THE EFFECT OF DEPARTMENTALIZATION AND TEACHER EDUCATION ON FIFTH GRADE STUDENTS' MATH ACHIEVEMENT

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THE EFFECT OF DEPARTMENTALIZATION AND TEACHER EDUCATION ON FIFTH GRADE STUDENTS' MATH ACHIEVEMENT

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THE EFFECT OF DEPARTMENTALIZATION AND TEACHER EDUCATION ON FIFTH GRADE STUDENTS' MATH ACHIEVEMENT

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By

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I would like to dedicate this paper to my amazing husband, Michael Rogers, my daughter, Ella Rogers, and my son, Emmitt Rogers. Michael spent many days and nights being Mr. Mom and one of my biggest fans by continuously encouraging me to continue and complete this paper. Without the love and encouragement of my family, this paper would not have been possible.

Throughout the course of this journey I have faced many tribulations and celebrations. The loss of my beloved father, who I know has been with me every step of the way, was one of the hardest sufferings I have faced in my life, let alone during this time of self-growth. Dad always believed I could do anything I set my mind to, because as he would have said, "You are just stubborn enough to accomplish all that you want!" As the circle of life continued, my husband and I welcomed our son, Emmitt to the world in January. His entrance to this world made me realize there may never be a perfect time to pursue my dreams, but a quote by Earl Nightingale summed it up, "Never give up on a dream just because of the time it will take to accomplish it. The time will pass anyway." Yes months and years have passed, but now I have the rest of my life to enjoy my family, all while knowing I accomplished my personal goal!

I would also like thank my mother, the strongest woman I know. She has not only helped me by watching my children while I had class, but by having the upmost faith in my ability to complete this personal goal. She was without a doubt, my biggest fan.

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Abstract

The purpose of the study was two-fold in determining if significance existed between student achievement in traditional classroom settings and departmentalized settings and what impact teacher knowledge had on student achievement. With the shift in conceptual skills in CCSS, fifth grade mathematics skills are increasingly more difficult than they were prior to CCSS implementation. Participants completed a demographic survey and answered seven perception questions on their own mathematical knowledge. Data for respondents was analyzed and compared by years of teaching experience, number of math sections taught, number of fifth grade math sections taught and education. These factors were compared to responses from the perception statements. Analysis of the quantitative data indicates a lack of significance between teachers' perceptions of mathematical knowledge and student achievement on fifth grade math MAP test. Recommendations of this study included: (a) further research into the impact of teacher education in mathematics; (b) utilizing an assessment to determine respondents' true mathematical knowledge; and (c) extending research to the entire state of Missouri.

CHAPTER ONE

The Effect of Departmentalization and Teacher Education on Fifth Grade Students' Math Achievement

Introduction

In February of 2009, President Obama signed into law the American Recovery and Reinvestment Act (ARRA). From this act, the Race to the Top Fund provided $4.35 billion to be spent on educational reform. Two core areas of reform of the Race to the Top Program asked states to demonstrate significant progress in raising achievement and create great teachers and leaders. These reform tasks focused on increasing student achievement in mathematics, attempted to close the achievement gaps between subgroups, provided high-quality pathways for aspiring teachers and principals, improved teacher and principal effectiveness based on performance, ensured equitable distribution of effective teachers and principals, improved the effectiveness of teacher and principal preparation programs, and provided effective support to teachers and principals. With these areas of focus, participating states had to increase the number of effective teachers teaching subject areas such as mathematics and link student achievement to teachers. In the end, teacher compensation may be directly tied to their students' achievement and growth (USDE, 2009).

In response to ARRA, the National Council of Teachers of Mathematics (NCTM) proclaimed essential components of a high-quality school mathematics program called for well-prepared and well-supported teachers. The organization believed all students could learn mathematics when they had access to high-quality mathematics instruction (NCTM, 2000). For conceptual learning to take place, students would have to be able to take factual learning and apply the information to a situation (Sutherland, 1969).

According to Hill, Rowan, and Ball (2005) a significant relationship existed between the mathematical knowledge held by teachers and the achievement of their students.

Missouri's seniors were ranked thirty-third among the United States in mathematics in the 2011 school year with 29.9 percent of its seniors scoring proficient or advanced on the National Assessment of Educational Progress (NAEP) (PEPG, 2011). According to the requirements of the Missouri Department of Elementary and Secondary Education (DESE), a person must receive a minimum 21 credit hours in mathematics to obtain certification in Middle School Mathematics for fifth through ninth grade instruction. The elementary teacher's preparation in math instruction was limited to a minimum of five credit hours in mathematics to obtain certification in Elementary Education for first through sixth grade instruction (Department of Elementary and Secondary Education, 2014). The elementary certification requirements are generalized in all subject areas; therefore the elementary teacher should have a general knowledge base in multiple content areas. According to the Association of Mathematics Teacher Educators (AMTE), many elementary teachers lacked the knowledge to teach mathematics with coherence, precision, and reasoning so a systemic problem with grave consequences existed (2010).

The researcher's focus was on identifying if a measurable difference in student achievement existed between mathematics instruction from a teacher who taught in a departmentalized classroom and mathematics instruction from a teacher who taught in a traditional classroom setting. Another focus of the researcher was on identifying if a measurable difference existed between the teachers' mathematical training and student achievement in mathematics. For the purpose of this study, a math specialist was defined

as a teacher who had a degree in middle school education with an emphasis in mathematics instruction. A teacher who taught all subjects to one group of students in a traditional classroom setting was defined as a generalist instructor for the purposes of this study. A teacher who taught mathematics to two or more sections was considered a departmentalized instructor for the purposes of this study.

Every elementary school in the southwest region of the state of Missouri was given a demographic survey to determine current teaching assignments in fifth grade classrooms and the amount of training the teacher had in mathematics. In an attempt to include all districts no matter their size, districts with only one section of fifth grade were considered departmentalized if the fifth grade math teacher taught math in another grade level as well. Missouri Assessment Program (MAP) scores of students identified as proficient or advanced from the schools identified as having departmentalized content teachers were analyzed and compared to MAP scores of students identified as proficient or advanced from the schools identified as having a traditional classroom organization. Findings from this research will help schools determine best practices in regard to classroom organization and teacher education to ensure student achievement increases in math content areas.

Theoretical Framework

Constructive learning is when one develops an idea on previously known information. Mathematics is a cumulative science in which new results are built upon and depend on earlier results. According to Howard Gardner, logical/mathematical as one of the eight multiple intelligences people possess (1983). People who have a logical/mathematical tendency to learn have learned in a constructivist style. These types

of learners build new knowledge on prior knowledge to develop a deeper understanding of a concept (Moursund, 2006). A teacher with more mathematical training may be able to help students develop a deeper understanding of each concept because their understanding is deeper (Moursund, 2006; Hill, H.C., Rowan, B., Ball, D.L, 2005).

Jean Piaget conducted extensive research on the child's cognitive development. The stages of development include sensorimotor, preoperational, concrete operational and formal operational (Ojose, 2008). The development of each stage occurs as children grow (Piaget, 1952). Knowledge of each stage enlightens educators on the types of skills students should possess and their ability to reason mathematically (Ojose, 2008).

Problem Statement

Content area departmentalization and teacher training in mathematics may positively affect fifth grade student achievement in mathematics as measured by Missouri MAP. Departmentalization allows teachers to specialize in one content area as opposed to teaching many content areas. By focusing on one subject area, teachers are able to devote more time to planning a single, long-range path of study. Common core state standards (CCSS) are contributing to a shift in higher level mathematics content being taught at the elementary level. Elementary teachers may not all have the content training to support the shift in skills. Currently, teachers certified to teach middle school mathematics in the state of Missouri must possess a middle school certificate. Obtaining a middle school certificate requires college preparation with an emphasis in mathematics which includes an additional 16 hours of mathematics courses. These additional courses provide a deeper understanding of the content taught in the middle grades (DESE, 2014).

With the CCSS shift of skills, this deeper understanding is needed by all elementary teachers seeking to teach mathematics at the fifth grade level.

Rationale for the Study and/or Purpose for the Study

With the implementation of the Missouri's Learning Standards (MLS), which were created using CCSS as a base, mathematics instruction is seeing a shift in complex concepts being introduced in lower grades. The expectations for more students to be proficient or advanced in each content area, affirms the desire to increase student achievement. The results of this study will help school districts determine the best way to organize the structure of their fifth grade classrooms to allow students to reach their highest potential. Districts may also realize the importance of educators' training in mathematics. Educators may have a deeper understanding of teaching methods most effective in regards to instructional time and student achievement.

Research Questions

1. What are the perceptions of fifth grade mathematics teachers in regard to mathematical knowledge?
2. Does the teachers' perception towards their own mathematics knowledge affect student achievement in fifth grade mathematics? Are there differences according to:
    a) Classroom organizational structure
    b) Years of teaching experience
    c) Number of math sections taught
    d) Number of fifth grade sections taught
    e) Educational degree of teacher

3. Does a departmentalized classroom setting positively affect student achievement in comparison to a traditional classroom setting?

Limitations

Limitations include but are not limited to response rate. Research accessibility may also be limited in reaching all fifth grade teachers. A limitation is the cooperation of the building principal in circulating the survey to their fifth grade teachers. This study does not address school size or socioeconomic status of the students. The study also did not address teachers' opportunities for professional development in mathematics instruction.

Delimitations

Delimitations include surveying Missouri teachers and receiving MAP data disaggregated by classroom teacher. Another, delimitation is the study will be conducted using school districts in the southwest instructional supervisory region of Missouri. Another delimitation of the survey is definition of a departmentalized classroom structure. A departmentalized classroom structure was defined as a classroom setting in which one instructor teaches a specific subject or subjects to several different groups of students. The respondents' perception of their math knowledge was a delimitation.

Definition of terms

Common Core State Standards- "The Common Core State Standards provide a consistent, clear understanding of what students are expected to learn, so teachers and parents know what they need to do to help them. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that our young people need for success in college and careers." (Common Core State Standards, 2013)

Departmentalized Classroom- A departmentalized elementary classroom setting is one in which one instructor teaches a specific subject or subjects to several different groups of students. (Commission on Teacher Credentialing) For the purposes of this study, math will be the subject with a departmentalized setting.

Departmentalized Teacher- The definition for the purposes of this study is a teacher who teaches math to at least two sections of students with at least one section being fifth grade students.

Generalist- The definition for the purposes of this study is a teacher who teaches all content areas to one and only one group of students.

Math Specialist- The definition for the purposes of this study is a math teacher who has additional math training from workshops or college course work beyond an elementary education degree.

Missouri Learning Standards – According to DESE, the Missouri Learning Standards are standards the state of Missouri has adopted to help students gain knowledge and skills they need for college or other types of postsecondary training and a career. These standards currently include the Common Core State Standards for English language arts and mathematics. (DESE, 2014)

Traditional Self-Contained Classroom- A self-contained classroom setting is one in which the teacher is responsible for teaching all subjects to a group of students. (Commission on Teacher Credentialing)

Summary

Review of the literature indicates a need to know the impact teacher knowledge and classroom organization has on student performance. With the onset of CCSS, skills

once taught in the middle level grades will be taught in fifth grade. Currently, teachers who teach middle school math have to have more content specific courses to obtain certification. Research in this area will be insightful and help districts determine if teacher development in mathematical skills would be beneficial in regard to student achievement.

Chapter Two covers relevant literature offering further understanding of the importance of teacher knowledge and classroom organization. Chapter Three details the methodology utilized in this study. Chapter Four presents the research results. Chapter Five states the conclusions and recommendations for school districts in regard to teacher knowledge and classroom organization.

