DISCUSSION

The purpose of this chapter is to summarize the findings of the research in the current study and discuss the findings based on the data that were presented in Chapter 4. This chapter provides an avenue for the researcher to further explain the findings and suggest areas for future research. This chapter is organized into the problem statement, research questions, limitations, discussion of the literature, implications of findings, recommendations for future research, and a summary.

Problem Statement

The tremendous number of students who need to begin college by taking remedial coursework suggests a need for scrutiny of the high school curricula. Adams (2014) presents statistics from the State of Tennessee on the issue of high school transitional courses. Adams (2014) declared that 70% of students attending college after high school require remedial coursework in college, and of those who enter the remedial pathway in college, only 5% are graduating from community colleges in a 3-year time span according to Tennessee Board of Regents. This statistic shows the need for transitional coursework prior to entrance into college. Many states are looking into this type of structure for those students who seek a post-secondary degree at institutions of higher education. Adams (2014) stated that there are many ways to combat the problem, and the Southern Regional Education Board (SREB) has developed one such curriculum. This new curriculum developed by SREB has been piloted in seven states in 20 different schools. SREB is aiming to close the “readiness gap” and has stated that over 50% of students admitted to 2-year public colleges require remedial coursework in math, English, or both (Essential Elements, 2013).
Research Questions

The overarching question for this study is: Does a transitional math curriculum exist that will decrease student’s need for remedial coursework in college? In order to answer that question, data collected by the North Carolina Early Mathematics Placement Testing program (NC EMPT) was collected based on the implementation of SREB’s Math Ready transitional course called Essentials for College Math in the state of North Carolina in 2014-2015 academic year. These data were analyzed to evaluate the significance of the program in better preparing students for college level math.

Research questions for this study include:

1. What difference, if any, exists in pre and post-test NC EMPT scores of students taking the transitional math course called Essentials for College Math?

2. What relationship, if any, exists in post-testing levels for students who have completed the Essentials for College Math course compared to the level students tested during the pre-test?

3. What difference, if any, exists between the percentage of students who were at the proficiency level as identified in the NC EMPT pre-test (not needing remedial coursework upon entrance to college), compared to the percentage of students at the proficiency level following the Essentials for College Math on the post-test?

Chapter 4 provided answers to these three research questions.

Limitations

There were several limitations to this study. The researcher received guidance from experts in the field of statistical research in order to minimize these limitations. The findings were limited to 26 high schools all located in the state of North Carolina. The
study was limited by its focus on only one transitional math course. This study utilized the data set from the 2014-2015 academic year collected by NC EMPT. The benign data set did not include:

1. Demographic information on students
2. Population of the schools
3. Geographic setting for each of the 26 schools.

Limitations to the statistical analysis included how students were assigned to the group taking the course and those that were not assigned to take the course. The pedagogical style of the teachers was unknown. Due to these limitations, it is difficult to generalize the findings. While the focus was on results from one state, the results of this study have ramifications for states nationwide with regard to high school transitional math coursework.

Providing teachers, county and school administrators, and state departments of education methods to address the issue of the large numbers of high school graduates who need remedial coursework upon entrance to college could prove invaluable. Additional audiences that can benefit from this study are institutions of higher learning, other organizations designing transitional math curricula, and agencies providing funding for designing such coursework.

**Discussion and Related Literature**

This study was designed to examine the effectiveness of the *Essentials for College Math* course that was designed by the Southern Regional Educational Board (SREB) and implemented in the state of North Carolina during the 2014-2015 academic year in 26 high schools. The study looked at the results that were gathered by the North Carolina Early Mathematics Placement Testing agency. Barnett, Fay, and Pheatt (2016)
stated that research in the area of effectiveness of transitional math programs across the country is in its early stages. This research study has contributed to that body of knowledge. This study sought to increase understanding and delve into the problem that exists with so many graduating high school seniors still needing to take remedial coursework in the area of math upon entrance to college because they are not properly prepared in high school. Barnett, Fay, Pheatt, and Trimble, (2016) state that two-thirds of students entering community colleges and 40% of students entering four-year institutions are placed into remedial coursework upon entering college. There are other transitional math curricula that school systems can use, but this study examined the effectiveness of one of these transitional courses.

