THE EFFECTS OF MATH LAB ON STUDENT MATHEMATICAL GROWTH IN THREE SUBURBAN MISSOURI MIDDLE SCHOOLS

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ABSTRACT

The setting for this study was a Midwest suburban school district (District A) outside of Kansas City. The population was the seventh and eighth grade students in District A. The purpose of this study was to determine if a difference exists in mathematical growth, as measured by a difference in scale score on the mathematics portion of the Missouri Assessment Program among students who enrolled in Math Lab zero, one, two, three, or four semesters. The second purpose of this study was to determine if the difference in mathematical growth, as measured by the change in scale score, was affected by ethnicity. Additionally, the purpose was to determine if the difference in mathematical growth was affected gender. The dependant variable in this quasi-experimental quantitative study was mathematical growth as measured by the difference in scale score from sixth to eighth grade. The independent variables in the study were number of semesters enrolled in Math Lab, gender, and ethnicity.

The test conducted for the first research question revealed the main effect for enrollment was significant, indicating that students enrolled in Math Lab three semesters had significantly more growth than students enrolled one semester. The test conducted for the second research question revealed the interaction effect for enrollment by ethnicity was not significant, indicating that ethnicity does not affect the mathematical growth among students enrolled in Math Lab zero, one, two, three, or four semesters. The third research question considered the interaction effect for enrollment by gender. The results of the analysis of the interaction for enrollment by gender was not significant, demonstrating that gender does not affect the mathematical growth among students enrolled in Math Lab zero, one, two, three, or four semesters.

Recommendations for further research include replicating the study and add a qualitative component to create a mixed methods research design. The second recommendation is to replicate the study using additional dependent variables such as grade point average (GPA), mathematics course grade, or high school end of course assessments. The third recommendation is to replicate the study at the high school level in District A. A fourth recommendation is to conduct the study using a longitudinal design.

DEDICATION

This dissertation is dedicated to my loving and supportive family who stood by me every step of this journey. Your hugs, smiles, snuggles, and happy thoughts carried me through the many nights I had to be away from you. I am so grateful that God has given me such precious gifts. I love you, forever and ever.

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CHAPTER ONE

INTRODUCTION AND RATIONALE

As students progress from pre-kindergarten to eighth grade, they should become increasingly proficient in mathematics. Proficiency should enable them to cope with the mathematical challenges of daily life and to continue their study of mathematics in high school and beyond (Kilpatrick, Swafford, & Bradford, 2001). Unfortunately, this is not the case for all students. According to the 2000 National Assessment of Educational Progress (NAEP), only 27% of eighth-graders performed at proficient levels in mathematics (NAEP, 2001). The results of the 2009 NAEP indicated improvements in national eighth grade mathematics scores with 34% of eighth grade students performing at proficient levels (NAEP, 2009). Although there was a 7% improvement from 2001 to 2009, 66% of eighth-graders are still not proficient.

Because schools are accountable for achieving the goals set forth in No Child Left Behind (NCLB), urgency exists for schools to implement support programs designed to move students toward proficiency. Signed into law in 2002, NCLB requires statewide assessments based on challenging state standards. Tracking adequate yearly progress (AYP) is part of the NCLB mandate that requires student achievement to be monitored yearly. The goal of NCLB is for all students to reach academic proficiency by 2014 (USDE, 2004a). As stated in the 2008 U.S. Department of Education, Stronger Accountability Report-Progress by Our Schools, "NCLB spurred a nationwide accountability movement" (p.2).

Problem Statement

Research has been conducted related to math support programs and student mathematics growth. Support programs studied include co-teaching (Andrews-Tabo, 2009), after-school tutoring (Roukema, 2005), summer school (Haymon, 2009), specialized instruction (Mahoney, 2008), teacher-student mentoring (J. Johnson, 2008), computer-aided instruction (Odom, 2006), learning focused school implementation (Hickey, 2006), and supplemental/remedial math (Maxwell, 2010). The results of the studies have been mixed regarding the effect of various support programs on students' mathematical growth. Five of the eight studies found no significant difference in math scores. Data from studies related to specialized instruction, teacher-student mentor program, and computer-aided instruction revealed a statistically significant improvement in the mathematics achievement for students involved.

While multiple mathematics support programs have been studied, very little research exists related to dual enrollment in grade-level mathematics and a mathematics support program at the middle school level. District A, a suburban school district southeast of Kansas City, Missouri, implemented this type of program during the 2005 - 2006 school year. The purpose of the Math Lab program was to provide support to students who had previously been enrolled in below-grade-level mathematics. Now that these students were being held accountable for grade-level mathematics, District A recognized the need to provide support for them within the school day. The Math Lab program has evolved over six years; however, District A has not studied the effectiveness of the program.

Background and Conceptual Framework

District A was reorganized in 1949 when 16 rural elementary districts combined with a surrounding school district to serve about 1,200 students (District A, 2010). By 2009, District A educated over 17,000 students per year. District students are served by three high schools, grades 9 - 12; three middle schools, grades 7 and 8; and 18 elementary schools, grades K - 6. This study focused on students enrolled in the three middle schools, which for the purposes of this study are referred to as School 1, School 2, and School 3. Middle school enrollment data from the 2005 - 2006 school year to the 2009 - 2010 school year are presented in Table 1.

Table 1

District A September Enrollment Data by Middle School and Gender

		05 - 06	06 - 07	07 - 08	08 - 09	09 – 10
School 1		984	932	955	999	957
	Male	514	466	457	506	483
	Female	470	466	498	493	474
School 2		930	892	858	871	898
	Male	499	438	395	429	455
	Female	431	454	463	442	443
School 3		763	843	834	830	852
	Male	376	425	430	411	438
	Female	387	418	404	419	414
Total Middle School		2,677	2,667	2,647	2,700	2,707

Note. Adapted from September PowerSchool Enrollment Summary for District A from 2005 - 2009. Retrieved on October 11, 2010.

From 2005 to 2009, District A enrollment increased by 873 students, which included 30 middle schools students. Male enrollment at the middle schools in District A decreased 1% from 2005 to 2009, while female enrollment increased by 3%. District A has gained an average of 181 students per year since 2005, with enrollment for 2009 - 10 reaching 17,319. The demographics of the district are slowly changing. As shown in Table 2, the student body is gradually becoming more diverse.

Table 2

District A September Enrollment Data by Race 2005 - 2009

		2005	2006	2007	2008	2009
Asian	Number	363	352	371	375	395
	Percent	2.2	2.0	2.1	2.2	2.2
Black	Number	1,680	1,837	1,977	2,144	2,153
	Percent	10.2	10.9	11.6	12.4	12.4
Hispanic	Number	553	533	647	666	703
	Percent	3.4	3.6	3.8	3.9	4.1
NA/AN*	Number	45	34	64	71	73
	Percent	0.3	0.3	0.4	0.4	0.4
White	Number	13,805	13,911	13,976	13,978	13,995
	Percent	84.0	83.1	82.0	81.1	80.7
Total Enrollment		16,446	16,667	17,035	17,234	17,319

Note. Adapted from September PowerSchool Enrollment Summary for District A from 2005 - 2009. Retrieved on October 11, 2010.

*NA/AN= Native American/Alaskan Native

District A showed a 3.3% increase in the minority population from 2005 to 2009, with the greatest increase in the Black subgroup. According to PowerSchool September 2010 enrollment data, the percent of Black students increased from 10.2% in 2005 - 06, to 12.4 % in 2009 - 10. Additionally, the federal free/reduced lunch rate has increased from 11.1% in 2005 - 06 to 15.6% in 2009 - 10.

Beyond the expectations set forth under NCLB, District A continues to increase efforts to meet the needs of each student. As stated in the 2005 - 2010 Comprehensive School Improvement Plan (CSIP), District A is dedicated to offering the necessary support (District A, 2006). Therefore, between the 2004 - 2005 and 2005 - 2006 school years, the structure of the middle school mathematics program changed. Table 3 outlines the mathematics course offerings in the 2004 - 2005 and 2005 - 2010 school years. During the 2004 - 2005 school year, students had three mathematics course options: below grade-level, grade-level, or advanced math. During the 2005 - 2010 school years, only grade-level math and advanced math were offered. Students who did not qualify for advanced mathematics were placed in a grade-level mathematics course with the objective of mastering the Missouri Grade-Level Expectations. Identified students, in need of additional math support, would be dually enrolled in a grade-level mathematics course and Math Lab (District A, 2005a).