CHAPTER TWO

Review of Literature

Introduction

Teachers were once considered generalists with knowledge in all subject areas across all grade levels. Researchers such as Deborah Ball suggest teachers must be specialists in certain core areas with the implementation of Common Core State Standards (CCSS) or Missouri Learning Standards (MLS) since the new standards push conceptual skills into elementary grades (AMTE, 2010; Ball, 2001)). Conceptual mathematics skills are taught in middle and secondary schools where departmentalization is considered normal. At the secondary level, certification of the instructor in certain content areas is regulated by the state, necessitating a departmentalized setting (Chang, 2008; DESE, 2012).

With the downward shift of advanced mathematical skills, thoughts on departmentalization of math instruction are trickling down into third through sixth grades in elementary schools (Chang, 2008). School district administrators are beginning to realize teachers need to have more in-depth training in mathematics instruction to ensure educators can teach the complicated concepts being taught in earlier grades. The generalist approach to teach content standards is no longer considered enough by some districts. Departmentalization at the elementary level is considered a cost neutral way of upgrading instruction (Hood, 2010).

Since the beginning of compulsory schooling states have allowed communities the flexibility in the ways their schools were organized (Katz, 1976). This leniency has been granted through each phase of education reform throughout the nation, ranging from one-room school houses to education as seen today. Implementation of MLS/CCSS may

call for a change in the certification requirements in Missouri and across the nation (AMTE, 2010).

The proceeding will look at the phases of formal education in the United States, the history of the organization and certification of Missouri schools leading up to the Common Core State Standards and the impact these standards have played on teacher certification and mathematics instruction.

Phases of Formal Education in the United States

The first organized account of compulsory education came in 1647, in the Massachusetts Bay Colony, requiring communities with fifty households or more to provide a teacher to instruct children in reading and writing. Often times, this teacher would provide instruction from different homes each school term. In communities of 100 households or more, a grammar school was set up (Katz, 1976). Multiple revisions made to the Massachusetts Bay Colony compulsory education law suggested the law was not effectively enforced. However, two prerogatives were established by the state. The first was the state had the authority to lay down minimal standards for the education of children. The second right of the state was the right to compel the establishment of two minimal educational provisions: teachers and schools (Katz, 1976). States had the authority to decide who was capable of teaching their students and the logistics of the schools' organization. The importance of education is recognized globally and every developed country has compulsory school attendance laws which align to each country's philosophical and political views towards education (Nawaz, 1975). Therefore, it was important to make the school experience attractive and meaningful for the learner to see the necessity in attending school (Nawaz, 1975).

In an attempt to assimilate immigrants and transform them into productive American citizens, free publicly supported common schools were established in the 1850s (Katz, 1976). In in 1852, Massachusetts was the only state in the union which had a loosely regulated law requiring parents to send their children to public schools in their city for at least twelve weeks. By 1918 all states in the union had enacted compulsory schooling statutes (Katz, 1976). These laws were not uniform. There were differences in the lengths of required attendance, with the number of required years ranging from seven to sixteen (Katz, 1976). Compulsory school attendance laws institutionalized the normative standard that young people should be in school rather than working (Katz, 1976, Nawaz, 1975). However, with compulsory education laws, enforcement in some states was found to be a large problem. Many states were unable to apply the laws as there were inadequate school accommodations and people were unwilling to report their neighbor's noncompliance with the authorities (Katz, 1976.)

Finally, between 1900 and 1930, mandatory schooling laws became reasonably effective laws. Compulsory education became a simple order requiring school attendance, school truancy officers with defined responsibilities, establishment and support of truancy schools, delegation of jurisdictive power, and a mass amount of regulations concerning child labor. These regulations for child labor often required education as a condition for younger children's employment and made it impossible for employers to hire children during their schooling years (Katz, 1976).

By 1920, statistics on school attendance showed 85 percent of students eligible for enrollment were attending either public or private educational institutions. The average number of days pupils attended school rose to 143 by 1930. Schools were able

to keep track of attendance with the institutionalizing of school censuses with the establishment of attendance offices. Certainly when state aid became tied to average daily attendance, attendance departments harnessed their administrative attendance teams to producing favorable set of figures by enforcing the compulsory attendance laws with students and parents (Katz, 1976). Along with the desire for state aid, compulsory attendance was socially accepted more as the United States' population tripled from 1860 to1910 with eastern and southern European immigrants. More people competing for jobs sweetened the outlook on having an education to be proven a punctual, hardworking, and obedient worker (Katz, 1976).

In the United States of America, schools were believed to be the solution to the social problems during John F. Kennedy's "new frontier" days by providing opportunities for the poor and minorities to enhance the quality of society (Katz, 1976). The goal of education was to develop a fully functioning individual who could apply problem solving skills to current and future problems (Nawaz, 1975). Unfortunately, the 1970s brought high rates of daily absenteeism and widespread truancy in urban schools which suggested compulsory schooling laws were not working. In 1975, 75 percent of all 18-year-olds graduated high school (Katz, 1976). Throughout the 1970s, the outlook towards the success of a student rested highly on his attendance in high school. Good attendance alone was thought as a social compulsion preparing America's youth for the work force (Katz, 1976).

In the 1980s, the United States saw a shift in the outlook on education and student success in schooling with the inception of Outcome-Based Education. States found themselves focusing on three basic premises: all students can learn and succeed, success

breeds success, and schools control the conditions of success. The 1991 National Goals for America's Schools demanded major efforts to improve all aspects of schooling in order to improve student outcomes. Improvements in curriculum, instruction, assessment, attendance, credentialing, accreditation and accountability were emphasized in the plan for improving student learning (Spady, 1991).

The late 1990s brought No Child Left Behind (NCLB) legislation. The intent of NCLB was to ensure all children had a fair, equal, and significant opportunity to obtain a high-quality education and reach proficiency on challenging state academic achievement standards and state academic assessments (United States Department of Education, 2001). Implementation of NCLB required teachers to be highly qualified in core content areas. For an educator to be considered highly qualified, he or she must possess a bachelor's degree, full state certification or licensure, and prove that they know each subject they teach. For a middle school or high school teacher, the teacher must prove he or she knows the subject they teach in one of six ways: either a major in the subject he or she teaches, credits equivalent to a major in the subject, passage of a state-developed test, an advanced certification from the state, or a graduate degree. Current teachers can also show this knowledge through high, objective, uniform state standard evaluations (HOUSSE) which demonstrate subject-matter competency and meet highly qualified teacher requirements. This proof can be found by a combination of teaching experience, professional development and knowledge gained in the subject over the course of a teaching profession (USDE, 2004). NCLB also created a desire for all schools to ensure all students were proficient in math and communication arts.

In February of 2009, President Obama signed into law the American Recovery and Reinvestment Act of 2009 (ARRA). One area of interest directly affected through this legislation was education reform. Government officials hoped an investment of $4.35 billion Race to the Top Fund in education would lead to improved results in the productivity and effectiveness of United States' schools (United States Department of Education, 2009). The areas of reform include:

> Adopting standards and assessments that prepare students to succeed in college and the workplace and to compete in the global economy; building data systems that measure student growth and success, and inform teachers and principals about how they can improve instruction; recruiting, developing, rewarding, and retaining effective teachers and principals; turning around our lowest achieving schools. (USDE, 2009).

One core area of reform through Race to the Top was creating great teachers and leaders. This task focused on providing high-quality pathways for aspiring teachers and principals, improving teacher and principal effectiveness based on performance, ensuring equitable distribution of effective teachers and principals, improving the effectiveness of teacher and principal preparation programs, and providing effective support to teachers and principals (USDE, 2009).

According to the overview of Race to the Top, developing and adopting common standards was another criterion for states to vie for a chance at grant money. In response, states developed high-quality plans to address the needs to offer rigorous standards which are supported by evidence that they are internationally benchmarked and built towards college and career readiness. To receive funding, states had to band together by August

2010 and show commitment and progress towards adopting a set of K-12 standards (USDE, 2009). These standards would later be formed and called Common Core State Standards.

History of Organization and Certification in Missouri Schools

Efforts to bring education to the region currently known as Missouri began before its statehood in 1821 and long before compulsory education laws were established in the state in 1905. Three distinct influences can be identified in Missouri's early efforts to secure a formation of a school system for the state so children could receive a solid education. Some of these influences emerged before Missouri's statehood (Phillips, 1911). The first influence was the notion New Englanders brought with them of the township organization for political and school purposes. A second factor in the development of Missouri Schools resulted from colonists coming from Southern States bringing with them private schools supported by a few wealthy individuals. These private schools were referred to as Academies and were located in more populous centers. The southern settlers also brought along the idea of private tutors being employed for one or more wealthy families. The third influential factor in the establishment of Missouri schools came from the ideas of Thomas Jefferson. Jefferson believed the State should be responsible for the education of all its citizenship, for primary grades up to the University level. Jefferson's ideas prevailed as they had a strong presence in the Geyer Act of 1839 when Missouri made its first attempt to give the state a complete school system (Phillips, 1911).

One of the earliest schools on record dates back to 1774, in the city of St. Louis. According to public records, J.B. Tribeau was thought to the sole teacher for

approximately 40 years in Missouri, as it was the only school on record for a long period of time. The earliest general type of established school was the Academy. There were at least 110 Academies charted by the state before 1875 and probably as many more established without any charter from the state. Even with this onset of Academies, some families felt it necessary to form themselves into an association for the purpose of educating their children. Families would elect a trustee of the group to find a teacher and provide a room for the school to take place. Each family paid an amount for each child to the teacher. Along with the fee, each family usually boarded the teacher for a week or longer. These subscription-like schools usually took place for three to four months. Records indicate these schools were in existence until 1839 (Phillips, 1911). The Geyer Act of 1839 laid the foundation for Missouri's present school system. The act provided funds to various states, county and township schools, assigned a state superintendent of schools, provided white students aged eight to sixteen schooling, and established a state university (Shoemaker, 1922). By 1843, 42 counties of Missouri's 77 counties supported common schools. Approximately 33 percent of the states' children attended public schools in the early 1850s. By 1859, half of Missouri's children attended public schools in log, one-room schoolhouses or in the teacher's home. One room schoolhouses continued to be built in Missouri until 1950 (National Park Service, 2014). The establishment of city systems began the transition of brick two-story school houses in larger cities (Phillips, 1911).

After the Civil War, Missouri's constitution placed an emphasis on educating negro and white children. To support this emphasis, the state appropriated one-third of the general revenue for public schools in addition to monies provided to the state's school

fund (Shoemaker, 1922). In 1905, with the enactment of a compulsory education law, attendance of students aged eight to fourteen increased. Prior to 1921, Missouri's elementary education was confined to a few subjects including reading, writing, arithmetic, geography, history and English grammar. The teacher in this setting was considered a generalist because he or she was responsible for teaching all subjects across all grade levels (Shoemaker, 1922, Katz, 1976; Nawaz, 1975). Teachers received two years of training prior to becoming certified to teach elementary school (Setchel, 1920). It was not until the early 1920s that elementary education added cultural and practical value courses.

Certification requirements of teachers can be traced back to the early 1800s. Teachers had to attend teachers' institutes, colleges and pass examinations in order to have the right to teach (Shoemaker, 1922). In the early 1800s, in order for teachers to obtain a certificate, they had to take an oath to support the Constitution, have knowledge in "Orthography, Reading in English, Penmanship, Arithmetic, English Grammar, Modern Geography, and History of the United States" (Phillips, 1911). To obtain a secondary certificate, the teacher had to pass a higher mathematics and natural sciences exam. By 1890, in addition to the preceding criteria, teachers had to attend a two to four week institute in order to retain their certificate (Phillips, 1911). Throughout the middle 1800s, State Superintendents urged the establishment of Normal Schools where pre-service teachers could be trained, producing efficiency and uniformity in the mode of instruction across the state. This recommendation was revisited by each consecutive State Superintendent until 1867, when North Missouri Normal opened its doors to over 140 students (Phillips, 1911).