**Research Question 1: Difference in Pre- and Post-Test Scores**

The purpose of research question one was to see if there was a significant difference between the pre- and the post-test scores of the 887 students at 26 high schools that took a pre- and post- NC EMPT test, and completed the *Essentials for College Math* course. Students were given the 32 question test prior to taking the *Essentials for College Math* course and were again given the test after completion of the course. After examining the data set for pre- and post-test scores, the researcher found that there was an increase of .491 on a scale of 1-4 with a p<.000. The mean of the pre-test was a 1.269 and the mean on the post-test was a 1.760. This shows an approximate increase of 12.5% improvement following completion of the course for all students. This percentage shows definite improvement, but the level of improvement is small, yet statistically significant.

Barnett et. al. (2016) state that the way students are targeted for placement into these transition courses could impact the outcome. Transitional courses are geared
toward students who score below a certain cut score, or ACT score for placement into the transition sections. Barnett et. al. (2016) assert that, for example, in West Virginia, students who score below the cut score are placed into the transitional course, but students who score above the cut score are also placed into the course, as are students who have no intention of attending college, and students who simply need a fourth math credit, not necessarily a transitional math course.

Similarly in North Carolina, SREB stated that the Essentials for College Math course was designed for students just below the readiness cut-off and in the middle-band of mathematical abilities. They gave specific ACT and COMPASS scores that student should score before placement into the course. The North Carolina Department of Public Instruction highly recommended that each school system follow the preceding guidelines established by SREB. However, the implementation of these guidelines sometimes did not make it down to the individual high schools that were ultimately responsible for placing students into this program. Students in North Carolina are required to take a fourth unit of math and the Essentials for College Math course often simply served this purpose (E. Hilgoe, personal communication, April 21, 2016).

In the state of West Virginia, students who score below the college and career readiness benchmark as a junior are required to take transitions math. However, transitions math is offered to all students as a fourth math requirement, just as it is in North Carolina. Students are required to take the course if they score below the benchmark even if they have already taken the required number of courses to meet the graduation requirement in math. When a student scores below the benchmark, they can
either take the transitions course, or they can enroll in a higher level math to meet the policy recommendation (C. Burke, personal communication, June 14, 2017).

The improvement that was seen in the answer to research question one did show statistically significant improvement in pre- and post-test scores in students after completing the Essentials for College Math course in the state of North Carolina. One area that needs to be addressed is how students are placed into the course. Transitional math courses are designed for students who desire to continue their education but have not yet acquired the necessary mathematical skills to make them successful at an institution of higher learning. If this is the design of transitions courses, then one question that should be considered is: should students who do not intend to go to college be placed into the transitions course, or should the transitions courses be labeled as improving skills for college and career readiness to accommodate a greater number of students for preparation for the workplace as well as college? Better procedures need to be in place with clear information about the design of transitional courses, their intention, and student qualifications for placement into them. The 12.5% improvement that was seen in this study as the answer to research question one has the potential to show even greater improvement when these criteria are met.

**Research Question 2: Does Initial Placement Dictate Level of Improvement**

The purpose of research question two was to see if a significant difference existed when examining post-test scores depending on which level students were assigned based on pre-test scores. The data set was analyzed and students were placed into one of 16 different groups (See Table 5). Each group showed students remaining at the same level, improving, or declining in level from pre- to post-test. The Chi-square analysis of this
information showed a statistically significant difference did exist between the groups, with a p<.000. One limitation of the Chi-square test is showing exactly where this significant difference is found. The group with the largest frequency of students was the group of students who scored a level 1 on the pre-test and a level 1 again on the post-test. This accounted for 41.9% of all students. The second largest frequency of students was in the group that showed an improvement from a level 1 to a level 2 on the pre- and post-test levels. This accounted for 26% of students. Just these two groups combined make up 67.9% of students and none have scored at the proficiency level in these cases. Three other groups, however, showed higher percentages of student frequencies. The first of these was the group that improved from a level 1 to a level 3 on the pre- and post-test scores, or 9.7% of students. The second group in this category were the students that improved from a level 2 to a level 3 on the pre- and post-test scores, or 6.7% of students. Similar in number to this is the third group which had 6.8% of students and made up the group of students who stayed at a level 2 for both the pre- and the post-test. These five groups account for over 90% of students that were tested. There was a distinct difference between the 16 groups. For this reason, it is important that teachers, administrators, and guidance counselors scrutinize how students are placed into these courses as discussed in research question one. When students score low, or a level 1, as a pre-test score, then they are more likely to show low levels of improvement for their post-test scores. Interestingly, in the group where students stayed at the highest level, a level 4, no student stayed at that level pre- and post-test. There were also no students in the group that dropped from a level 4 to a level 1. These are important statistics again for teachers to
pay close attention to, because where students score in their pre-test level does have an impact potentially on their improvement by the end of the course.