Table 3

District A Middle School Mathematics Course Offerings

	2004 – 2005	2005 – 2010
7th Grade	Pre-transition (below GL*)	7th grade math (GL) & Math Lab (support class)
	7th grade math (GL)	7th grade math (GL)
	Pre-Algebra (above GL)	Pre-Algebra (above GL)
8th Grade	Transition Math (below GL)	8th grade math (GL) & Math Lab (support class)
	8th grade math (GL)	8th grade math (GL)
	Algebra (advanced)	Algebra (advanced)

Note. Adapted from 2004 - 2005 Middle School Program of Study for District A and each subsequent year until 2010.

*GL -Grade-level

In May 2005, district officials and the Math Lab teachers met to determine the necessary supplies needed for Math Lab and to preview the technology that would be utilized in the program the following fall. The minutes of this meeting detailed the purpose of the support class implemented in District A. The purpose of the Math Lab class was to provide identified students who struggle with mathematics an additional 48 minutes of daily math support. The daily support class was developed to assist the students, who previously would have been enrolled in the below grade-level course, with the new expectation of mastering grade-level mathematics (District A, 2005b). Dually enrolling an identified struggling math student in grade-level math and a math support program provides the help needed to improve mathematical skills and increase confidence (Berkas & Pattison, 2006; Fratt, 2006; Parrett, 2005). "Providing more time for learning is especially crucial for helping at-risk students" (Woelfel, 2005, p. 28).

The district addresses three goals with the implementation of Math Lab. First, Math Lab provides an opportunity for on-grade-level math skills to be previewed, creating an increase in student confidence when the skills are taught in the 'regular' on-grade-level math class (District A, 2005b). Previewing is a key component of Math Lab. A few days before the 'regular' on grade-level math instructor teaches a lesson, the Math Lab teacher previews the lesson. The Math Lab teacher focuses on activities related to the operational vocabulary needed for each lesson. Thompson et al. (2002) viewed previewing as a form of acceleration. Instead of re-teaching what students did not master, it accelerates their knowledge by previewing concepts in small chunks before learning for mastery.

The second goal addressed in Math Lab is to identify individual student's mathematical strengths and weaknesses in order to strengthen each student's mathematical foundation. Minutes from the May 2005 Math Lab teachers' meeting in District A indicate a mathematics skills test is administered to Math Lab students to identify skill gaps. Based on the results of the skills test, students are assigned work related to their identified areas of need.

The third goal addressed in Math Lab is for students to improve basic skills and fact fluency. Fact fluency would have previously been a focus in the below grade-level courses (District A, 2005b). Fact fluency strengthens students' mathematical foundation.

May 2005 Math Lab teachers' meeting minutes also provide a framework for student selection and class size. Struggling math students are identified for Math Lab based on sixth grade district mathematics common assessment scores, Missouri Assessment Program (MAP) mathematics scores, fact fluency, and teacher recommendation. Generally speaking, students recommended for Math Lab complete all daily work but earn a D or lower, maintain consistent attendance, lack a variety of math skills and strategies, ask questions, and participate in class (yet still struggle), and work well in a small group setting. Normally, special education students are not enrolled in Math Lab as they are provided additional services through their individualized education programs (District A, 2005b).

Also discussed at the May 2005 Math Lab teachers' meeting was the Math Lab exit criteria. A student may be considered for release from Math Lab if they meet the majority of the established criteria. The criteria include: students must master the concepts on the Math Lab Skills Tests, demonstrate fact fluency, achieve appropriate gains on the individualized computer program, maintain an average or above average math grade, and have approval from the Math Lab teacher, math class teacher, and the parent (District A, 2005b).

A 10:1 student-to-teacher ratio has been established for Math Lab classes (District A, 2005b). This low student-to-teacher ratio affords students an opportunity to work in a smaller class setting to practice and acquire strategies needed to overcome academic obstacles. Marzano (2003) and Reeves (2006) both support the importance of smaller class sizes that provide an emotionally safe environment for struggling students. With a smaller number of students, it was easier for teachers to create an approachable relationship with students, encourage them, and boost their confidence (Marzano, Pickering, and Pollock, 2001).

Information provided from a guidance counselor in District A indicates students may be enrolled in a middle school Math Lab for one, two, three, or four semesters. The counselor also shared the number of semesters a student is enrolled in Math Lab varies based on a student's academic needs or scheduling. She pointed out a student may be removed from Math Lab to take a required health course, enroll in a reading lab, or enroll in a learning lab. Additionally, a student may opt out of the Math Lab support at any time with parental permission (personal communication, January 5, 2011).

According to the Math Lab teachers' meeting minutes from May 2009, program modifications have occurred. As the district mathematics curriculum has been modified, the skills addressed on the skills test have been adapted to support the curriculum modifications. The skills test has been revised and renamed Math Lab Skills Test. The skills tests have been designed to identify the prerequisite skills the students were lacking. The second programming change is related to software. After three years of use, the initially adopted software was no longer meeting program expectations and has been replaced by a different software program (District A, 2009).

Significance

As reported in board documents for District A, $9.1 million in cost containment occurred in the 2009 - 2010 school year. District A anticipated additional cost containment of $2.1 million in 2010 - 11 (2010). Districts must make tough programming decisions when facing such cost containments. Therefore, districts are taking a closer look to determine which programs to modify or possibly eliminate.

Math Lab is an example of an additional support program that provides an additional period of math during the school day for identified students. Research related to double periods of math, in the middle school, as a type of math support program appears to be limited. Thus, the study will add to the body of research on this type of math support program. These programs are expensive due to the low pupil-teacher ratio. No previous research has been conducted in District A regarding the effects enrollment in a middle school math support program has on a student's mathematics growth. The findings from this study could provide facts to facilitate informed decision-making for District A and provide valuable information for schools considering a similar program.

Purpose Statement

The purpose of this study was to determine if a difference exists in mathematical growth, as measured by a difference in scale score on the mathematics portion of the MAP, among students who enrolled in Math Lab zero, one, two, three, or four semesters. The second purpose of this study was to determine if the difference in mathematical growth, as measured by the change in scale score, is affected by ethnicity. The third purpose of the study was to determine if the difference in mathematical growth, as measured by the change in scale score, is affected by gender.

Delimitations

According to Lunenburg and Irby (2008), delimitations are self-imposed boundaries set by the researcher on the purpose and scope of the study. This study was limited to the middle schools in one suburban Missouri school district. The mathematics achievement data was limited to MAP mathematics scale scores. Only students who had MAP mathematics scores for sixth, seventh, and eighth grade were included in the study. Data from the sixth year of the Math Lab program was not available at the time the research was conducted; therefore, the researcher used data from five of the six years

Math Lab was implemented. These delimitations may affect the ability to generalize the findings beyond the suburban school district in this study.

Assumptions

Assumptions are what the researcher takes for granted relative to a study (Roberts, 2004). This study included the following assumptions:

1. Each student gave his/her best effort on the mathematics portion of the MAP.
2. All district data retrieved for this study was accurate.
3. All data entered into Excel and the IBM SPSS Statistics 18.0 Faculty Pack for Windows was accurate.
4. All teachers were trained to follow the course curriculum and utilize district adopted software according to established guidelines.
5. Teacher effectiveness is equal in areas of communication, classroom management, organization, and implementation of the Math Lab program.

Research Questions

Lunenburg and Irby (2008) refer to the research questions as the "directional beam for the study" (p. 126). The following questions guided this study.

1. Is there a difference among students who enrolled in Math Lab zero, one, two, three, or four semesters in mathematical growth, as measured by a difference between the sixth and eighth grade scale score on the mathematics portion of the MAP?
2. Is the difference in mathematical growth, as measured by the change in scale score, affected by ethnicity?

3. Is the difference in mathematical growth, as measured by the change in scale score, affected by gender?

Definition of Terms

This section of the study lists terms used that do not have a common meaning or that may be easily misunderstood (Roberts, 2004). The following terms are referenced throughout this study.

Adequate Yearly Progress (AYP). The Missouri Department of Elementary and Secondary Education established Missouri's AYP targets based on a formula from the NCLB Act and an analysis of Missouri Assessment Program (MAP) data, attendance rate data, and graduation rate data from prior years. When all targets are met, the requirements of AYP are met (DESE, 2005).

Ethnicity. A particular ethnic affiliation or group (Merriam-Webster Online Dictionary, 2009). For the purposes of the study, the ethnic groups were identified as minority (Asian, Black, Hispanic, and Native American/Alaskan Native) and non-minority (White).

Mathematical growth. For the purposes of this study, mathematical growth is defined as the difference in a student's scale score from sixth grade to eighth grade on the mathematics portion of the Missouri Assessment Program.

Missouri Assessment Program (MAP). The Missouri Assessment Program (MAP) is one of several educational reforms mandated by the Outstanding Schools Act of 1993. As a result of this legislation, the State Board of Education directed the Missouri Department of Elementary and Secondary Education (DESE) to identify the knowledge, skills, and competencies that Missouri students should acquire by the time they complete high school and to assess student progress toward these academic standards. DESE staff worked with educators, parents, and business professionals throughout the state to develop the Show Me Standards and to create the MAP as a tool for evaluating the proficiencies represented by the Standards (DESE, 2000).