In the early 20th century, urbanization and emergence of larger cities with school systems called for a major transformation in teacher education. Teacher education programs were established and specialized certificates were created. These programs were controlled and shaped by an "education trust" comprised of college faculty, superintendents, state education officials, state association leaders and the United States Bureau of Education staff (Angus, 2001). A desire for greater influence over teacher training and certification requirements was shown after World War II by liberal arts faculty and the National Education Association. After Sputnik, colleges of education were accused of offering theory based courses as opposed to teaching practices and subject mastery. This accusation called for reform in teacher training. Still yet, American teachers' degrees were mostly in education and scarce in subject matter mastery (Angus, 2001).

Education has transitioned slowly throughout the history of the United States and Missouri. As it transitioned, the requirements educators had evolved to match community expectations. In the 1800s, the purpose of school was to keep students out of the workforce forcing states to require school attendance as a prerequisite for an employer to offer employment to an individual (Nawez, 1975; Katz, 1976). During this phase, education was controlled by the local community including certification requirements of its teachers. Each certification was valid only in the county it was received (Phillips, 1911). Years later, the focus of education was to provide a self-reliable adult who was able to use problem solving skills to solve current and future problems (Spady, 1991). Currently, the purpose of education in Missouri is to prepare every child for success in school and life by having all students ready for college or a

career by the time they graduate high school (DESE, 2014). Presently, certification requirements are determined by the Department of Elementary and Secondary Education (DESE). Typical certificates require a four year Bachelor's degree in the field of education with additional content area courses for secondary education (DESE, 2014). According to DESE (2010), an education degree has general requirements and professional requirements. The general requirements for a degree include the student's ability to obtain a baccalaureate degree from a college having a teacher education program which has been approved by the Missouri Department of Elementary and Secondary Education or one approved by the state agency in states other than Missouri. In addition, the student must receive a recommendation to be in the teacher education program while maintaining a grade point average of at least 2.5 in the major area of study. The student must also complete the content knowledge or specialty test designated by the State Board of Education with a score equal or higher than the Missouri qualifying score. The professional requirements require differ between an elementary and middle school degree. For an elementary degree a minimum of 60 semester hours of professional preparation must be demonstrated with competency in Foundations for Teaching with at least ten hours, Teaching Methods with at least 15 hours, Clinical Experiences with at least ten hours, Elementary School Courses with at least 17 hours five of which include two mathematics courses totaling 5 hours and an Area of Concentration with 21 hours.

According to DESE (2012), a middle school degree's professional requirements include the completion of at least 53 hours of professional education and demonstration of competency in Foundations for Teaching with at least 12 hours, eight of those hours

include The Pupil/Society, and four include The School/Society. Middle School Concentration requires at least 31 semester hours with 10 semester hours covering Middle School Methods and at least 21 semester hours focusing on a subject area of emphasis. In addition to the semester hours the middle school certificate requires at least ten hours of clinical experience. A Middle School Math Degree requires 16 additional semester hours of math than an elementary degree (DESE, 2012). The CCSS shift in concepts has served as a catalyst for current shifts in teacher education programs.

Common Core State Standards

The Common Core State Standards (CCSS) were developed through a state-led initiative and adopted by 45 states. In 2012, Missouri's Department of Elementary and Secondary Education announced Missouri's Core Academic Standards (CAS) would include the Common Core State Standards (CCSS). Later in 2013, Missouri changed the name of these standards to Missouri Learning Standards (MLS) (DESE; 2013). These standards enhance many states' previous standards for English and mathematics. The standards were benchmarked by looking at high performing countries on international tests such as the Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS). They aim to provide a clear understanding of what students will be expected to learn at every grade level and determine each student's strengths and weaknesses. With the implementation of CCSS, states maintained the option to gather a collective set of expertise and resources in order to reduce costs for each individual state and bring a cohesive plan around implementation of the standards. The standards will allow students to stay on track with school curriculum as their families move between states (Common Core State Standards

Initiative, 2013). The CCSS are meant to hold students to rigorous, attainable, academic benchmarks designed to define the knowledge and skills students need to ensure each high school graduate is ready to enter college or begin career readiness training (National Governors Association, 2012; DESE, 2014; CCSSI, 2013). The standards also demand students to apply the knowledge gained through the standards through higher order thinking skills.

Missouri House Bill 1490. Despite efforts to bring the United states together on common standards, the CCSS are not being received well by all states. Missouri's House of Representatives created House Bill 1490 (2014) requiring the Missouri State Board of Education to assemble work groups on each subject area to develop, evaluate, modify or revise academic learning standards. Members of these work groups were comprised of parents and educational professionals. Groups will work from October 2014 to October 2015 to develop their recommended learning standards for each content area. The bill also prohibits DESE from mandating curriculum, textbooks, or instructional materials to be used in public schools. After standards have been adopted for each content area, the state board must modify and revise the statewide assessment. Standards adopted through this process will be implemented in the 2016-2017 school year.

CCSS Mathematical Shifts. The CCSS mathematics standards differ from previous standards in three main ways: greater focus on few subjects, coherence of topics across grade levels, and rigor. The first shift calls for a greater focus of mathematical concepts. The focus is narrowed for each grade level in a way where teachers do not have to teach a wide range of topics, but instead can spend time teaching a topic thoroughly. The intent of this shift is to help students have a solid understanding of

mathematical foundations. With a solid conceptual understanding, students will be able to apply knowledge learned in the classroom and solve problems in and out of the classroom. The deeper understanding gained from time spent on each topic will allow students to see how each skill and topic are related to one another. The coherence of the standards will reinforce skills taught previously and students will be able to apply them to newly taught topics or skills. In order for these shifts to take place, teachers will need to pursue conceptual understanding, procedural skills and fluency and application with rigor (Common Core State Standards Initiative, 2014).

Standards for Mathematical Practices. The Common Core State Standards include both content and procedural standards in mathematics. The content standards include the mathematical knowledge and skills students should learn. The process standards specify the ways students should think while learning mathematics concepts (Parker & Novak, 2012). These process standards are described as eight Mathematical Practices which build on the National Council of Teachers of Mathematics (NCTM) process standards and the National Research Council's five strands of mathematical proficiency; communication, representation, reasoning and proof, connections, problem solving, procedural fluency, conceptual understanding, strategic competence, adaptive reasoning, and productive disposition (Parker & Novak, 2012). The Common Core Standards for Mathematical Practices and brief student identifiers of each are:

1. Make sense of problems and persevere in solving them. Students who are mathematically proficient start by explaining to themselves the meaning of a problem and look for possible ways to find a solution. Students monitor and

evaluate their progress and drive their learning while continually gaging if the answer makes sense.

2. Reason abstractly and quantitatively. Students who are mathematically proficient make sense of quantities and the relationships in math problems. They understand the meaning of quantities and are flexible in the use of their operations all while attending to the meaning of the quantities in regard to the math problem.
3. Construct viable arguments and critique the reasoning in others. Students who are mathematically proficient make guesses and build logical progression of statements to explore the truth of their answers. The ability to construct arguments using concrete objects is present. Students are also able to ask clarifying questions to improve their arguments.
4. Model with mathematics. Students who model with mathematics understand this as one way to reason quantitatively and abstractly. They can apply the mathematics skills they know to everyday problems and represent problems mathematically.
5. Use appropriate tools strategically. Students who model this practice understand the strengths and limitations of available mathematical tools. Familiarity of grade-level appropriate tools is evident when students can use tools strategically to deepen their understanding of mathematics concepts.
6. Attend to precision. Students who attend to precision communicate with others using clear mathematical language when discussing their reasoning. Understanding of the meanings of symbols and appropriately labeling

quantities are both present in students who attend to precision. The ability to calculate efficiently and accurately is also a quality of students who attend to precision.

7. Look for and make use of structure. Students who exhibit this practice should be able to apply general mathematical rules to specific situations. Looking for overall structure and patterns in mathematics is obvious when students look and make use of structures. Students who use this practice are able to successfully see complicated things dually as single objects or several objects.
8. Look for and express regularity in repeated reasoning. Students who are able to look for and express regularity in repeated reasoning notice if calculations are repeated. They are also able to evaluate the reasonableness of their results (CCSS, 2014).

According to Principles and Standards for Mathematics, process standards are descriptions of what mathematics instruction should enable students to know and do (NCTM, 2000). Although the Mathematical Practices are articulated as eight separate items, in theory and practice, they interconnect with the content standards. The Mathematical Practices should rarely be used in isolation from one another. Rather they should be integrated throughout mathematics instruction. According to Deborah Ball (2008), teachers need to understand three critical concepts when teaching the Mathematical Practices. They must have an appreciation of how vital the Mathematical Practices are to learning the content. Teachers must develop a conviction that students can develop proficiency with the Practices. And the last critical concept is teachers need mathematical knowledge (Hill et al., 2008). Once students are able to intertwine the

content standards and practice standards together, their learning will become engaging and meaningful (Parker & Novak, 2012).

CCSS Impact on Teacher Certification. In an effort to successfully implement the new standards and enhance educator effectiveness, the National Governors Association Center (NGA) is vying to improve educator effectiveness through policies to prepare, license, evaluate, and develop teachers and principals. The NGA Center hopes to build effectiveness of educators by aligning policies of professional standards to the CCSS through four policy levers including preparation programs, licensure and certification qualifications, evaluation processes and professional development (NGA, 2012). The preceding gives reason to believe an educator's knowledge of the CCSS may affect his or her effectiveness in the classroom.

The NGA Center is proposing governors whose states have adopted the Common Core State Standards, play an important role in creating policy changes to teacher preparation programs in their states. This policy proposal calls for a plan to integrate CCSS in teacher preparation courses. According to Tabitha Grossman, increasing teachers' content knowledge is the most important in-school factor for improving student achievement (NGA, 2012). Teacher preparation programs should increase an emphasis on content knowledge to ensure educators can teach the students the standards required (NGA, 2012).

Requiring licensing to be contingent on proof of content knowledge to teach at the rigorous level required for the standards is another way to help ensure educators are ready for students when they enter their classroom (NGA, 2012). When standards are raised, students are not solely affected; the teachers must also learn and understand the new

standards in order to teach them to the students (Hood, 2010). Governors are encouraged to ask their state chief and board of education to change the requirements of certification. Educators seeking licensure will be mandated to demonstrate their knowledge of the new standards through either an assessment or a portfolio showing their mastery of the standards (NGA, 2012).

Missouri's Office of Educator Quality released the Code of State Regulations, detailing the requirements for elementary education certification. The requirements include successful completion of and educator preparation program approved by the Department of Elementary and Secondary Education. A baccalaureate degree from a regionally accredited college is the first criteria to obtain a elementary certificate. The applicant for a certificate graduating prior to spring of 2017 must have a grade point average of 2.50. Graduates finishing after Spring of 2017 must possess a cumulative grade point average of 2.75 and a grade point average of 3.00 or higher in professional education and the specific content area for which certification is sought. Applicants not meeting grade point average criteria may demonstrate achievement with exit assessments with scores satisfactory to the State Board of Education (Kander, 2014). Elementary education majors must take a minimum of six credit hours of mathematics. Middle school education majors must take a minimum of 24 credit hours of mathematics.

Once teachers get in the classroom, high quality evaluations are necessary to ensure students are learning the standards. Some states are addressing the role of CCSS in evaluations, having current teachers illustrate their knowledge of the standards and how they are helping their students master the new standards. Many of the states are tying student performance to teacher evaluations. This accountability ensures teachers

make an honest attempt to understand the standards and present them to the students in the most effective way (NGA, 2012; Hood, 2010).

Professional development for teachers is necessary to effectively implement the CCSS. Just as the standards call for a rigorous delivery to students, professional development should be delivered to teachers in the same manner. Professional development programs must be evaluated to determine whether teachers are gaining the support they need. Professional development should be effective and consistent with the content and rigor of CCSS (NGA, 2012).