**Research Question 3: Level of Proficiency**

The purpose of research question three was to see if there was a statistically significant difference in the number of students who scored at the proficiency level during the pre-test compared to the number of students who scored at the proficiency level during the post-test. The goal of transitional courses is to improve student understanding of mathematical concepts to the point where they will not need remedial coursework in college, or get them to a level of proficiency. This research question addressed the ultimate goal of a transitional math program. Students were placed into the four categories of levels 1, 2, 3, or 4 depending on their scores for the pre-test and again for the post-test. To be considered proficient, students have to score a level 3 or 4. The frequencies for the scores can be seen in Tables 6 and 7 on page 72. On the pre-test, a total of 41 students scored at the proficiency level of 3 or 4, which was 4.8% of the population. On the post-test, 181 students scored at the proficiency level of 3 or 4, which was 20% of the population. Level 3 showed a 22% improvement and level 4 showed a 44% improvement. The Chi-square analysis of the data checking the change in level of proficiency was statistically significant with a p<.000. Through this particular *Essentials for College Math* course, a significant improvement in proficiency level among students was shown. The researcher perceives this to be the most important of the three research questions to be answered. To truly check the effectiveness of the course, the number of students reaching the proficiency level is crucial. North Carolina holds an agreement through NC EMPT in association with 58 community colleges and 15 UNC institutions,
that if students score at a level 3 or 4 on the NC EMPT test that they do not have to take placement exams to attend those institutions. They can enter these schools taking a credit-bearing course and not a remedial course (Hattingh & Hilgoe, 2015). High school students entering transitions courses should strive to reach this level of proficiency and should be the goal of teachers and administrators as well.

**Implications for Action**

The number of students needing to take remedial coursework upon entering an institution of higher learning continues to be a staggering phenomenon. The specific statistics on this topic vary, but the severity of the problem continues to be evident. Attewell, Domina, and Levey (2006) stated that 40% of all students entering as undergraduates are placed into remedial coursework. Mangan (2012) stated that 50% of all undergraduates and 70% of community college attendees are placed into the remedial sequence upon entering college. Adams (2014) asserted that this statistic is 70% of all incoming undergraduates being placed into remedial coursework. The most recent of these statistics comes from Barnett et. al (2016), which declared the remedial statistic as two-thirds of incoming students to community colleges and 40% of incoming students at 4-year institutions. This group of statistics has shown that in the past ten years, there has been very little change in the number of students entering college underprepared from high school. Carnevale, Smith, and Strohl (2010) stated that the workforce in the United States is changing and there are more jobs now than ever before that require a bachelor’s degree. Bradley (2015) affirmed that students entering the remedial sequence in college struggle more than students who do not have to enter the remedial sequence, to graduate and complete their bachelor’s degree. This cycle of being underprepared for
college, entering and getting stuck in the remedial pathway, and not completing a degree can be short-circuited by better preparing students for college at the high school level. That is where transitional coursework becomes so important, and why analyzing the effectiveness of transitional programs was essential.

The following recommendations are offered for state boards of education and local public school system administrators and teachers:

1. An established effective curriculum for a transitional math course is essential for states or individual school systems to have in place to make these courses available for students who are underprepared for a career or for college.
2. SREB’s Math Ready course has been shown to be statistically significant in its improvement of pre- and post-test scores in the state of North Carolina.
3. Discuss the findings of this study with West Virginia Board of Education and local administrators and teachers to open a dialogue about the effectiveness of the course.
4. How students are identified and placed into the transitional course is very important in order to achieve the desired outcome of being college-ready.

Recommendations for Future Research

This study and the related literature review showed that further research into the effectiveness of transitional math courses in high school is warranted. This study, although limited in scope, has shown promise and has laid the groundwork for future research in the area of transitional math coursework. There are many variables that affect student learning and level of improvement in a high school math class, but state and local public school administrators need to be on the same page to provide the best opportunity
for their students to be college and career prepared when they graduate from high school. Based on the findings of this study, the following recommendations for further research include:

1. This research focused on the effectiveness of one transitional math course in one state. Duplicating the same type of research in states that also have Early Mathematics Placement testing in place and have an established transitional math curriculum also in place would give a broader perspective.