MAP Scale Score. CTB/McGraw-Hill uses the students' correct responses and points earned to derive a MAP Scale Score. The overall scale score for a content area quantifies the achievement being measured by the mathematics. In other words, the scale score represents the students' level of achievement, where higher scale scores indicate higher levels of achievement on the test and lower scale scores indicate the lower levels of achievement. The scale score describes achievement on a continuum that in most cases spans the complete range of Grades 3 - 8. These scores range in value from 450 to 910, across grade-levels and content areas (DESE, 2000).

Math LABS - Learning and Building Skills. Math LABS is the name of the mathematics support program at the targeted middle schools. At the targeted middle schools, Math LABS are referred to as Math Lab (District A, 2005b).

No Child Left Behind (NCLB). Signed into law by President Bush in January 2002, The No Child Left Behind Act reauthorized the existing Elementary and Secondary Education Act (ESEA). The Act includes significant new accountability measures for all public schools. It is based on the goal that *ALL* children will be proficient in reading and math by 2014. By 2006, all states had to develop new tests in reading and math for grades 3 - 8, plus one grade-level in high school, to measure students' academic progress. The law requires that all children be taught by "highly qualified" teachers. The law also emphasizes improving communication with parents and making all schools safer for students (DESE, 2009).

PowerSchool. This is a web-based student information system. District A utilizes the PowerSchool student information system (PowerSchool, version 6.1).

Overview of Methodology

Johnson and Christensen (2008) define a quasi-experimental research design as an experimental research design that does not provide for full control of potential confounding variables primarily because it does not randomly assign participants to comparison groups. This quasi-experimental quantitative study involved three middle schools (grades 7 and 8) in District A. The researcher utilized student data from sixth, seventh, and eighth grade for three cohorts of students from 2005 through 2010. Archived data from the PowerSchool Student Information System in District A was used for the study (PowerSchool, version 6.1). MAP mathematics scale scores for sixth, seventh, and eighth grade; number of semesters enrolled in Math Lab; gender; and ethnicity were collected for students who enrolled in Math Lab zero, one, two, three, or four semesters.

A computer technologist for District A organized the data into an Excel spreadsheet. Data was coded by the technologist to maintain student privacy and building anonymity. The researcher exported the data into IBM SPSS Statistics 18.0 Faculty Pack for Windows Data for analysis.

Two two-factor ANOVAs were used to test the three hypotheses that address the research questions. The first two-factor ANOVA was utilized to determine the main effect for the number of semesters of enrollment, the main effect for ethnicity, and the interaction effect for number of semesters of enrollment by ethnicity. The main effect for number of semesters of enrollment addressed research question one and the interaction effect for enrollment by ethnicity addressed research question two. A second two-factor ANOVA was utilized to determine the interaction effect for level of enrollment by gender. The interaction effect for enrollment by gender was used to address research question three.

Summary and Organization of the Study

Chapter one included an introduction to the study, the problem statement, and background information of District A. The significance, purpose statement, delimitations, and assumptions of the study were provided. The research questions and definitions of terms were identified. The final part of chapter one was a brief overview of the methodology. Chapter two presents a review of the literature that provides an overview of NCLB and MAP. Minorities and mathematical achievement and mathematical achievement related to gender are examined. Finally, chapter two summarizes information connected to intervention programs utilized to increase mathematics achievement. Chapter three provides the research design, population and sample, sampling procedures, instrumentation, validity and reliability, data collection procedures, statistical analysis, hypothesis testing, and concludes with limitations as related to this study. Chapter four presents the descriptive statistics, results of the hypothesis testing, and additional analyses when appropriate. Finally, chapter five focuses on the findings related to the literature, conclusions, implications for action, and recommendations for future research.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

Since the passage of NCLB, schools have increased efforts aimed at improving the success of students. The NCLB Act of 2001 required schools to "develop comprehensive school reforms, based upon basic academics and parental involvement so that all children can meet challenging state academic content and academic achievement standards" (USDE, 2003, p.13). Federally mandated reforms forced school districts to evaluate current programs and determine how to abide by federal guidelines and ensure the best possible education for all students.

This chapter presents the literature relevant to middle school math intervention programs and mathematics achievement and is divided into five sections. First, an overview of NCLB and the impact NCLB has on state assessments is provided. Second, pertinent information regarding the Missouri Assessment Program (MAP) and Adequate Yearly Progress (AYP) is presented. Third, minorities and mathematics achievement is addressed. Fourth, gender and mathematics achievement is investigated. Finally, an analysis of studies conducted that focus on math intervention programs implemented to meet the requirements of NCLB and improve student's mathematical achievement is included.

Study results have varied, but the overall message is the same in all the studies. School districts are working to develop programs to assist students who are struggling to reach proficiency. In *Adding it up*: *Helping Children Learn Mathematics*, Kilpatrick, Swafford, and Bradford (2001) note, "Mathematical proficiency for all cannot be achieved through piecemeal or isolated efforts. All interested parties - including parents and caregivers, teachers, administrators, and policy makers - must work together to improve school mathematics" (p. 1).

Overview of No Child Left Behind (NCLB)

The purpose of Public Law 107 - 110, NCLB Act of 2001, was "to ensure that all children have fair, equal, and significant opportunity to obtain a high-quality education and reach, at the minimum, proficiency on challenging state academic standards and state assessments" (USDE, 2004b, Sec. 1001). "NCLB made the most sweeping changes in federal law regarding public schools in nearly 40 years" (DESE, 2005, p. 1). Accountability, student achievement, proficiency, and raised expectations are all terms educators have used to summarize NCLB. The United States Department of Education (USDE) (2004a) identified four pillars of the federal mandate: "(a) stronger accountability for results, (b) increased flexibility and local control, (c) expanded options for parents, and (d) an emphasis on teaching methods that have been proven to work" (p. 7). The USDE (2004a) indicated NCLB created, "a culture of accountability, requiring schools to reassess what they are doing to raise achievement of all students and support teaching and learning" (p.6).

Guilfoyle (2006) identified NCLB as the newest iteration of the decades-old education law, the Elementary and Secondary Education Act (ESEA). As noted in the timeline created by Guilfoyle (2006), in 1965, ESEA was enacted to provide monetary assistance to schools for low-income students. Three years later, Congress added Bilingual Education to the ESEA. In 1978, ESEA allowed Title I money to be spent school-wide if 75% of the students are considered low-income. Ten years later, ESEA required the assessment of a district to be done using standardized tests scores. In 1994, ESEA was reauthorized as the Improving America's Schools Act. The reauthorization mandated states to pinpoint schools that were not achieving adequate yearly progress (Guilfoyle, 2006). His timeline continues with President George W. Bush signing No Child Left Behind into law in 2002. The first year of NCLB accountability began with baseline test scores from the 2001 - 2002 school year. During the 2002 - 2003 school year, NCLB required reading and math assessments to be given once in third through fifth grade, sixth grade through ninth grade, and tenth grade through twelfth grade. In the 2005 - 2006 school year, NCLB required districts to administer reading and mathematics test annually in grades 3 - 8 and once in grades 10 - 12 (Guilfoyle, 2006).

The USDE (2004a) stated in the publication, *NCLB, Tool Kit for Teachers,* that in addition to an increased number of students reaching academic proficiency, improved parent access to student, district, and state assessment data are also part of NCLB law, known as the Parents' Right to Know. Parents were provided with data that details their child's academic strengths and weaknesses in each tested area. Parents can access general information regarding the progress of their state and district by accessing the school report card. "The report cards must state student performance in terms of three levels: basic, proficient and advanced. Achievement data must be disaggregated, or broken out, by student subgroups according to: race, ethnicity, gender, English language proficiency, migrant status, disability status and low-income status. The report cards must indicate which schools have been identified as needing improvement, corrective action or restructuring" (USDE, 2004a, p. 7). NCLB requires school districts to provide parents the information regarding the schools their children attend in a timely manner. In most states, parents can access the school report cards online for all schools.

As stated in *NCLB Toolkit for Teachers* (USDE, 2004a), NCLB allows states to establish their own standards and assessments in order to achieve the goal of all students proficient by 2014. States had flexible guidelines to follow as standards and high-quality assessments were designed. The assessment results were used by districts and schools to measure students' growth related to the standards. The yearly assessments supply educators with significant data outlining each student's strengths and weaknesses in the assessed areas. Provided with assessment data, teachers can design lessons to address the needs of each student. The data is also beneficial for building principals to determine where the school should invest resources (USDE, 2004a).