CCSS's Impact on Mathematics Specialist Certification. Mathematics education has seen many failed attempts towards reform over the last century. One explanation for why the many attempts of mathematics education reform have failed is teacher education (Ball et al., 2001). "How well teachers know mathematics is central to their capacity to use instructional materials wisely, to assess students' progress, and to make sound judgment about presentation, emphasis, and sequencing" (Ball et al., 2005 p.1). Currently in the state of Missouri, teachers who teach grades first through sixth grade must hold an elementary education certificate. This certificate requires a baccalaureate degree from a college or university having a teacher education program approved by the Missouri Department of Elementary and Secondary Education (DESE) or from a college or university from another state which has been approved by that state's education agency. In Missouri, the elementary education program requires 60 semester hours of professional preparation. Of those 60 hours, eight are required mathematics courses. Education majors choose an area of emphasis. This area includes an additional 12 hours of concentration in a chosen content (DESE, 2012). The certification process

produces teachers with general knowledge in a variety of subject areas; therefore they may lack the in-depth knowledge and expertise needed to teach to fifth grade mathematics Missouri Learning Standards (MLS).

Pre-service Preparation for Mathematics Teachers

Research by Ball, Lubienski and Mewborn (2001) suggests knowledge learned during college courses in teacher education preparation programs tends to be less influential for pre-service teachers than the influence from their personal experiences in how they learned math in elementary and secondary school. Personal learning experiences, good or poor, shape an individual's understanding of mathematics. The method of how pre-service teachers were taught mathematics in elementary and secondary school often mirrors how they teach, creating a cycle of subpar mathematics instruction (Ball et al., 2001 & 2005). Ma (1999) published results of her study between teacher knowledge of mathematics of United States and Chinese elementary math teachers. Ma defined the deep understanding of elementary mathematics curriculum as "Profound Understanding of Fundamental Mathematics" or PUFM. Teachers who possessed PUFM did not gain the knowledge through their college work, but from on-the-job training. A majority of teachers with PUFM taught only mathematics or mathematics and one other subject, allowing them to specialize in mathematics instruction. Many frequently changed the grade level they taught allowing them to see the development of mathematics from the perspective of a teacher (Ma, 1999). In a study completed by Ball, Hill and Bass (2005), teachers of mathematics who scored higher on designated measures of mathematical knowledge for teaching produced better gains in student achievement (Ball et al., 2005). Strawhecker (2004) reported the pre-service

elementary teachers who were enrolled in mathematics methods courses, mathematics content course and a field experience concurrently, had significant gains in pedagogical content knowledge and were able to see the connections between mathematical topics. Teachers who have a deep conceptual understanding of mathematics are better prepared to teach a concept in multiple ways and think about how others may understand the concept (Ball, 2000). In a qualitative study by Ford and Strawhecker (2011), teachers with low math ability made many negative comments towards math concepts in comparison to other pre-service teachers.

According to Hill, Rowan, and Ball (2005), teachers of mathematics should understand skills and concepts differently than non-teaching adults (2005). The preceding researchers found teachers' mathematical knowledge positively predicted student gains in mathematics achievement during first and third grades, suggesting teachers' content knowledge plays a role for basic mathematics content (Hill et al., 2005). Teachers should have content knowledge, pedagogical content knowledge and curriculum knowledge. Content knowledge includes facts and concepts within a topic and why facts and concepts are true and work the way they do. Teachers with content knowledge may provide better mathematical explanations, construct better representations and understand the structures underlying elementary mathematics. Pedagogical content knowledge is taking the content knowledge and applying it in way students can easily learn mathematics (Hill et al., 2005). Educators must have thorough mathematical understanding to explain mathematical concepts to students, interpret students' thought processes, determine and use effective resources and provide students with examples of practical mathematical concepts. Curriculum knowledge allows teachers to see the long

range plan and present information in a method where the sequence aligns in a cohesive manner (Hill et al., 2005).

Pre-service Preparation for Mathematics Specialists

Hungs-Hsi Wu suggests creating a smaller group of teachers with strong content knowledge who would teach mathematics starting in at least fourth grade (2009). An organization composed of major national education organizations, the Learning First Alliance, recommends every student be taught by a mathematics specialist beginning in fifth grade (Askey, 1999).

> The Association of Mathematics Teacher Educators (AMTE), the Association of State Supervisors of Mathematics (ASSM), the National Council of Supervisors of Mathematics (NCSM), and the National Council of Teachers (NCTM) recommend the use of Elementary Mathematics Specialists (EMS) in pre-K-6 environments to enhance the teaching, learning, and assessing of mathematics to improve student achievement. (NCTM, n.d.).

The AMTE consortium of mathematics organizations advocates every elementary school have an EMS who possesses a deep and broad knowledge of mathematics content, expertise in using and helping teachers use effective instructional strategies, the ability to provide enrichment and remedial support to students groups of students, and the ability to advocate efforts which help all pre-K-6 students learn mathematics (NCTM, n.d.).

The Association of Mathematics Teacher Educators (AMTE) endorses the need for an increase in preparation for professionals who are educating young students in mathematics. The organization supports a need for mathematics specialists. These specialists would have a deep and practical knowledge of mathematics content and

pedagogy of how elementary students learn mathematics (2010). According to AMTE, at least nine states offer additional certifications for elementary mathematics specialists. The Elementary Mathematics Specialist standards require individuals to have a teaching certificate and at least three years of successful mathematics teaching experience. The program focuses on mathematics through 24 semester hours of mathematics and pedagogy preparation and a teaching practicum where the individual obtains experience working with student and adult learners in a variety of professional development settings (AMTE, 2010).

Missouri recently recognized a need for mathematics specialists in elementary schools. In order to obtain a certificate for Mathematics Specialist in the state of Missouri, a teacher must have a valid Missouri teaching certificate, two years of successful mathematics teaching experience, recommendation of designated official education in the college or university of an approved program of study, complete and pass a content knowledge test and take a minimum of 24 semester hours beyond initial certification covering mathematical content knowledge, pedagogical content knowledge for mathematics, foundations of leadership and clinical experiences (DESE, 2012).

Good Mathematics Instruction

According to Ball, Lubienksi, and Mewborn (2001), many Americans have an insufficient understanding of mathematics regardless of the formal schooling the United States provides. Despite many attempts for math reform in the United States, many aspects of mathematics education has remained the same since the early 1900s. Many students are told simple steps and rules to follow when learning mathematics instead of understanding the reasons for the steps and rules (Ball et al., 2001). Students embrace

what their instructor says as the correct way to answer a problem and do not seek why a problem can be solved a certain way. Too often curriculum and teaching methods deluge students with many skills and procedures without the understanding and joy mathematics offers. Early studies by Ball, Lubienksi, and Mewborn (2001) suggest teachers' knowledge of the content area shape their interpretations and uses of the curriculum materials, therefore making new curriculum only as good as the educator teaching it. United States mathematics education is weak because United States teachers' knowledge of mathematics is weak too (Ball et al., 2001).

Due to high stakes testing, many teachers feel pressure to make sure students master content needed to pass the state testing. This pressure forces teachers to attempt to briefly cover all concepts and rarely allows them to thoroughly teach a skill so students have a deeper understanding of how a problem can be solved (Ball et al., 2001). Teachers cannot just model how to work a problem; they must be able to explain the reasoning, listen to students' questions, and examine students' work to analyze the source of errors. Doing these tasks requires additional mathematical insight and content understanding. According to data from Ball, Hill, and Bass's study (2005), teachers must be fluent with mathematical language to make explanations of mathematics clear for students.

How the Brain Learns Mathematics

Jean Piaget devoted time researching cognitive development. Through his work, he identified four primary stages of development. Those stages included sensorimotor, preoperational, concrete operational and formal operational (Ojose, 2008). Typically, children are grouped into each stage by chronological age; however, this does not

necessarily ensure students' developmental levels are similar (Weinert & Helmke, 1998). Piaget believed children developed gradually throughout each stage and one's experience in each stage formed the foundation for movement to the next (Ojose, 2008).

Mental and cognitive attributes develop from birth until language development in the sensorimotor stage. Object permanence and linking numbers to objects are skills acquired during this phase (Ojose, 2008). This stage begins at birth and typically ends around two years of age. The sensorimotor stage is comprised of six subset stages; reflexes, primary circular reactions, secondary circular reactions, coordination of secondary circular reactions, tertiary circular reactions, and mental representations (Ormrod, 2008).

The preoperational stage is characterized by in an increase in language ability, symbolic thought, egocentric perspective, and limited logic (Ojose, 2008). This stage occurs from toddlerhood through early childhood, approximately seven years of age. During this stage, children begin to develop memory and imagination allowing them to understand there is a difference between what happened in the past and what happened in the future. Children in this stage begin engaging in make-believe play (Benaroch, 2012). A lack of logic is associated with the preoperational stage. While a child at this stage can see three plus two is five; he cannot perform the reverse operation of taking two from five. This inability stems from seeing objects from one dimension (Ojose, 2008).

The concrete operations stage shows significant cognitive growth, occurring from ages seven through twelve. Most fifth grade students fall within this stage of development. Children at this stage utilize all five senses in order to know a particular skill. The ability to consider multiple dimensions simultaneously exists at this stage.

Children gain the ability to order objects according to the length, weight or volume and classify objects based on a common attribute (Ojose, 2008).

The final stage of Cognitive Development is the formal operations stage. Students often enter this stage around the age of twelve and remain there through adulthood (Benaroch, 2012). This stage is where a child becomes capable of forming hypotheses and inferring the possible consequences. Children in this stage are able to think abstractly by generalizing and evaluating logical arguments (Ojose, 2008).

Each stage of cognitive development varies depending on an individual's experience. Piaget believed children were not less intelligent than adults, but rather they thought about things differently based on their level of development. The progression of children's development occurs in the preceding stages (Piaget, 1952).

What Educators Can Do to Enhance Cognitive Development of Mathematics

Education of children starts at birth. Educators should lay a solid mathematical foundation for children by providing activities that enhance conceptual development of numbers such as incorporation of counting. Use of children's picture books with mathematical concepts and ideas which include pictorial illustrations allows learners the benefit of seeing pictures of objects and their respective numbers simultaneously (Ojose, 2008).

Educators should utilize effective questioning while classifying objects with students in the preoperational stage of development. After investigating objects, teachers can engage students in discussions or interactions to stimulate their discovery of multiple ways to group objects (Thompson, 1990).

Fifth grade students typically fall in the concrete operations stage of development. Ways educators can foster the development of this stage include offering hands-on experiences and showing multiple ways students could represent a solution to a mathematics problem. Hands-on activities provide students an opportunity to use manipulatives to explore concepts. Manipulation with a variety of math tools allows abstract concepts to become concrete (Ojose, 2008). Mathematical practice standard five requires students to use appropriate tools strategically (Parker & Novak, 2012). Mathematical practice standard five should be consistently implemented in mathematics classrooms which educate students at the concrete operations stage. A need for educators to help students build their mathematical confidence during this stage is crucial. One way educators can build a student's confidence is by showing students multiple ways to test and confirm their reasoning when solving a math problem. Educators can do so through think-alouds and modeling of desired behavior. This includes making connections between the work students do with manipulatives and how it relates to the abstract math concepts (Parker & Novak, 2012).

During the final stage of development educators should work with students on their abilities to clarify, infer, evaluate, and apply math skills. Teaching students to determine which information is relevant allows them to identify and analyze elements of a mathematics problem. This process clarifies what is needed to solve a problem. Asking students to infer inductively and deductively allows students to reason from general concepts to specific instances and extract similarities and differences among objects (Hemmelgarn, 2011).

Teachers, parents, and other influential people in adolescents' lives should understand the different stages of cognitive development. Each stage requires an educator to have the ability to provide the appropriate learning tools for a student to become successful. Without emphasizing the mathematical practice standards such as the use of appropriate learning tools, students are unable to effectively learn and are unable to gain enough knowledge and experience to advance to the next developmental stage (Hemmelgarn, 2011).