2. This study only looked at a test group and did not have the ability to compare to a control group. This control group could be students who take a different version of math during their senior year besides transitional math. Pre- and post-test scores and levels would need to be assessed to accurately depict results.

3. In addition to the research from this study, a broader look at the findings could come from following students who take transitional math as high school seniors and tracking them through their college careers to test levels of bachelor’s degree attainment compared to level of proficiency in math at the completion of high school.

4. During this study, one limitation was the evaluation of teacher pedagogy for transitional math courses. Ascertaining the strengths and weaknesses of pedagogical style would add useful information to the body of literature.

5. The benign data set available for this research limited the analysis of some variables that would add to the strength of the research. Assessment of trends in other variables such as socioeconomic status, ethnicity, demographic location and size of the high school where the course is taught would broaden the scope.
6. Other types of transitional math also exist. This study could be replicated to establish effectiveness of other transitional math programs which would also add to the body of literature.

The large percentage of students that are underprepared for college level math following high school continues to be a problem for these students and the institutions of higher learning they choose to attend. When students enter the remedial pathway in college, this often slows or even stagnates their progress toward a degree, which prevents some of them from attaining a bachelor’s degree. Research should investigate transitional math courses in high school for their effectiveness and for variables that positively and negatively impact these practices. Further investigation into different curricula that target students in the mid-range of mathematical abilities and the lower end of mathematical abilities should also be identified. Clear results using pre- and post-testing in multiple states with multiple types of transitional coursework should be explored. Further research in these areas will broaden the understanding and potential impact of transitional math coursework in order to reduce the number of high school students graduating and being underprepared for college.

Summary

Based on the data presented in Chapter 4, the following conclusions were drawn about the implementation of the SREB Math Ready course renamed Essentials for College Math in the state of North Carolina during the 2014-2015 academic year. A statistically significant improvement was seen in the pre- and post-testing scores of students completing the Essentials for College Math course. The level that students were assigned based on the number of correct answers on the pre-test made a statistically significant impact on the level of improvement seen on the post-test level scored. In
addition, students that achieved the level of proficiency on the pre-test compared to students that achieved the level of proficiency on the post-test showed statistically significant improvement.

Based on the findings of this study, school systems should take a closer look at this research and its potential application of a transitional math program within their state, county, or district. Decreasing the percentage of students who leave high school underprepared for college is necessary in order to fulfill the job requirements that currently exist in the workplace requiring a bachelor’s degree. Finally, educational leaders should keep the goal of students leaving high school being college and career ready at the forefront of their expectations for student achievement.
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October 24, 2016

Jennifer Riggleman
Davis & Elkins College
100 Campus Drive
Elkins, West Virginia 26241

Dear Ms. Riggleman:

You have permission from the Southern Regional Education Board to use the data from the North Carolina Early Mathematics Placement Test (NC EMPT) in your dissertation. The data that you have received consists of pre- and post-test scores on the NC EMPT exam from schools teaching Math Ready / Essentials of College Mathematics during the 2014-15 school year. If you have any questions about the data, its origin, or its use, please let me know and I will be glad to assist you as needed. Of course, I would be interested in receiving a copy of your dissertation once it is completed.

Please let me know if I can be of further assistance.

Sincerely,

[Signature]

John Squires
Director of High School to College Readiness,
Southern Regional Education Board
Office of Research Integrity

July 31, 2017

Jennifer S. Riggelman
College of Education and Professional Development
Marshall University

Dear Ms. Riggelman:

This letter is in response to the submitted dissertation abstract entitled “Effectiveness of Essentials for College Math as a High School Transitional Course.” After assessing the abstract it has been deemed not to be human subject research and therefore exempt from oversight of the Marshall University Institutional Review Board (IRB). My understanding is that the data furnished by the Southern Regional Education Board was provided in a de-identified format. The Code of Federal Regulations (45 CFR 46) has set forth the criteria utilized in making this determination. Since the study does not involve human subjects as defined in DHHS regulation 45 CFR §46.102(f) it is not considered human subject research. If there are any changes to the abstract you provided then you would need to resubmit that information to the Office of Research Integrity for review and determination.

I appreciate your willingness to submit the abstract for determination. Please feel free to contact the Office of Research Integrity if you have any questions regarding future protocols that may require IRB review.

Sincerely,

Bruce F. Day, THD, CIP
Director

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