In March 2010 President Obama signed into law an update to NCLB titled *A Blueprint for Reform: The Reauthorization of Elementary and Secondary Education Act.* In the preface of this document, the President states, "Every child in America deserves a world-class education" (USDE, 2010, p.1). Math is fundamental part of a world class education.

The 2010 Reauthorization of the Elementary and Secondary Act extends the NCLB framework. The extended framework requires, "equity and opportunities for all students with rigorous and fair accountability for all levels, meeting the needs of diverse learners, and greater equity" (USDE, 2010, p. 3). President Obama stated, "We must raise the expectations for our students, for our schools, and for ourselves - this must be a national priority" (USDE, 2010, p.1). The extended framework also requires, "promoting innovation and continuous improvement by fostering innovation and accelerating success, supporting, recognizing, and rewarding local innovations, and supporting student success "(USDE, 2010, p. 3).

Overview of Missouri Assessment Program (MAP)

In order to be eligible for federal funds under NCLB, states were required by USDE to set standards and enforce them (USDE, 2004a). The standards are viewed as the "state's assurance" that students are being educated. The Missouri Assessment Program (MAP) is the assurance created by the Missouri Department of Elementary and Secondary Education (DESE). MAP is considered a standardized assessment. The USDE defines "standardized assessments as professionally developed tests administered under standard conditions, producing scores that can be used to evaluate programs or children" (USDE, 2004a, p. 22).

In the *Guide to Interpreting Results*, DESE (2007) indicates MAP is one of several educational reforms mandated by the Outstanding Schools Act of 1993. "The mandates of the Outstanding Schools Act guided the State Board of Education to direct the Missouri Department of Elementary and Secondary Education to identify the skills, knowledge, and competencies that Missouri students should acquire by the time high school is completed" (DESE, 1998, p. 4). The department was also assigned the duty of determining how to evaluate students' progress in achieving the established academic standards. In order to complete these tasks, DESE assembled teachers, administrators, parents, and business professionals from across the state to develop the Show-Me Standards/GLE Strands and the assessment system to evaluate students' proficiencies.

The Show-Me Standards and Framework for Curriculum Development were adopted by Missouri State Board of Education in 1996 with the MAP being administered for the first time in 1998. The grade-span assessments developed to measure Missouri's Show-Me Standards were administered first in Mathematics to grades 4, 8, and 10. In 2004, DESE published the Grade-Level Expectations (GLE's) to more clearly identify what is expected of students at each grade-level (DESE, 2009). However in 2005, the grade-span assessments were administered for a final time (DESE, 2009). In 2006, the mathematics grade-level MAP was administered in grades 3 - 8 and in high school. Over time, the Show-Me Standards were refined to delineate content standards, process standards, and content strands in order to comply with the requirements of NCLB. DESE continued to update the Grade-Level Expectations with Version 2.0 being released in 2008. The last operational administration of the MAP based on Version 1.0 GLE's was administered in 2009 (DESE, 2009).

DESE implemented multiple changes over the years in order to increase efforts to meet NCLB requirements. However, the Show-Me Standards, the Frameworks for Curriculum Development, and the GLE's, each continue to keep the same goal in mind. The goal is to help all students learn and achieve to their highest potential. Each addresses what children should know and be able to do by the time they graduate from high school. They also ensure that all children are learning similar content at the appropriate grade-levels.

Adequate Yearly Progress (AYP)

Required by NCLB, annual proficiency targets were established for all students and student subgroups to determine if they were making adequate yearly progress. The annual proficiency targets were progressive in nature in order for all students to achieve the established goal of proficiency by 2014, as measured by the state assessment. The

Missouri Department of Elementary and Secondary Education (2005) described Adequate Yearly Progress (AYP) as one of the most complicated but essential elements of NCLB. "A school district must have enough students scoring proficient or above to meet or exceed the Annual Proficiency Target. A school or district must meet AYP in aggregate and for up to nine subgroups of students. A school or district's performance in relation to AYP is determined by looking at the percent of students who score in the top two levels" (DESE, 2010, p.4). A school may also utilize the growth model calculations to determine if AYP has been met. Appendix A provides further details regarding the requirements to meet AYP.

A school not meeting the AYP requirements must first develop a two-year improvement plan. A school not meeting AYP for two consecutive years is considered a school in need of improvement. These schools must provide the school transfer option that entitles students to transfer to another school within the district that did make AYP. For schools in this situation, resources must be provided by districts and states to aid schools in making necessary changes to improve. Appendix B outlines the NCLB Required Actions for Schools In Need of Improvement.

The federal, state, and district levels have requirements set forth by NCLB. NCLB established requirements for a state's definition of AYP, required subgroup accountability, and set the goal of 100% proficiency for all students including subgroup students by 2014. States create their own reading and math assessments. States monitor participation rates and at least one other academic indicator to determine AYP. States use the assessment data to determine yearly benchmarks in order to reach the 100% proficiency goal by 2014. States manage districts' actions and provide assistance for districts in need of improvement. Districts must provide data to the state regarding performance on all indicators. Districts analyze the assessment data to determine achievement gaps and to make informed decisions. At the school level, educators use assessment data, participation rates, and other indicators to improve student achievement (DESE, 2009).

Growth Model

In a 2008 memorandum, school administrators were notified of Missouri's approval, by the U.S. Department of Education, to implement a growth model for use in determining Adequate Yearly Progress (AYP). Missouri's AYP growth model "provides an additional opportunity for districts and schools to meet AYP by incorporating methods of measuring individual student growth over time" (B. Odneal, personal communication, June 26, 2008). The 2008 memorandum included the following pertinent information:

> "Missouri will first calculate AYP using the current status model to determine the percent of students that are proficient. The growth model calculations will be applied to provide an additional opportunity for schools and district to make AYP. The first time a student is assessed on a MAP assessment in either Mathematics or Communication Arts, individual growth targets will be established to determine if each student is Proficient or "on Track to be Proficient" (On Track) within four years or by grade 8."

The growth model "tracks the achievement of an individual student compared with the student's established growth target" (DESE, 2008, p. 2). The model serves as a valuable tool for schools and districts to meet AYP by allowing the schools and districts an opportunity to earn credit for students who exhibit growth over time

Minorities and Mathematics Achievement

"Minority students represent the most rapidly growing part of the school-age population. Differing birth rates, immigration patterns, and age distributions among population subgroups suggest that by 2030, the elementary population could be divided equally between white children and children of all other racial and ethnic groups combined (Hodgkinson, 1992). NCLB requires states to report state assessment scores of various racial/ethnic subgroups. This requirement highlights the differences in achievement within the minority subgroups. Additionally, it provides a comparison between minority and non-minority student achievement. Results of the 2003 National Assessment of Educational Progress (NAEP) indicate racial/ethnic subgroups have shown improvement since the 1990. The NAEP scores show that White students and Asian/Pacific Islander students continue to outperform Black, Hispanic, and American Indian/Alaskan native students at every grade-level (National Center for Education Statistics, 2003).

The National Council of Teachers of Mathematics (NCTM, 2000) suggests six principles to overcome racial inequities in mathematics instruction. The principles include high standards for all students, teachers who understand what students need to learn and then challenge and support them, a coherent curriculum of important mathematics, articulated across grade-levels, instruction that builds new knowledge from experience and prior knowledge, assessment that supports learning and provides useful information to both teachers and students, and technology that influences the mathematics taught and enhances student learning (NCTM, 2000).

A March 2010 report released by the Center on Education Policy (CEP) provided pertinent details related to the slow and uneven progress in narrowing the achievement gap. The analysis looked at trends on state tests from 2002 through 2009 at grades 4, 8, and the high school grade tested for NCLB. Even though every major group had made gains on state math tests and achievement had increased, the gaps have not always narrowed. For this study, CEP identified achievement as the percentages of students scoring proficient on state tests and average (mean) test scores (CEP, 2010). Although in math most subgroups typically performed lower than White students, the Asian students outperformed White students in most states. "In many states, the gaps in percentages proficient between Black and White students and between Native American and White students amounted to 20 or 30 percentage points" (CEP, 2010, p. 4). From 2002 - 2009, in grade 8 math, the gap between Black and White students in mean scores on state tests narrowed in 74% of the 27 states with sufficient data and widened in 15 % of these states. During the same time, in grade 8 math, the gap between Latino and White students in mean score on state tests narrowed in 76% of the 29 states with sufficient data and widened in 17% (CEP, 2010).

Factors that influence eighth grade Black and White students' mathematics scores on the MAP were investigated by Grana (2010). When comparing the mean MAP scores of Black students to White students, residing and attending an urban St. Louis school, Grana found the mean score for the Black students to be 22.92 points lower than the White students. He also found an even greater gap of 31.4 points in the results when comparing the MAP scores of Black students to White students residing and attending suburban St. Louis schools. Grana further researched how to reduce the Black-White achievement gap by analyzing the effects of teachers, community, and family. His findings revealed the effects of school, including the characteristic of the teacher, do influence student achievement, specifically the achievement of Black students more so than White students. His research on family and community effects on the achievement gap focuses on the importance of these groups and their roles in affecting the achievement gap (Grana, 2010).