Introduction of Organizational Structures of Instruction

Education has transitioned from one-room school houses to grade level and content level structures. The National Mathematics Advisory Panel has recommended researchers look at the effectiveness of departmentalized instruction to teach math. Beginning in the 1980s, organizations such as Carnegie Council on Adolescent Development, Carnegie Foundation for the Advancement of Teaching, Carnegie Task Force on Teaching as a Profession, and National Commission on Excellence in Education issued a call for structural change in the United States (Lee &Smith, 1993). McPartland (1987) found instruction from a traditional classroom benefited student-teacher relations yet lacked high quality instruction while instruction from a departmentalized classroom improved the quality of instruction in a subject area yet lacked student-teacher relations.

Departmentalized Classrooms. Across the nation, more elementary schools are transitioning to a departmentalized structure to allow their students a chance to be taught math by someone who can focus primarily on mathematics. Some of these schools are beginning this departmentalized approach as early as first grade (Hood, 2010). At Loveland Classical School in Loveland, Colorado, instruction in grades first through fifth

grades is departmentalized so experts teach each subject. The school builds the students' education by having teachers teach what they love and have a passion towards. The teams of teachers meet daily for departmental curriculum discussions, grade-level interdisciplinary discussions, or sessions on effective teaching. Days are also set aside for teachers to discuss students and how to help them learn best. Traditional relationships are formed through the use of a classroom coordinator who is with the class the entire day as the experts come to the classroom and teach their content area. This coordinator also takes care of all housekeeping tasks which are present in a school setting. The classroom coordinator is the first point of contact for parents with instructional concerns (Yu, 2014). Research indicates achievement increases among students in departmentalized math classes. In the Palm Beach County School District, departmentalization is mandated for third, fourth and fifth grades in 107 of its elementary schools after 40 schools successfully increased student achievement by implementing departmentalized instruction (Hood, 2010). According to education consultant, Steve Peha, fifteen years ago, five percent of the nation's schools were departmentalized. This number recently increased to twenty percent and Peha predicts it will increase more in the next few years as states work on reforming education (Hood, 2010).

Educators in departmentalized settings testify benefits go beyond increased student achievement, citing the opportunity to collaborate on curriculum with content coworkers and sharing their passion for their content areas (Hood, 2010; Dropsey, 2004). According to a qualitative study by Liu (2011), educators found additional advantages to departmentalization of core subjects including an increase in teachers' enthusiasm about the core subject, a focused attention on a specialized area, easier transition for students to

junior high school, designated times for all subjects, and less anxiety expressed by teachers who have a dislike for certain subjects. When educators teach subjects they have a passion for, teacher retention is improved. Another benefit of departmentalized classrooms is students learn to adapt to a variety of teaching styles (Dropsey, 2004). When teachers are enthusiastic about mathematics, less anxiety is shown to students and a better chance of students developing the same admiration for the subject as the specialized teacher exists. As is the case in the medical field, teachers who specialize in one area are able to be more creative and imaginative because they focus on one subject (Liu, 2011; Hood, 2010). By only teaching mathematics, teachers have much needed time to prepare their lessons and to perfect their knowledge of mathematics (Askey, 1999; Hood, 2010). Teacher knowledge can be enhanced through targeted professional development and collaboration time to focus on content with peers from their content area. Therefore, departmentalization is considered cost neutral because mathematics professional development funds can be spent on fewer teachers (Hood, 2010).

Vygotsky (1978) placed an emphasis on the effect students' social interactions have on their learning. When students are placed in a departmentalized setting they are given the opportunity to benefit and adapt to more than one teaching style and experience socially rich environments to explore mathematics with their peers and teachers (Vygotsky, 1978; Dropsey, 2004). The very essence of teaching and learning is socially constructed by interactions between teachers and students. In a departmentalized setting, classroom teachers must plan together to integrate all subject areas together. When these interactions correlate to one another, students are able to connect content areas to one another leading to concept development (Dropsey, 2004).

Disadvantages of departmentalized classrooms are also evident. It is difficult for multiple teachers to collaborate to plan integrated curriculum. In order to integrate content areas, teachers have to find time to plan integrated lesson. This proves difficult when trying to meet on a regular basis.

Traditional Classrooms. The structure formed by a traditional classroom setting has benefits and disadvantages. In traditional, self-contained classrooms, fewer transitions can provide more time for learning required standards. Teachers are afforded flexibility in scheduling, allowing them to build upon their students' strengths and weaknesses (Dropsey, 2004). This flexibility can make it easy to choose to teach subjects other than mathematics when schedules have to be modified.

Traditional classrooms allow teachers to spend more time with a group of students. Teachers who use this class time to build effective teacher-student relationships support student learning by gaining good classroom management. The quality of these relationships is a source for classroom management; teachers who had effective teacher-student relationships saw a 31 percent decrease in discipline problems (Marzano & Marzano, 2003a). Positive relationships formed between students and teachers helps instructional strategies become more effective (Marzano, 2011). Research by Marzano showed the relationships teachers made with students in the classroom had twice the impact on student achievement as school policies on curriculum, assessment, school culture, and community involvement (2003b). Positive teacher-student relationships support student learning (Marzano & Marzano, 2003a).

Disadvantages of traditional classrooms include isolation between teachers from one another and lack of time teachers have to collaborate with one another. This setting

also limits the amount of support teachers can provide one another to deliver students with a lesson complete with innovative learning experiences (Ball et al., 2001). Teachers in a traditional elementary setting must also teach many other subjects in addition to mathematics, therefore, limiting their time and efforts in planning and organizing rigorous experiences for their students (Ball et al., 2001). The responsibility of teaching all subjects requires teachers to be generalist, having a general knowledge of every subject (Hood, 2010). Proponents of traditional classroom settings argue the needs of the whole child are best met in a setting with the same teacher, where their physical, emotional and cognitive needs are met in the learning experience (Gray, 1997).

Summary

In Chapter Two, the researcher presented the review of relevant literature. The researcher included literature related to the educational history of the organization of the school in the United States and in Missouri, the onset of CCSS and mathematical shifts in content and Mathematical Practices, the impact the CCSS had on teacher certification and the impact on mathematics specialist certification, pre-service preparation for mathematics teachers and mathematics specialists, good math instruction, how the brain learns mathematics, what educators can do to enhance cognitive development, and the introduction of the organizational structures of current fifth grade classrooms.

Chapter Three details the methodology utilized in the study. Chapter Four presents the research results. Chapter Five states the conclusions, recommendations, and implications for school districts and teachers to utilize when hiring and organizing fifth grade classrooms.

CHAPTER THREE

Research Design and Methodology

Introduction

The purpose of the study was to determine if teachers' perception towards their own mathematics knowledge affected student achievement in fifth grade mathematics. The study looked at differences in perceptions and student achievement according to classroom organizational structure, the years of teaching experience, the number of math sections taught, the number of fifth grade math sections taught, and the education of the teacher. The study also compared student achievement from a departmentalized classroom setting to student achievement from a traditional classroom setting. Achievement was measured based on the percentage of students scoring advanced or proficient on the Missouri Assessment Program (MAP) fifth grade mathematics test. The details of the study are presented in the following sections.

Participants

Data was gathered through demographic and a perception of mathematical knowledge survey responses of fifth grade math teachers throughout Missouri's Region C Supervisor Instructional Area. This supervisory area has a variety of rural and suburban schools and is comparable to a majority of other regions throughout Missouri. District enrollment in this region varies from 52 students to 24,352 students. School districts/buildings which participated were identified as having fifth grade students. Participants in this survey ranged housing one section of fifth grade students to fifteen sections of fifth grade sections. The elementary principals served as a liaison in distribution of the survey to fifth grade math teachers.

For the purpose of this study, departmentalization referred to one teacher teaching math to two or more sections of students. Traditional classroom, for the purpose of this study, referred to one teacher responsible for teaching all subjects to one set of students. A total of 91 responses were received. Sixty schools throughout the region were represented in the responses. Forty-six respondents were from schools organized in traditional self-contained classrooms. Forty-five respondents were from schools organized in departmentalized classrooms.

Educational backgrounds of the respondents varied. Sixty-eight (75%) respondents had a Bachelor's Degree in Elementary Education without an emphasis in math. Three (3%) responding fifth grade teachers had a Middle School Math Certification. Twenty (22%) fifth grade teacher participants had a degree other than Elementary Education or Middle School Education with an emphasis in Mathematics.

By completing the survey and reading the informed consent, educators understood all information would be used only to analyze any comparisons between the teachers' perception towards their own mathematics knowledge to student achievement in fifth grade mathematics and the differences according to demographical data such as organizational structure of classroom, years of teaching experience, number of math sections taught, and education of teacher.

Selection/Sampling

The researcher defined the population as teachers who taught math to fifth grade students in Region C of Missouri's Supervisory Area of Instruction. Region C is comprised of 20 counties with a variety of rural and suburban schools. The student enrollment of districts in this region ranged from 52 students to 24,352 students. This

sample is similar in qualities of the other six supervisory instructional areas throughout the state, excluding Regions A and B. Kansas City (Region B) and St. Louis (Region A) supervisory areas were excluded because their organizational structure is not similar to schools throughout the state. Each of the seven supervisory areas included in the comparison represent 11 to 20 counties. Regions A and B are comprised of only four counties. Regions C through I host 51 to 94 districts. Each region in the comparison group has a variety of rural and suburban schools. The grouping was purposive sampling as they met particular criteria.

The researcher sent the survey to every elementary school in Region C in the state of Missouri with fifth grade students. A total of 121 school buildings received the survey instrument. The researcher asked Missouri elementary principals to forward the survey to their fifth grade teachers. The purpose of this study was to identify if a cause and effect relationship existed between classroom organizations, specialized training of the teacher and student achievement, therefore a survey was sent to the population of interest. The researcher determined members of the population as teachers who taught fifth grade mathematics. The anticipated sample size according to an estimated population size of 121 elementary schools with fifth grade teachers with a confidence interval of 95 percent and a five percent margin of error was 92 responses.

Research Design

The researcher created a demographic and perception survey to understand the district's organization of fifth grade mathematics and the teacher's self-perceptions of their mathematical knowledge. Demographic questions included teacher certification type, years teaching mathematics, number of fifth grade math sections taught and number

of math sections taught. The researcher completed an ethics class and all ethical standards were applied. Participants in the study were informed their participation was completely voluntary. The researcher only used the respondents' school names to collect the respective fifth grade mathematics MAP data. The researcher used the school names to ensure the MAP data aligned respective to the correct school building in the survey report. Care was taken to ensure confidentiality in the responses in regard to identifiable information of the respondents. The researcher then used the report to complete a SPSS. The researcher deleted the columns with the school districts' names from the Excel copy of the survey report. After the completion of the study, the researcher will completely delete the survey report to ensure data will not be shared in any way.

The researcher developed the survey to send to all elementary principals in Region C of the state of Missouri in May, 2014. Prior to distribution, the survey was field tested by third and fourth grade teachers in elementary schools without fifth grade students. To ensure representation of the population was considered, the field tested schools were within the same region as the final study. These schools did not house fifth grade students safeguard against confusion among respondents. Teachers were asked to answer all questions with the assumption the questions applied to third or fourth grade classrooms. After reviewing the results of the expert perception test, the researcher made corrections and deletions to help clarify the meaning of each question. The researcher made necessary adjustments to remove repetitive language in order to make the survey more precise and clear on the extent of mathematical background of the teacher. The survey was created using Question Pro, a web-based surveying tool.

Instrumentation

The researcher, using the web-based survey tool, Question Pro, designed a demographic and perception survey. The survey included identification of the school district, the organization of fifth grade classrooms in regards to traditional self-contained classrooms or departmentalized classrooms, the schooling or preparation the mathematics educator received in mathematics, the number of math sections the educator taught and the number of fifth grade math sections the educator taught. A printed copy of the final survey is provided in Appendix B.