Gender and Mathematics Achievement

Although NCLB does not require schools and districts to be accountable for making AYP for male and female subgroups in the same manner it does for racial/ethnic and other subgroups, the act does requires states and districts to disaggregate and publish results based on gender. Disaggregating and publicizing the male and female results indicate a continued concern related to monitoring and addressing the gender achievement gap.

In 2001, Casey, Nuttall, and Pezaris studied the mathematical differences in gender groups. In order to determine whether spatial-mechanical aptitude and self-confidence were a variable of gender differences among middle school students, 187 eighth grade students from a middle-income suburban school were tested. The purpose of the test was to determine the students' levels of academic self-confidence, spatial-mechanical skills, and performance on a gender-based mathematics sub-test. The 15 question gender-based mathematics sub-test was constructed of released items from Third International Mathematics and Science Study (TIMSS) assessment. The results of the male sub-test indicated better spatial-mechanical skills of males compared to females and increased self-confidence of males while performing math problems. The results of the female sub-test showed that the advantages that females had in mathematical skills were counterbalanced by the disadvantages they had in lower-spatial skills and lower-self confidence (Casey, Nuttall, and Pezaris, 2001).

A comparison of the 2003 and 2007 TIMSS results for eighth grade mathematics found there was no measurable difference in the 2007 average mathematics scores of males and females. Even though there was no significant difference, males outperformed females in three of four mathematics content domains (number, geometry, and data and chance). However, in 2003 eighth grade males performed significantly higher on average overall than females (Mullis, Martin, and Foy, 2008).

According to a 2008 report from the University of Wisconsin-Madison, no gender difference exists in mathematical achievement between male and female students. A team of scientists reviewed the math scores of seven million students who were tested in compliance with NCLB. The scientists further analyzed the math score data by calculating the effect size. The effect sizes ranged from 0.01 to 0.06 indicating that average scores of girls and boys were nearly the same (University of Wisconsin-Madison, 2008).

In March 2010, the Center on Education Policy (CEP) released the findings of the report, *Are There Differences in Achievement between Boys and Girls?* The CEP found no consistent gender gap in 2008. Instead they found a “rough parity” in the percentages of boys and girls reaching proficiency at all three levels (p.1). “The percentage of boys and girls scoring proficient in math tended to be similar, with boys edging out girls slightly in some states and girls doing better in other states. No state had a difference in math between boys and girls of more than six percentage points” (CEP, 2010, p.1). At the middle school level, 47 states reported significant data. CEP found a median percent proficient of 69% for females and 68% for males. In an analysis of middle school mathematics achievement, ten states reported male students outperformed female students. However, twenty-four states reported female students outperformed male students. In 13 states the performance of male and female students was roughly equivalent (CEP, 2010).

Math Intervention Programs

As schools and districts feel the pressure to reach the goal of having 100% of their students become proficient by 2014, some of them established additional programs to support students. Multiple types of intervention programs have been implemented to improve student mathematical achievement. This review of literature concludes with an analysis of studies focused on math intervention programs that occurred during summer school, after-school, or during the school day.

The analysis of summer school programs included an evaluation of the impact training provided by the Accelerated Math Science (AMS) project had on migrant students after two years of implementation (Ochoa, 1994), the effects of middle school summer school program of achievement on NCLB identified subgroups (Opalinski, 2006), and the study of the impact of summer school on student achievement (Haymon, 2009). The after-school interventions analyzed were Roukema’s (2005) study of the impact of an after-school intervention program on student achievement, Cieslik’s (2007) investigation of the impact the Together Opportunities Produce Success (TOPS) middle school intervention programs had on student achievement, and Maxwell’s (2010) research on the impact of Supplemental Education Services on middle school at-risk learners' math and reading scores. The school day interventions include Brown's (2003) study that examined the effects of targeted, small group, interventions and the effects on student mathematics achievement, Mross' (2003) case study that examined the effects of the Math Edge program, an overview of a 2007 Texas Instrument report that details the math intervention program utilized in Texas that yielded tremendous growth, a Minnesota Department of Education review of a test score pilot program (2008), and Johnson's (2008) study of students who were dually enrolled in Algebra and Math Intervention. The purpose of each study was to determine the impact the intervention program had on a student's mathematical achievement based on the results of a standardized test.

Summer School Intervention

Schools and districts attempt to impact student learning even after the traditional school year ends. Many districts conduct summer school or specialized programs to maintain or improve student learning during June, July, and August. The following studies examined the impact of summer programs.

The impact training, provided by the Accelerated Math Science (AMS) Project, had on migrant students after two years of implementation was assessed by Ochoa (1994). One hundred four migrant students were selected based on district achievement and data on the 1991 - 1992 Region IX Student and Program Needs Assessment (SAPNA) data. The AMS program consisted of a 19-day curriculum with 80 to 95 hours of direct instruction. An AMS developed pre-post test was used to assess metric system (math), observational skills (science), and scientific method (science). The findings indicate significant growth in each of the assessed areas. Ochoa (1994) also looked at students' attitude toward math and science, and attendance rates. The results indicated a positive shift in attitude toward math and science and lower school absences.

Opalinksi (2006) considered the effects of a middle school summer school program on the achievement of NCLB identified subgroups. The quasi-experimental study consisted of a treatment and a comparison group which was matched based on grade-level, gender, ethnicity, special education, SES, ELL, and quartiles on the reading, writing, and math sections of the CAT6/Terra Nova. Opalinski's research consisted of a main study and a follow up study. The main study had a treatment group of 201 eighth students who attended summer school in 2003 at a middle school in Anchorage, Alaska and a matched comparison group who did not attend summer school. Achievement was measured with the 2003 CAT6/Terra Nova and the April 2004 Alaska Benchmark Examination. The follow up study included a treatment group of 64 low SES eighth grade students who attended summer school in 2004 and an equivalent comparison group of student who did not. The same instruments used in the main study to measure achievement were used to in the follow up study. The results of the main study revealed no statistically significant difference in mathematical achievement for the pooled population or for any individual subgroup. The results of the follow up study found the math mean scores stayed relatively flat for African American, Alaska Native, and Asian student, while the mathematical mean for Caucasian students decreased slightly. No significant main effects were found.

The impact of summer school on student academic achievement of a target population of St. Louis Public School students who attended the 2005 summer school program between their sixth and seventh grade years was analyzed by Haymon (2009).

The purpose of the quantitative study was to determine how summer school affects reading, writing, and math achievement. To measure the effects of summer school, pre-test and post-test scores from the Terra Nova Complete Test Battery (CTB) and results from the Missouri Assessment Program (MAP) were used. The sample included 60 sixth grade students who were split evenly into a treatment and a comparison group. The results of the CTB were inconsistent, with no clear patterns in the differences in language, reading, and math revealed. A statistically significant difference in the mean score between the treatment group and the comparison group was not identified.

After-school Interventions

Extending the school day by providing additional interventions after school is another strategy schools and districts are implementing to provide additional support for students. After-school programs present their own unique set of challenges. However, schools and districts continue to urge students to participate.

The impact of an after-school intervention program on student achievement was investigated by Roukema (2005). The Support Our Students (SOS) program was established in 77 school districts throughout North Carolina. The participants of the SOS after-school program worked on homework for an hour and then participated in structured activities for the second hour. The scores of participants in the SOS program were compared to the scores of non-participants to determine the impact the program had on the North Carolina End of Grade (EOG) test from 1999 - 2001. Roukema (2005) further analyzed the data to compare students' scale score growth in the categories of minority (non-White), socioeconomic status (SES), and gender. Middle school students who participated from 1998 to 2001 showed no significant difference in math scores from those who did not participate in the SOS program. The results indicated the no significant difference in math scores among participants and non-participants in SES, minority, or gender subgroups (Roukema, 2005).

In a mixed methods study, Cieslik (2007) investigated the impact of middle school mathematics intervention, Together Opportunities Produce Success (TOPS). TOPS incorporated the aspects of mathematics knowledge, test taking strategies, motivation, and test anxiety. During the 2006 - 2007 school year, 51 students in a New Jersey middle school were invited to participate in the TOPS program. Participation in the TOPS program was voluntary for students. The program met after school, two days a week from January to March. The data indicated that all three groups of students had an average gain in test scores between the NJ ASK (initial assessment) and the NJ GEPA (post assessment). The data showed that students who attended 70% or less of all TOPS lessons had the greatest percentage gain in test scores with a gain of 6.8%. The non-participants also saw an increase in percentage gain with a gain of 6.5%. Students who attended over 70% of all TOPS lessons also saw a gain in their test scores. The average gain for this group was 2.2%. The comparison of the pre and post-test scores saw no change in scores for the students who did not attend TOPS. Among the participants of TOPS those students who attended below 70% of TOPS lessons saw an average gain of 9.8% while students who attended above 70% of TOPS lessons saw an average gain of 20.5%.