The survey instrument was researcher designed based on the researchers experience as a classroom math teacher and the researcher's review of the literature. The survey design was not based on any specific reviewed survey but was created by the researcher. From knowledge gained throughout the review of literature and the researcher's professional experiences, the researcher developed perception statements to determine respondents' understanding of mathematical concepts. The validity and reliability was unknown but the researcher field tested the instrument on a sample of teachers similar to the target population.

The researcher used fifth grade math MAP scores to represent student achievement. The Missouri Assessment Program (MAP) was created in response to Missouri's Outstanding Schools Act of 1993 and No Child Left Behind legislation attempting to improve education. The purpose of the MAP is to test grade level expectations (GLEs) set by the state to ensure teachers are teaching students the grade level standards. The researcher used the Department of Elementary and Secondary Education website to obtain fifth grade MAP scores of participating districts. This

information was found by going to each district's quick facts page. The researcher selected Mathematics MAP data and ran an "Achievement Level 4 Report" for each responding building for the 2014 fifth grade Mathematics MAP scores. The researcher combined the proficient and advanced percentages to get a total top two levels percentage. By MAP standards, the top two levels indicate mastery of grade-level standards. This combined percentage is often reported to stakeholders to show how many students are considered at grade level or above. This data was inputted into a Microsoft Excel sheet and directly imported from Question Pro. Once the MAP data was entered, school district and building names were no longer referred to in the analysis of research. A Statistical Package for the Social Sciences (SPSS) report was conducted to analyze data. The results of the SPSS reports are included in the next chapter.

Perception Questions. In an attempt to ensure the perception questions represented the respondents' perceptions of their mathematical knowledge, the researcher circulated the perception questions to math enrichment teachers in the researcher's home district. The math enrichment teachers ranked the statements according to the degree in which the respondents' mathematical knowledge could be determined based off the answers given to the statements. After the experts responded, the researcher made adjustments to the statements to ensure they represented a true measure of the respondents' mathematical knowledge.

***Validity of Perception Questions*.** The researcher asked the math enrichment teachers to rank each of the eight perception questions indicating if the statement would give the researcher an understanding of respondents' mathematical knowledge. These teachers are considered experts in each building in regard to math related questions.

Professional development for these teachers is targeted to meet their content area's needs. These educators are considered each building's math gurus in regard to mathematical instruction and curriculum delivery. Experts ranked each question depending on how they felt it measured the respondents' mathematical knowledge. To rate the degree to which each item measured each objective, an Index of Item-Objective Congruence, developed by Rovinelli and Hambleton (1977), was performed based on the ratings provided by the panel of experts. The experts gave a score of one to each statement if they felt it measured the mathematical knowledge of the respondent. Math enrichment teachers gave a score of zero to each statement if they felt it did not measure the mathematical knowledge. A copy of the request for them to rank the statements is included in Appendix B. Table 1 illustrates the results of the math experts' rankings.

Table 1

Expert Opinion Ratings of Perception Statements

Perception Statement	Average Rank 0= Does not represent mathematics knowledge 1= Does represent mathematics knowledge
1. Math came easy for me in school. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	0.71
2. I consider myself as having a basic understanding of mathematics concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	1
3. I consider myself as having a thorough understanding of mathematics concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	1
4. I consider myself as having a poor understanding of mathematics concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	1
5. Mathematics comes naturally to me. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	0.57
6. My ability to explain mathematical reasoning to fifth grade students is high. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	0.86
7. I am comfortable with teaching mathematical concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	1
8. I can identify where students make mathematical mistakes. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	1

Table 1 shows the responses of the math enrichment teachers in regard to determining if the eight perception statements could represent a respondent's mathematical knowledge. The researcher eliminated statement five after responses indicated it would not necessarily measure a respondents' mathematical knowledge. In an attempt to ensure the statements measured mathematical knowledge statement five

was omitted and statement two was changed to ensure clarity. Due to the small sample size for the perception test, decisions to change the wording were based upon expert survey analysis and the expertise of the researcher.

Pilot. After changes from the expert ratings were completed, the researcher sent the field test to third and fourth grade teachers. In an attempt to eliminate confusion of grade levels taught, the teachers who participated in this field test did not house fifth grade students. The respondents were not participants in the researcher's final study. The field test was sent to 30 teachers and 21 responded.

Table 2

Factor Analysis on Pilot Study

Perception Statements	Extraction
Math came easy for me in school.	.477
I consider myself as having a basic understanding of mathematics concepts.	.008
I consider myself as having a thorough understanding of mathematics concepts.	.645
I consider myself as having a poor understanding of mathematics concepts.	.498
My ability to explain mathematical reasoning to fifth grade students is high.	.497
I am comfortable with teaching mathematical concepts.	.663
I can identify where students make mathematical mistakes.	.595

Validity of Pilot. Table 2 shows the results of the principal components factory analysis with varimax rotation. The researcher analyzed the results of the field test to determine if the questions elicited the information the researcher was seeking and if the replies were consistent throughout the test sample. The pilot study factor analysis includes the statements chosen for the final study. Face validity was conducted through

development of the review of literature and the researcher's expertise. Content validity was conducted through an expert Index of Item-Objective Congruence of the perception questions before field testing the survey. Each expert was considered a mathematics guru in their respective school building and received targeted professional development in their content area. Construct validity was conducted through the use of a factor analysis.

The researcher intended for these procedures to increase the construct validity of the instrument. These statements match the theorized idea the researcher was trying to measure. These numbers align with the researcher's intended expectations.

Reliability of Pilot. A Cronbach's Alpha of 1.00 would indicate a strong reliability of survey items. The respondents were highly consistent in the pilot as the Cronbach's Alpha equaled 0.635. This indicated a high rate of consistency in how respondents answered the perception questions. Based on this result, the instrument could be relied on from one application to the next.

Final Instrument. The final instrument was disseminated in August, 2014 electronically to the principals of 121elementary or middle school buildings which housed fifth grade students in Region C of the Supervisor Instructional Area of Missouri. A second request for survey completion was sent to the principals whose fifth grade teachers had not responded. Two separate requests of the building principals yielded 62 responses. In an attempt to gather more responses, the researcher sent emails to fifth grade teachers directly in September, 2014. This attempt received 29 additional responses, making for a total of 91 responses. The additional responses increased the number of schools represented by 15 schools.

Table 3

Factor Analysis of Perception Statements in Final Instrument

Perception Statements	Extraction
Math came easy for me in school.	.248
I consider myself as having a basic understanding of mathematics concepts.	.252
I consider myself as having a thorough understanding of mathematics concepts.	.586
I consider myself as having a poor understanding of mathematics concepts.	.342
My ability to explain mathematical reasoning to fifth grade students is high.	.549
I am comfortable with teaching mathematical concepts.	.638
I can identify where students make mathematical mistakes.	.518

Validity of Final Instrument. Table 3 shows the principal components factor analysis with varimax rotation. The factor analysis of the final study was conducted with responses from the participants. Factor analysis was initiated to determine if the survey items measured what they were intended to measure.

A principal components analysis was conducted to provide additional evidence of the construct validity. The purpose of this analysis was to determine the extent to which the items loaded together on the theorized factor. A varimax rotation was selected using a single factor model. Unfortunately, access to a sufficiently large number of teachers within accessible location boundaries was difficult, thus the sample for the study was relatively small. Because of the small sample size obtained for the study, care was made to interpret the statistical analysis in conjunction with expert ratings and the test developer for evaluation purposes.

Reliability of Final Instrument. The reliability of the final test was measured through Cronbach's Alpha. A Cronbach's Alpha of 1.00 would indicate a strong reliability of survey items. The respondents were highly consistent in the final instrument as the Cronbach's Alpha equaled 0.751. This indicated a high rate of consistency in how respondents answered the perception questions. Based on this result, the instrument could be relied on from one application to the next.

Map Score Averages

Table 4

MAP Score Averages

Average Percent of Fifth Grade Students Scoring Advanced or Proficient on the MAP in the state of Missouri	Respondents' Average Percent of Fifth Grade Students Scoring Advanced or Proficient in Traditional Settings	Respondents' Average Percent of Fifth Grade Students Scoring Advanced or Proficient in Departmentalized Settings
52.8	52.1	50.4

Table 4 illustrates average MAP percentages of different groups of fifth grade math students. The researcher collected fifth grade math MAP data of buildings responding to the survey. An average percent of respondents' fifth grade students scoring advanced or proficient on the math MAP test 51.3 percent. The data from respondents was compared to the state average of fifth grade math students scoring advanced or proficient on the MAP. The researcher used the Missouri Department of Elementary and Secondary Education website to obtain fifth grade MAP scores of participating districts. This information was found by going to each district's quick facts page. The researcher selected Mathematics MAP data and ran an "Achievement Level 4 Report" for each responding building for the 2014 fifth grade Mathematics MAP scores. The researcher

combined the proficient and advanced percentages to get a total top two levels percentage. The researcher inputted the data into the survey report and filtered the findings by departmentalized setting and traditional setting schools. The researcher then calculated the average for each subcategory.

Data Analysis

A causal comparative design was used to determine if there was a statistically significant difference in fifth grade math achievement in regards to the organizational structure of the classroom and teacher's educational degree. With comparison of departmentalized classroom scores to traditional classroom scores and scores from a math specialist compared to a generalist instructor, a multifactor analysis of variance test was conducted. The researcher compared student achievement of fifth grade students taught by a departmentalized teacher to the achievement of fifth grade students taught by a traditional teacher on the fifth grade math MAP. From this comparison, the researcher found no existence of significance among the populations. The researcher compared student achievement of fifth grade students taught by a teacher in a departmentalized setting to the achievement of fifth grade students taught by a teacher in a traditional setting. Mathematics instruction from a departmentalized classroom teacher and teacher education were the independent variables. Student achievement was the dependent variable. The research was prospective as the intent was to identify the effect the independent variables had on the dependent variable.

The researcher also compared the achievement of students taught by a teacher with Elementary Education Degree versus achievement of students taught by a teacher

with a Middle School Education Degree and also compared the achievement of students taught by a teacher with a degree indicated as “other”.

Summary

In Chapter III participants and sampling procedure was determined as fifth grade math teachers in Region C of Missouri’s Supervisor Instructional Area. Question Pro was chosen as the instrument utilized to design the survey. A demographic and perception survey was created by the researcher based off findings from the review of literature and the researcher’s professional experience. Validity and reliability of instrumentation was tested through factor analysis and Cronbach’s Alpha tests. Chapter IV details the results of the study. Chapter V offers the researcher’s conclusions, recommendations, and implications for schools.

CHAPTER FOUR

Results

Introduction

This quantitative study was implemented to answer the research questions, does the teachers' perception towards their own mathematics knowledge effect student achievement in fifth grade mathematics? Are there differences according to classroom organizational structure, years of teaching experience, number of math sections taught, number of fifth grade math sections taught, and education of teacher? Does a departmentalized classroom setting positively affect student achievement in comparison to a traditional classroom setting?

The number of usable responses was N = 91 for fifth grade math teachers. Departmentalized classroom teachers were 49.4 percent of the total population. Traditional classroom teachers were 50.5 percent of the total population. Elementary Education majors comprised 74.7 percent of the total population. Middle School Education majors comprised 3.3 percent of the total population. Other degrees comprised 22 percent of the population.

The demographic information for the participants is presented in table 5. Table 6 through table 11 summarizes the respondents' demographic responses compared to their perceptions of their own mathematical knowledge and the demographic findings compared to the MAP percentage of students scoring proficient and advanced on the fifth grade math MAP test in 2014. Missouri's average for fifth grade students who scored proficient or advanced on the 2014 Math MAP test was 52.8 percent. The average for

fifth grade students who scored proficient or advanced on the 2014 Math MAP test who participated in this study was 51.3 percent.

The research question will be addressed in the deductive conclusions. A summary of the chapter and introduction to chapter V concludes chapter IV.