Maxwell (2010) researched the impact of Supplemental Education Services program on middle school at-risk learners' math and reading scores. Maxwell collected the test scores of identified students from a middle school in rural southeast Georgia. The program took place after school, three days a week and on Saturdays. The students who were identified to participate in the Supplemental Education Services program were selected by the guidance department. The guidance department recommended students based on the student scores on the Georgia Criterion Referenced Competency Test (CRCT) in reading and math. Out of the 107 students identified to participate, only 37 actually participated in the Supplemental Education Services program. The findings indicated students who participated in Supplemental Education Services program scored higher in reading and math on the CRCT than students who did not participate. Participants in the program showed an average math score improvement of 14.74 points with an average level change of 1.63, while the non participant group showed an average math score improvement of 2.22 points with an average level change of 1.31 points. The results of Maxwell's study indicate the program was successful in assisting the participants in passing the CRCT.

School Day Interventions

Interventions within the school day are another option for schools looking to provide additional support for their students. Ease of access to the students is a huge benefit for this type of intervention. Additional transportation does not have to be provided. Some schools are even providing a double dose of mathematics for their students. Schools are restructuring their days in order to better meet the needs of their struggling learners.

Brown's (2003) mixed methods study examined the effects of targeted, small group, intervention instruction related to basic skills, to determine the effect on student achievement as measured by their performance on geometry and measurement portions of the Stanford Achievement Test. The targeted instruction took place in the Long Beach Unified School District during the 2002 - 2003 school year. Three levels of intervention instruction (low, medium, and high) were provided in single gender classes in a coed public school over a three to five week period. The intervention instruction was quantified by the number of times an intervention was provided in a study period, anywhere from four or less to more than eight times within the same time period. The intervention took place in small groups during the regular class time. Brown found significant improvements from year one to year two when taking into account intervention level and gender. For high level intervention males, the percent of students scoring below the average proficiency level decreased by 4.27%. The same group of students also demonstrated a 10.27% increase in students performing above the average proficiency level. The same pattern was discovered for high level intervention female students. However, the low level intervention females experienced a 7.54 % increase of students scoring in the below average proficiency group.

Mross (2003) conducted a case study to examine the effects of the Math Edge program. Math Edge was an instructional program that utilized direct instruction to address specific content knowledge and focused on test-taking strategies and types of student learning. The program targeted seventh and eighth grade students who scored 75 points or more below the proficiency level on the fifth grade state assessment. One hundred thirty students participated in the class that met 42 minutes a day, three days out of a six-day cycle, for an entire school year. The independent variables of the study were treatment, gender, and socioeconomic status of the students. The dependent variable was mathematics score as measured by a pre/post test utilizing the Terra Nova Second

Edition. The finding of the study indicated a significant improvement in mathematic scores on state tests for students who were enrolled in the supplemental program. Eighth grade students demonstrated a 5.93 increase in mean score while the seventh grade students demonstrated a 3.61 increase in mean score. SES and gender did not affect the difference in mathematical scores.

In 2007, Texas Instruments reported the tremendous growth in mathematics achievement of a group of at-risk middle school students who participated in a new mathematics intervention in Texas (Texas Instruments, 2007). This report revealed an increase of 33% on the Texas statewide standardized mathematics test. Significant changes were made to the mathematics program at Richardson Independent School District to support the goals of the pilot program. These changes included doubling math instruction time from 50 minutes to 100 minutes, an improvement in teacher-student ratio, adoption of an accelerated curriculum, and increased learning outcomes for students that were reinforced by teachers. Additionally, Texas Instruments technology was integrated to support the curriculum and to provide real-time assessments of students' levels of comprehension. Finally, professional development was provided to support teachers in the implementation of the pilot program (Texas Instruments, 2007). Due to the success of the pilot, the program was replicated in other Texas schools.

The Minnesota Department of Education (2008) revealed the results of a test score pilot program. Plymouth Middle School and Robbinsdale Middle School both participated in the pilot program. Plymouth Middle School served 1127 students in grades 6 - 8. Two hundred twenty students who had not met or who had partially met the proficiency level on the state math test were selected as participants of the pilot program.

The participants of the pilot were enrolled in a double-dose of daily math instruction for one quarter. Participants were removed from another required class or an elective course to enroll in a double dose of math. Participants showed a 4.5% growth on the Computerized Achievement Level Test (CALT) (Minnesota Department of Education, 2008).

Robbinsdale Middle School serves 769 students in grade 6 - 8. Just as in Plymouth Middle School, participants of the pilot program were selected based on their score on the state test. Sixty-five participants were dually enrolled in their regular mathematics course and an additional math support class. The math support class met three times a week for 45 minutes for an entire school year. Participants showed an overall growth of 0.5% on the CALT (Minnesota Department of Education, 2008).

Johnson (2008) investigated the effects of a mathematics intervention class on students' algebraic skills with an additional focus on previewing. The study was conducted in the suburbs outside of a large metropolitan city. The 90 students were equally divided into a control group and an experimental group (math intervention). Math Intervention students were dually enrolled in Algebra and Math Intervention. Forty-five students in Math Intervention were equally divided into three classes. All three classes utilized previewing as the main teaching strategy to maintain equivalency. The quantitative study utilized a pretest-posttest experimental design. Students in the experimental group began the investigation with lower score than the control group and ended the investigation with higher scores than the control group. The experimental group began the investigation with a raw pretest mean of 13.27 and ended the investigation with a raw post test mean of 29.48, indicating a raw mean growth of 16.21.

The control group started the investigation with a raw pretest mean of 16.11 and ended with raw mean of 27.57, indicating a raw mean growth of 11.46. Johnson found that there was a statistically significant difference in gain scores between students who enrolled in the Math Intervention program and students in the control group.

The above studies indicate schools are implementing mathematics interventions to improve students' mathematics achievement. While the results of a few studies did not indicate significant growth, schools continue to search for ways to improve the interventions. Research related to the cons of double periods of math is limited. However, a 2007 Chicago study related to select students being dually enrolled in Algebra and Algebra support created awareness of the other factors beyond a support class that contribute to the achievement. In this study, the double-dose support strategy was implemented for ninth grade students who tested below the national median on the eighth-grade math test. Teachers of double-dose classes were provided numerous instructional supports and professional development. Test scores of the students who were dually enrolled rose significantly, despite a greater concentration of students with low skill levels, attendance issues and discipline problems. In part, this was due to the change in teacher practices and the flexibility provided by two periods of math (Durwood, Krone, & Mazzeo, 2010). However, consideration should be given to the impact the intervention program implementation has on students not targeted to participate in the double periods of Algebra. In this study, high ability students assigned to one-period of Algebra improved their test scores but experienced a decline in their grades. For the higher skilled students, a more homogenous classroom environment enabled the teachers to teach more challenging curriculum than in the past, and they had fewer issues related to behavior and attendance (Durwood, Krone, & Mazzeo, 2010).

Summary

This review of literature provided an overview of NCLB and the impact NCLB has on state assessments. The literature review included pertinent information regarding the Missouri Assessment Program. The review of minorities and mathematics achievement found most minorities score lower than non-minorities. In the review of gender and mathematics achievement the majority of the studies found no significant difference in the mathematical achievement between male and female students. The review of others studies conducted related to math intervention programs/support programs which yielded mixed results. The majority of the studies reviewed found the intervention program had a positive impact on a student's mathematical achievement. However, in several of the studies the intervention program was not found to have an impact on the student's mathematical achievement.

Outcomes of these studies have demonstrated the strong force NCLB is for schools to prepare students to achieve proficiency, as well as the importance AYP has placed on the results of standardized test. Standardized test scores are utilized in many schools to measure student achievement. As noted in the MAP-Guide to Interpreting Results (DESE, 2007), assessment results are vital in shaping public perceptions about the abilities of students and the quality of a school. Assessment results are essential in every school, district, and state. The results of the assessments are often used to drive the innovation, establish higher standards, and guide educational excellence in many school districts. The literature has provided multiple examples of interventions that have supported the importance that is placed on standardized test scores. Whether the intervention takes place during the school day, after-school, or during summer school the intent is still the same - to improve student mathematical achievement. Chapter three presents the topics of research design, population and sample, hypotheses, limitations, data collection procedures, and statistical analysis as related to this study.