Teacher Demographics

Table 5

Teacher Demographics (N=91)

Characteristics	N	%
Number of 5th Grade Sections in Building		
1	13	14.3
2	22	24.2
3	14	15.4
4	9	11
5	4	4.4
6	2	2.2
7	7	7.7
8	11	12.1
10	1	1.1
12	4	4.4
14	3	3.3
15	1	1.1
Fifth Grade Math Sections Taught		
1	50	55
2	27	30
3	6	7
4	5	5
5	1	1
6	2	2
Years of Teaching Math		
0-5	46	51
6-10	27	30
11-15	11	12
16-20	4	4
21+	3	3
Departmentalized vs. Traditional		
Departmentalized	45	49
Traditional	46	51
Undergraduate Degree		
Elementary Education	68	75
Middle School Education Emphasis in Math	3	3
Other	20	22

Table 5 illustrates the respondents' demographic information. From the 91 responses, 49 percent of the teachers taught math in a departmentalized setting and 51

percent of the teachers taught math in a traditional setting. Elementary education majors made up 75 percent of the respondents. Of the respondents, 55 percent taught one section of fifth grade math. Teachers with 0-5 years of experience comprised 51 percent of the respondents. The researcher collected the demographic information to determine if significance existed in regard to teachers' demographic answers and student achievement. After analyzing the data, no true significance was found between MAP scores and teachers' demographics.

Table 6

Table of Scale Statistics

Mean	Standard Deviation	# of items
28.33	4.279	7

Table 6 indicates overall the respondents felt confident in their mathematical skills. The highest score indicating the most confidence would be 35 points. The lowest score indicating the least confidence would be seven points. Sixty-eight percent of the population had a total score between 24 and 32 when it came to their perception of math skills. This indicates 16 percent of respondents had high levels of confidence as their mean score ranged from 32 to 35. Sixteen percent of the respondents had a mean score of seven to 24, indicating few respondents had a lower confidence of their mathematical knowledge.

Knowledge vs. Number of Math Sections Taught.

Table 7

ANOVA Knowledge vs. Number of Math Sections Taught

	Sum of Squares	df	Mean of Square	F	Sig.
Between Groups	207.725	4	51.931	3.101	.020
Within Groups	1440.385	86	16.749		
Total	1648.110	90			

The researcher examined the impact of the number of math sections taught to the overall perceptions of the teachers in regard to beliefs about math knowledge. Results were analyzed using a one-way ANOVA, between groups design. The summary from this ANOVA is in Table 7. This analysis revealed a significant difference in the attitudes about the perceptions respondents had in regard to their mathematical knowledge, $F(4,86) = 3.101$; $p < .02$. Table 7 indicates there is significant difference between the respondents' number of math sections taught and their perception of math skills. Therefore, there are differences that exist between two or more groups in perceptions of math skills and the number of sections taught.

Table 8

Post Hoc Test: Knowledge vs. Number of Math Sections Taught

How many total sections of math taught?	How many total sections of math taught?	Sig.
1	2	.031
2	1	.031

Table 8 indicates Tukeys's Honestly Significant Difference post-hoc test revealed that teachers who taught two sections of math were more favorable towards their

knowledge of math than if they taught one section. Teachers who taught more than two sections of math had no significant differences in their responses in regard to their perception of their ability to teach mathematics.

Teachers who taught two sections had a more positive perception of their mathematical knowledge than teachers who taught one section of math. Therefore teaching two sections positively impacts the perceptions teachers had towards their mathematical knowledge.

Knowledge vs. Number of Fifth Grade Math Sections Taught.

Table 9

ANOVA Knowledge vs. Number of Fifth Grade Math Sections Taught

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	271.410	5	54.282	3.351	.008
Within Groups	1376.700	85	16.196		
Total	1648.110	90			

The researcher examined the impact of the number of fifth grade math sections taught to the overall perceptions of the teachers in regard to beliefs about math knowledge. Results were analyzed using a one-way ANOVA, between groups design. The summary from this ANOVA is in Table 9. This analysis revealed a significant difference in the attitudes about the knowledge of teachers, $F(5,85) = 3.351$; $p < .008$. Table 9 indicates there is significant difference between the respondents' number of fifth grade math sections taught and their perception of math skills. Therefore, differences xist between two or more groups in perceptions of math skills and the number of fifth grade sections taught.

Table 10

Post Hoc Test: Knowledge vs. Number of Fifth Grade Math Sections Taught

How many total sections of fifth grade math taught.	How many total sections of fifth grade math taught.	Sig.
1	2	.046
2	1	.046
2	6	.022
4	6	.049
6	2	.022
6	4	.049

Table 10 indicates Tukeys's HSD post-hoc test revealed that teachers who taught one section of fifth grade math considered themselves less knowledgeable in mathematics than teachers who taught two sections. Teachers who taught two sections of fifth grade math were more favorable towards their knowledge of math than if they taught one or six sections of fifth grade math. Teachers who taught four sections of fifth grade math also felt they were more favorable towards their knowledge of math than if they taught six sections. Teachers who taught six sections of fifth grade math did not consider themselves as knowledgeable in math as teachers who taught two or four sections of fifth grade mathematics. Teachers who taught three or five sections of fifth grade no significant differences in their responses in regard to their perception of their ability to teach mathematics.

Teachers who taught two and four sections of fifth grade math considered themselves to have a more positive perception of their mathematical knowledge than teachers who taught one or six sections of math. Therefore teaching two and four sections of fifth grade math positively impacts the perceptions of mathematics teachers.

Departmentalized vs. Traditional Classroom Structure. The researcher examined the impact of the organizational structure to the overall perceptions of the teachers in regard to beliefs about math knowledge. Results were analyzed using a t-Test, between groups design. This analysis revealed a significant difference in the attitudes about the knowledge of teachers, $t = 2.821$; $\underline{p} < .097$. The data indicates there is significant difference between the structural organization of the respondents and their perception of math skills. Therefore, there are true differences that exist between two or more groups in perceptions of math skills and departmentalized classrooms and traditional classrooms. The teachers who taught in a departmentalized setting considered themselves more knowledgeable in mathematics than teachers in a traditional classroom setting.

Table 11

MAP Score Averages

Average Percent of Fifth Grade Students Scoring Advanced or Proficient on the MAP in the state of Missouri	Respondents' Average Percent of Fifth Grade Students Scoring Advanced or Proficient in Traditional Settings	Respondents' Average Percent of Fifth Grade Students Scoring Advanced or Proficient in Departmentalized Settings
52.8	52.1	50.4

Table 11 shows the breakdown of the percent of fifth grade students scoring advanced or proficient on the fifth grade math MAP test in 2014. The state average is higher than the average of respondents who indicated they taught math in a departmentalized setting. Respondents who indicated they taught math in a traditional setting had slightly lower student achievement than the state average.

MAP Scores to Demographics. The researcher examined the impact of the number of math sections taught by a teacher to the overall percentage of students scoring proficient or advanced on the MAP test. Results were analyzed using a one-way ANOVA, between groups design. This analysis revealed there was no significant difference in the sections of math taught and the percentage of students scoring advanced or proficient on the MAP test, $\underline{F}(4,85) = .559$; $\underline{p} < .693$. Therefore, there were no true differences that existed between the number of math sections taught and student achievement.

The researcher examined the impact of the number of years a teacher had taught math to the overall percentage of students scoring proficient or advanced on the MAP test. Results were analyzed using a one-way ANOVA, between groups design. This analysis revealed there was no significant difference in the number of years a teacher taught math and the percentage of students scoring advanced or proficient on the MAP test, $\underline{F}(4,85) = 1.246$; $\underline{p} < .298$. Therefore, there were no differences that existed between the number of years a teacher taught math and student achievement.

The researcher examined the impact of the teachers' educational degree to the overall percentage of students scoring proficient or advanced on the MAP test. Results were analyzed using a one-way ANOVA, between groups design. This analysis revealed there was no significant difference in the number of years a teacher taught math and the percentage of students scoring advanced or proficient on the MAP test, $\underline{F}(2,87) = 1.257$; $\underline{p} < .290$. Therefore, there were no differences that existed between the educational degree of the teacher and student achievement.

Conclusions

A majority of teachers perceived their mathematical knowledge as fairly high. Teachers who taught two and four sections of mathematics had significant differences in their perception of their mathematical knowledge than those teachers who taught one or six sections of mathematics. Teachers in departmentalized settings considered themselves as having a higher perception of mathematical knowledge than teachers who taught in a traditional setting.

Missouri Assessment Program scores of fifth grade students did not show significance between student achievement and teacher demographics or teacher perceptions. The researcher presents conclusions and recommendations in Chapter V.

CHAPTER FIVE

Conclusions, Interpretations and Recommendations

Introduction

Current legislation calls for an increase in student achievement. Therefore, districts are faced with the task of continuously improving student achievement in mathematics. With implementation of Common Core State Standards, mathematical skills are being shifted into lower grade levels. Skills which were once taught in middle school by teachers, who had degrees with a mathematics emphasis, are now being taught in fourth and fifth grades by teachers with a generalist elementary education degree. Districts need to know if additional training for teachers is needed to effectively teach fifth grade mathematics. Knowledge of how classroom organizational structures effect student achievement also must be considered. A desire to increase student achievement was the purpose the researcher conducted this study. A quantitative analysis of a region of data focused on the effects of departmentalized education and teacher knowledge on fifth grade mathematics achievement. While teacher perception of math skills showed significant differences in some areas, relationships between perceptions compared to MAP scores did not prove to be significant.

Conclusions

Number of Years Teaching Compared to Student Achievement. The researcher observed the respondents' number of years in the teaching field had no significance on fifth grade student achievement on the math MAP test. No clear difference existed in students taught by a veteran teacher or a new teacher. Many reasons may be attributed to this finding. Newer teachers may be graduates from Missouri

schools which implemented GLEs in 2004 in an attempt to increase student achievement. These new teachers may have a stronger mathematics foundation due to the standards they were taught. This foundation may be more beneficial than years of teaching experience.

Number of Math Sections Taught Compared to Perception. The researcher analyzed the data presented in Chapter IV and concluded respondents had a high level of confidence in their mathematical knowledge. This appeared to be especially true with teachers who taught two sections of math in comparison to teachers who taught one section of math. Teachers who taught two sections of fifth grade math were more favorable than teachers who taught one or six sections of fifth grade mathematics. Teachers who taught four sections of fifth grade mathematics also had a higher perception of their mathematical knowledge than teachers who taught six sections of fifth grade mathematics. The results suggest the more often a teacher teaches a subject, the more comfortable the teacher feels in his or her content knowledge. The exception to this rule is for teachers who teach six sections of fifth grade mathematics. The source of this difference may stem from teacher burnout from repetitive teaching. The researcher believes when the amount of students a teacher is responsible for teaching increases, the number of questions a teacher receives increases too. As a teacher experiences a large number of mathematical questions, he or she gains the ability to create conjectures as to why students make the mistakes they make and are able to diagnose where the student does not understand the skill. This diagnostic ability may factor into the higher confidence of math skills by teachers teaching two sections and teachers teaching four sections of math.

Number of Math Sections Taught Compared to Student Achievement. The researcher observed no clear difference existed in regard to the number of math sections taught by the respondents when compared to the fifth grade math achievement. However, the difference between perceptions of mathematical knowledge and the number of math sections taught was found to have significance. Respondents who taught more than one section of math perceived their mathematical knowledge positively; yet student achievement did not indicate differences in the number of math sections taught. When considering the findings of Ball, Hill, Bass, Lubienksi, Mewborn teachers' knowledge was one of the most influential aspects of student achievement in mathematics. Therefore, the researcher believes the respondents' perceptions are inaccurate representations of actual mathematics knowledge.