CHAPTER THREE

METHODS

The purpose of this study was to determine if differences exist among students who enrolled in Math Lab zero, one, two, three, or four semesters in mathematical growth, as measured by a difference between the sixth and eighth grade scale score on the mathematics portion of the Missouri Assessment Program (MAP). The second purpose of this study was to determine if the difference in growth among any of the above-mentioned participants is affected by ethnicity or gender.

This chapter describes the methodology used in conducting the clinical research study. Included in this chapter are a description of the research design, population, and sample of the students studied. Detailed information related to the sampling process, data collection, data analysis, hypothesis testing, and the limitations of the study are provided.

Research Design

This quasi-experimental study was designed to use quantitative research methods. Random assignment was not possible due to the use of student cohorts with specified categories of enrollment in Math Lab. The three cohorts involved in the study included students in grades sixth, seventh and eighth grades in District A during the 2005 - 2010 school years.

The research study includes the dependent variable, mathematical growth. The dependent variable was measured as the difference in scale score from sixth grade to eighth grade on the mathematics portion of the MAP. The independent variables in the study were number of semesters enrolled in Math Lab, gender, and ethnicity. Number of semesters enrolled in Math Lab was categorized into zero, one, two, three, or four semesters. For the purposes of the study, the ethnic groups were identified as minority (Asian, Black, Hispanic, and Native American/Alaskan Native) and non-minority (White).

Population and Sample

Sixth, seventh, and eighth grade students identified to enroll in Math Lab in District A comprised the population of the study. Three cohorts were defined for the study. Members of each cohort are identified in Table 4. Each cohort included students from Middle School 1, Middle School 2, and Middle School 3 who were enrolled in Math Lab zero, one, two, three, or four semesters.

Table 4

Cohort Identification for Participants of the Study from District A

	Grade 6	Grade 7	Grade 8
Cohort 1*	2005 – 2006	2006 – 2007	2007 – 2008
Cohort 2*	2006 – 2007	2007 – 2008	2008 – 2009
Cohort 3*	2007 – 2008	2008 – 2009	2009 – 2010

*Each cohort includes students from Middle School 1, Middle School 2, and Middle School 3

Sampling Procedures

In this study, the researcher used purposive sampling to identify participants. Johnson and Christensen (2008) defined purposive sampling as the researcher specifying the characteristics of the population of interest and locating individuals with those characteristics. The first established criterion for participation in the study was attendance at Middle School 1, Middle School 2, or Middle School 3 in District A. The second criterion established was MAP data was available for the participant in sixth, seventh, and eighth grade. All students enrolled in Math Lab one, two, three, or four semesters who met the two criteria were included in the study. Students enrolled in Math Lab zero semesters that met the first two criteria had to meet an additional criterion related to MAP scale score. In Cohort one, students had to have a sixth grade mathematics MAP scale score greater than or equal to 598, but less than or equal to 698. In Cohort two, students had to have a sixth grade mathematics MAP scale score greater than or equal to 573, but less than or equal to 709. In Cohort three, students had to have a sixth grade mathematics MAP scale score greater than or equal to 537, but less than or equal to 713. The ranges were selected in order to create an equitable sample across the students not enrolled in Math Lab. In addition, a random sample of students enrolled zero semesters was selected to obtain a more similar sample size.

Instrumentation

Based upon the research question and the hypotheses identified in the study, the dependant variable analyzed was mathematics growth as measured by a difference between sixth grade and eighth grade scale score. The instrument used to measure mathematics growth was the Missouri Assessment Program (MAP) mathematics scale score.

As indicated in the 2009 MAP technical report,

> "The MAP is designed to measure how well students acquire the skills and knowledge described in Missouri's Grade-Level Expectations (GLEs). The assessments yield information on academic achievement at the student, class, school, district, and state levels. This information is used to diagnose individual

> student strengths and weaknesses in relation to the instruction of the GLEs and to gauge the overall quality of education throughout Missouri" (p. 5).

Each assessment includes three styles of questions: selected-response, constructed-response, and performance events. Selected-response items, also known as multiple choice, include a question along with three to five response options. Constructed-response items require the students to provide an appropriate response with work to support the solution. Performance events require students to use higher level thinking to solve more difficult problems, but often allow for more than one approach to solve the problem (DESE, 2009).

Student performance is reported at one of the following achievement levels: below basic, basic, proficient, or advanced. The "levels describe a pathway to proficiency. Each achievement level represents standards of performance for each assessed content area" (DESE, 2009, p.11). Appendix C provides DESE's (2001, p.9) description of each achievement level and score ranges by grade level. In addition to the achievement level, a student's achievement is also reported as a scale score indicating a student's total performance in the specific content area. A higher scale score indicates higher levels of achievement (DESE, 2009).

Validity and reliability

In 2009, the Missouri Department of Elementary and Secondary Education, in partnership with CTB/McGraw-Hill, published a technical report providing the confirmation of validity and reliability of the MAP test scores. CTB "ensures the meaningfulness or validity of MAP scores as indices of proficiency relative to the Show-Me Standards by using methodical and rigorous test-development procedures" (DESE, 2009, p.3). An additional process utilized to verify the meaningfulness of MAP scores is to analyze the "underlying psychological traits or 'constructs' that a given assessment measures" (p. 4). The process routinely utilized by CTB and DESE to analyze "various item- and score-pattern analyses conducted on MAP results show that each assessment is measuring the traits it is intended to measure and does not measure unrelated constructs" (DESE, 2009, pg. 3).

"Score dependability or reliability can be quantified and reported as a number ranging from 0 to 1; the higher the coefficient, the more dependable the score. All coefficients are high and indicate that we can have confidence in MAP scale scores" (DESE, 2009, p. 4). In grade 8, DESE reported a reliability coefficient of 0.93 for mathematics. "There is ample technical evidence to support the claim that MAP scores are reliable and valid measures of achievement relative to the Show-Me Standards" (DESE, 2009, p. 7).

Data Collection Procedures

Prior to conducting the study, the researcher acquired consent by completing a request for permission to conduct research in District A. Archival data was requested for each cohort. The completed form was electronically mailed to the Associate Superintendent of Instruction and School Leadership for the district (see Appendix D). It should be noted in Appendix D - F, any reference to district personnel has been eliminated. Any reference to the district has removed or substituted with District A. The Instructional Operations Team (IOT) in District A reviewed the request to determine whether permission to conduct the research would be granted. After review of the request, the researcher was interviewed by District A's Associate Superintendent of

Secondary Instruction. Following the interview, a meeting was held with the researcher, secondary mathematics curriculum specialist, and District A's Executive Director of Technology. The Executive Director of Technology assigned a member of the technology department the responsibility of collecting and coding the data. The research was approved on February 24, 2010, by the IOT (see Appendix E). The Associate Superintendent of Secondary Education sent the approval for conducting the research via email (see Appendix E).

An Institutional Review Board (IRB) request was submitted to Baker University on December 14, 2010 (see Appendix F). The Baker University Institutional Review Board approved the research on February 24, 2011 (see Appendix G). After obtaining approval from IOT and the Baker University IRB committee, the researcher contacted each middle school principal in District A via email to create an awareness of the research being studied. The researcher offered to share the findings of the study.

Data Coding

A computer technologist for District A organized the data into an Excel workbook. Data was coded by the technologist to maintain student privacy and building anonymity. The archival data was re-coded by the researcher from the original data to determine which students had MAP mathematics scale scores for all three years (grades). The data was also re-coded to establish level of enrollment in Math Lab (zero, one, two, three, or four semesters). The researcher combined data from the three cohorts into one Excel spreadsheet. Mathematical growth was calculated by subtracting the sixth grade mathematics MAP scale score from the eighth grade mathematics MAP scale score.

Data Analysis and Hypothesis Testing

Data from the Excel workbook was imported into IBM SPSS Statistics 18.0 Faculty Pack for Windows. Two two-factor ANOVAs were utilized.

Research question one: Is there a difference among students who enrolled in Math Lab zero, one, two, three, or four semesters, in mathematical growth, as measured by a difference in scale score from sixth to eighth grade, on the mathematics portion of the MAP?

Research hypothesis one: At least two means for mathematical growth are different among students who are enrolled in zero, one, two, three, or four semesters in Math Lab.

The first two-factor ANOVA was utilized to determine the main effect for the level of enrollment, the main effect for ethnicity, and the interaction effect for level of enrollment by ethnicity. The main effect for enrollment was used to test research question one. A Tukey's Honestly Significant Difference (HSD) was used to determine which of the growth means were different among students enrolled zero, one, two, three, or four semesters in Math Lab. A table which included means, standard deviations, and sample size for each level of enrollment was produced as part of the analysis.

Research question two: Is the difference in mathematical growth, as measured by the change in scale score, affected by ethnicity?