Departmentalization vs. Traditional Settings Compared to Perception. The researcher observed there was a significant difference in regards to the organizational structure of the respondents' classroom. Respondents identified as teaching in a traditional setting had a lower perception of their mathematical knowledge than respondents identified as teaching in a departmentalized setting. The researcher believes this can be attributed to the teachers' inability to take time to hone in on one subject. Instead educators in traditional settings are considered generalist and must know content in all subject areas; they are unable to focus their attention on solely mathematics (Hood,2010; Dropsey, 2004). Teachers in a departmentalized setting typically have one subject area to focus on and therefore have a higher perception of knowledge in the given content area.

Departmentalization vs. Traditional Settings Compared to Student Achievement. When analyzing the respondents' average MAP scores, students identified as being taught in a departmentalized setting compared to students identified as being taught in a traditional classroom setting fared slightly lower than the students from a traditional setting. From the respondents, the average MAP score of students from traditional settings was 52.1 percent. From the respondents, the average MAP score of students from a departmentalized setting was 50.4 percent. The state average for fifth grade math MAP scores was 52.8 percent. Both groups performed under the state average. These results indicate other regions of the state performed higher on the fifth grade math MAP test. These results may also suggest respondents' perceptions are inaccurate representations of actual mathematics knowledge since the perceptions of departmentalized classroom teachers was higher than the perceptions of traditional classroom teachers. These perceptions did not align with student achievement.

Recommendations

Perceptions vs. Actual Content Knowledge. Although the overall respondents' perceptions were high in regard to their mathematical knowledge, the researcher recommends future studies include a small content test to assess the respondents' actual mathematical knowledge. Ball, Hill, & Bass imply teacher knowledge is an important factor in student achievement (2005). The researcher believes teachers mistook their familiarity of mathematics and their actual content knowledge. Research indicates teachers who have taught math for many years or teachers who taught multiple sections have a higher self-perception of their mathematical capabilities; when in reality, these educators have become complacent in their actual knowledge and do not always see a

need to improve their mathematics instruction. Comparing MAP scores to actual knowledge as opposed to perceptions of knowledge may yield different results.

Degree Matters. Survey data indicated there was no significance in the respondents' educational degree obtained and student achievement. The study indicates the current MAP test assessed grade level expectations (GLE) as opposed to CCSS. GLEs have been taught and assessed in fifth grade since 2004. With implementation of CCSS in fifth grade classrooms in the 2014-2015 school year, the researcher believes future summative assessments will show a significant differences. When looking at the mathematics CCSS, concepts previously taught in middle school have been pushed into fifth grade with CCSS. Therefore, the researcher believes fifth grade teachers would benefit from a pre-service preparation program similar to previous middle school math preparation programs. Elementary Education majors comprised 75 percent of the respondents. This large percentage of teachers with a generalist educational background may impact student achievement in mathematics. Findings from the study indicate a possible connection related to deep content understanding between student achievement and teacher education. The researcher recommends districts aim to employ future fifth grade math teachers with a solid content knowledge in mathematics. An elementary education degree may not provide the knowledge necessary to teach fifth grade mathematics successfully.

Classroom Structure and Professional Development. Yu implied departmentalized settings allow experts of certain content areas to teach subjects they enjoy, thus creating a win-win scenario for students and teachers (2014). Hood also suggested departmentalization was cost-neutral for school districts as fewer teachers

could be sent to mathematical professional development (2010). Districts would save money not sending every fifth grade teacher; while the students would reap the reward of being taught by a teacher with additional mathematics instruction training. The survey results indicated respondents from departmentalized settings had a high regard for their mathematical knowledge. Yet the study indicated departmentalization yielded lower student achievement from students in departmentalized classrooms than students in traditional classroom settings. Researchers such as Ball, Hill and Bass stated the most influential factor for student achievement was teacher knowledge (2005). It is recommended to allow teachers to become more skilled in mathematics content understanding and pedagogy by providing professional development to all mathematics teachers. Since the findings of this research indicate students in traditional classroom settings fared better on the MAP test, the researcher recommends for school districts to consider providing mathematics instructional professional development to teachers before making any adjustments to classroom structures until more research can be completed.

Expand Scope of Respondents. In consideration of the research results and the review of relevant literature, it is recommended to expand the scope of the research to the entire state of Missouri. Expansion of the scope of research would increase the population and sample sizes of possible respondents. Since the average MAP scores of respondents were lower than the state average, the researcher believes the results may fare differently if the boundaries were expanded. By statistical analysis, it appears there is a region of Missouri where MAP scores were slightly higher than Supervisory Instructional Area Region C. The demographical information for these other regions may uncover a prevalent relationship not indicated in Region C's findings.

Summary

This chapter summarized the data and made conclusions and recommendations for future teacher assignments of fifth grade classrooms. Perception versus actual knowledge were considered and shared. Recommendations were made in regards to organizational structure of fifth grade classrooms, the educational background a fifth grade mathematics teacher should possess, and professional development plans.

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Appendix A

Pilot Survey: Informed Consent

You have been invited to be a participant in a research study on the effects of departmentalization and teacher education on student achievement. The researcher, Kelli Rogers, is a student in the Doctoral Program of Educational Leadership at Southwest Baptist University. This study aims to determine if correlations exist between teacher education and mathematics achievement and/or classroom organization and mathematics achievement of fifth grade students. Knowledge gained from this study will help districts determine best practices in regard to the structural organization of mathematics classrooms and education of the teacher of mathematics.

You were selected because your administrator identified you as a fifth grade teacher in the state of Missouri. Your participation requires completion of the following survey and is completely voluntarily, yet very much appreciated. Estimated completion time is 5- 10 minutes.

In order to address confidentiality, the researcher will assign a random number to every response as it is submitted, along with a corresponding number to the school's MAP data. It is the researcher's intention to analyze MAP scores only how they relate to teachers' educational backgrounds and organizational structure. Building names and MAP data will not be linked together in an identifiable way. The researcher foresees no risks or discomforts to the subject.

Completion of this survey indicates your understanding of the previous statements.

The researcher conducting this study is Kelli Rogers. If you have any questions, please contact Kelli Rogers at P.O. Box 96, Crane, Missouri 65633 or call 417-838-8937.

THIS PROJECT HAS BEEN REVIEWED BY THE SOUTHWEST BAPTIST UNIVERSITY RESEARCH REVIEW BOARD FOR RESEARCH AND RESEARCH-RELATED ACTIVITIES INVOLVING HUMAN SUBJECTS (417)326-1659.

1. Which district do you teach in? ___
2. Which building do you teach in? ___
3. How many 5th grade sections are in your building? ___
4. How many sections of 5th grade math do you teach? Select from a list.
5. How many sections of math (any grade) do you teach? Select from list.
6. How many years have you taught math at any grade level? Select from a list.
7. Has your school been departmentalized in 5th grade mathematics for more than one school year? Yes or No
8. What is your undergraduate degree? Select one of the following:
    a. Elementary Education
    b. Middle School Education with an emphasis in Mathematics
    c. other (please specify) _____

Below are seven statements regarding your mathematical content knowledge. Please read each one and indicate to what extent you agree or disagree.

9. Math came easy for me in school. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree

10. I consider myself as having a basic understanding of mathematics concepts.

    Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree

11. I consider myself as having a thorough understanding of mathematics concepts.

    Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree

12. I consider myself as having a poor understanding of mathematics concepts.

    Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree

13. My ability to explain mathematical reasoning to fifth grade students is high.

    Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree

14. I am comfortable with teaching mathematical concepts. Strongly Disagree,

    Disagree, No Opinion, Agree, Strongly Agree

15. I can identify where students make mathematical mistakes. Strongly Disagree,

    Disagree, No Opinion, Agree, Strongly Agree

Appendix B

Final Survey: Informed Consent

You have been invited to be a participant in a research study on the effects of departmentalization and teacher education on student achievement. The researcher, Kelli Rogers, is a student in the Doctoral Program of Educational Leadership at Southwest Baptist University. This study aims to determine if correlations exist between teacher education and mathematics achievement and/or classroom organization and mathematics achievement of fifth grade students. Knowledge gained from this study will help districts determine best practices in regard to the structural organization of mathematics classrooms and education of the teacher of mathematics.

You were selected because your administrator identified you as a fifth grade teacher in the state of Missouri. Your participation requires completion of the following survey and is completely voluntarily, yet very much appreciated. Estimated completion time is 5- 10 minutes.

In order to address confidentiality, the researcher will assign a random number to every response as it is submitted, along with a corresponding number to the school's MAP data. It is the researcher's intention to analyze MAP scores only how they relate to teachers' educational backgrounds and organizational structure. Building names and MAP data will not be linked together in an identifiable way. The researcher foresees no risks or discomforts to the subject.

Completion of this survey indicates your understanding of the previous statements.

The researcher conducting this study is Kelli Rogers. If you have any questions, please contact Kelli Rogers at P.O. Box 96, Crane, Missouri 65633 or call 417-838-8937.

THIS PROJECT HAS BEEN REVIEWED BY THE SOUTHWEST BAPTIST UNIVERSITY RESEARCH REVIEW BOARD FOR RESEARCH AND RESEARCH-RELATED ACTIVITIES INVOLVING HUMAN SUBJECTS (417)326-1659.

16. Which district do you teach in? ___
17. Which building do you teach in? ___
18. How many 5^{th} grade sections are in your building? ___
19. How many sections of 5^{th} grade math do you teach? Select from a list.
20. How many sections of math (any grade) do you teach? Select from list.
21. How many years have you taught math at any grade level? Select from a list.
22. Has your school been departmentalized in 5^{th} grade mathematics for more than one school year? Yes or No
23. What is your undergraduate degree? Select one of the following:
    a. Elementary Education
    b. Middle School Education with an emphasis in Mathematics
    c. other (please specify) _____

Below are seven statements regarding your mathematical content knowledge. Please read each one and indicate to what extent you agree or disagree.

24. Math came easy for me in school. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree

25. I consider myself as having no more than a basic understanding of mathematics concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree
26. I consider myself as having a thorough understanding of mathematics concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree
27. I consider myself as having a poor understanding of mathematics concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree
28. My ability to explain mathematical reasoning to fifth grade students is high. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree
29. I am comfortable with teaching mathematical concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree
30. I can identify where students make mathematical mistakes. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree

Appendix C

From: Kelli Rogers
Sent: Friday, May 02, 2014 4:31 PM
To: Leslie Sallee; Kathryn Martin; LaDonna Hunt; Monica Andrews; Suzie Ringgold; Connie Hunt; Peggy Braddock
Subject: I need your expert opinions!

Hello Ladies!

Some of you may know I am currently working on my dissertation. The topic is the effects of departmentalization and teacher education on 5th grade students' math achievement. I will soon be sending a survey out to 5th grade math teachers. Before I do so, I am checking to see if the questions I am asking will actually help me determine the mathematical knowledge of the teacher. Since you ladies are math experts, I wanted to get your opinion! I would love if you would be willing to go through the next 8 questions and determine if the response received from the question might help me determine the responding teacher's level of mathematical understanding. If you think the response from the question would help me have an understanding, then rate it 1. If you don't think the answer would help me understand their mathematical knowledge, then rate it a 0. Thanks so much! Also, as a little incentive, please tell me your favorite Sonic drink…I will surprise you at least once with it before the end of the school year!

Question	Rate (Please type 1 or 0)
1. Math came easy for me in school. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	
2. I consider myself as having a basic understanding of mathematics concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	
3. I consider myself as having a thorough understanding of mathematics concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	

4. I consider myself as having a poor understanding of mathematics concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	
5. Mathematics comes naturally to me. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	
6. My ability to explain to explain mathematical reasoning to fifth grade students is high. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	
7. I am comfortable with teaching mathematical concepts. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	
8. I can identify where students make mathematical mistakes. Strongly Disagree, Disagree, No Opinion, Agree, Strongly Agree	

Kelli Rogers Ed.S.
Asst. Principal- Espy Elementary
Asst. Principal- High Pointe Elementary
Nixa, Missouri 65714

Too blessed to be stressed!