Research hypothesis two: At least two means for mathematical growth are different among minority and non-minority students who enrolled zero, one, two, three, or four semesters in Math Lab.

The interaction effect for enrollment by ethnicity from the first ANOVA was used to address research question two. A Tukey's Honestly Significant Difference (HSD) was used as a follow-up post hoc.

Research question three: Is the difference in mathematical growth, as measured by the change in scale score, affected by gender?

Research hypothesis three: At least two means for mathematical growth are different among male and female students who enrolled zero, one, two, three, or four semesters in Math Lab.

A second two-factor ANOVA was utilized to determine the interaction effect for level of enrollment by gender. The interaction effect for enrollment by gender was used to address research question three. A Tukey's Honestly Significant Difference (HSD) was used as the follow-up post hoc.

Limitations

Lunenburg and Irby (2008) describe the limitations of a study as not being under the control of the researcher. Limitations are factors that may have an effect on the findings. Student investment, equivalent teacher recommendations for enrollment in Math Lab, consistency of instruction, accuracy of records, and MAP measurability are factors out of the control of the researcher. An additional limitation is the fact that students can opt out of a semester or more with parental permission or to take the required health course or learning lab. The Math Lab Skills Test and software used from Fall 2005 through Spring 2008 school years were different from the Math Lab Skills Test and software used in the Fall 2008 through Spring 2010 school years. The Math Lab Skills Test was modified to support the Grade-Level Expectations and effectively gather data needed to better support the Math Lab students. Furthermore, as the program developed over time, it became apparent that the software used in the Math Labs was not meeting the established requirements, so new software was piloted and implemented.

Summary

This chapter restated the purpose of the study. Research questions were re-stated and hypotheses were identified. The participants were middle school students enrolled in grades seven and eight from three middle schools in District A. Data collection procedures were shared. Data analysis methods for each research hypothesis were described. Limitations of the study were acknowledged. Chapter four includes the results of the hypothesis testing.

CHAPTER FOUR

RESULTS

The purpose of this study was to determine if a difference exists in mathematical growth, as measured by a difference in scale score on the mathematics portion of the Missouri Assessment Program (MAP), among students who enrolled in Math Lab zero, one, two, three, or four semesters. The study further determined if the differences in mathematical growth, as measured by the scale score, are affected by ethnicity or gender. This chapter presents the results of the data analysis for students in Middle School 1, Middle School 2, and Middle School 3 from District A during the 2005 - 2010 school years. Descriptive statistics were used to describe the sample and two ANOVAs were utilized to test three hypotheses.

Descriptive Statistics

The population for this study was sixth, seventh, and eighth grade students in District A. The sample was 861 middle school students who had MAP mathematics scale scores for sixth, seventh, and eighth grade who were enrolled in Math Lab zero, one, two, three, or four semesters during the 2005 - 2010 school years. The IBM SPSS Statistics 18.0 Faculty Pack for Windows statistical program was used to analyze the data for this study. The demographics of the sample, by the number of semesters enrolled, are included in Table 5. The sample included 446 female and 415 male students, 220 minority and 641 non-minority students.

Table 5

Demographics of the Sample by Semesters Enrolled in Math Lab during the 2005 - 2010 School Years in District A (n = 861)

	0	1	2	3	4	Total
Female	218	68	54	58	48	446
Male	212	68	54	43	38	415
Minority	93	36	36	36	19	220
Non-Minority	337	100	72	65	67	641

A cross tabulation of 6^{th} grade math level and 8^{th} grade math level is presented in Table 6. Movement across the below basic, basic, and proficient levels were investigated between sixth and eighth grade. Analysis of the level changes noted in Table 6 indicated 1.5% of students enrolled in Math Lab zero semesters moved from below basic to basic, while 0.8% of students enrolled one semester, 4.6% of students enrolled two semesters, 4.7% of students enrolled three semesters, and 5.8% of students enrolled four semesters moved from below basic to basic. Examination of students moving from basic to proficient found 14.6% of students enrolled in Math Lab zero semesters, 10.5 % of students enrolled one semester, 10.2% of students enrolled two semesters, 7.5% of students enrolled three semesters, and 5.8% of the students enrolled four semesters moved from basic to proficient. These results imply a higher percentage of students enrolled in Math Lab moved from below basic to basic, whereas a higher percentage of students enrolled zero semesters moved from basic to proficient.

Table 6

Mathematics MAP Level Changes from Sixth Grade to Eighth Grade

6th grade math level		8th grade math level Below Basic	Basic	Proficient
0 semesters	Below Basic	11	6	0
	Basic	19	121	59
	Proficient	2	50	137
1 semester	Below Basic	5	1	0
	Basic	5	66	13
	Proficient	1	13	20
2 semesters	Below Basic	6	5	0
	Basic	14	55	11
	Proficient	0	9	8
3 semesters	Below Basic	4	5	0
	Basic	11	70	8
	Proficient	0	3	0
4 semesters	Below Basic	8	5	0
	Basic	14	47	5
	Proficient	0	7	0

Note. Advanced level not included as it only pertained to students enrolled zero semesters

The descriptive statistics provided specifics about the sample of study whereas, the results of the hypothesis test reveal the researcher's expectations related to the differences between variables. The following section contains the result of the hypotheses testing.

Hypothesis Testing

Research question one: Is there a difference among students who enrolled in Math Lab zero, one, two, three, or four semesters, in mathematical growth, as measured by a difference in scale score from sixth to eighth grade, on the mathematics portion of the MAP?

Research hypothesis one: At least two means for mathematical growth are different among students who are enrolled in zero, one, two, three, or four semesters in Math Lab.

A two factor (Enrollment X Ethnicity) ANOVA was used to test hypothesis one and hypothesis two. The results of the test of the main effect for enrollment provided evidence for a significant difference in mathematical growth between at least two means ($F = 2.750$, $df = 4, 851$, $p = .027$). Table 7 includes the results of the first ANOVA, the *F* statistic, degrees of freedom (*df*), and significance *(p)*.

Table 7

Mathematical Growth for Enrollment by Gender

Source	*SS*	*df*	*MS*	*F*	*p*
Gender	1182.236	1	1182.236	2.933	.087
Enrollment	4434.053	4	1108.513	2.750	.027
Gender x Enrollment	1807.748	4	451.937	1.121	.345
Error	343074.302	851	403.143		
Total	1220091.000	861			

A follow-up Tukey's HSD provided evidence that students enrolled for three semesters experienced significantly more growth (36.56) than those who were enrolled one semester (27.69). Table 8 contains the means, standard deviations, and sample sizes for students enrolled zero, one, two, three, or four semesters in Math Lab. This provides support for hypothesis one.

Table 8

Mathematical Growth Descriptive Statistics for Students Enrolled Zero, One, Two, Three, or Four Semesters in Math Lab

Semester	*M*	*SD*	N
0	31.5930	18.6872	430
1	27.6912	19.1673	136
2	32.5926	19.6222	108
3	36.5644	17.6309	101
4	32.5930	29.4672	86
Total	31.7851	20.1802	861

Research question two: Is the difference in mathematical growth, as measured by the change in scale score, affected by ethnicity?

Research hypothesis two: At least two means for mathematical growth are different among minority and non-minority students who enrolled zero, one, two, three, or four semesters in Math Lab.

A two factor (Enrollment X Ethnicity) ANOVA was used to test hypothesis two. The result of the second ANOVA revealed the interaction effect for enrollment by ethnicity was not significant ($F = .756$, $df = 4$ and 851, $p = .554$) indicating that ethnicity does not affect the mathematical growth among students enrolled in Math Lab zero, one, two, three, or four semesters. Table 9 includes the results of the second ANOVA, the *F* statistic (*F*), degrees of freedom (*df),* and significance *(p).*

Table 9

Mathematical Growth for Enrollment by Ethnicity for Students Enrolled Zero, One, Two, Three, or Four Semesters in Math Lab

Source	*SS*	*df*	*MS*	*F*	*P*
Ethnicity	147.872	1	147.872	.366	.546
Semester	2992.708	1	748.177	1.850	.117
Ethnicity x Enrollment	1223.194	4	305.799	.756	.554
Error	344245.722	851			
Total	1220091.000	861			

Research question three: Is the difference in mathematical growth, as measured by the change in scale score, affected by gender?

Research hypothesis three: At least two means for mathematical growth are different among male and female students who enrolled zero, one, two, three, or four semesters in Math Lab.

The first two-factor (Enrollment X Gender) ANOVA described above was used to test hypothesis three. The results of the ANOVA are shown in Table 6 (F = 1.121, df = 4 and 851, p = .345). The interaction effect for enrollment by gender was not significant indicating that gender does not affect the mathematical growth among students enrolled in Math Lab zero, one, two, three, or four semesters.

Summary

Descriptive statistics were used to describe the characteristics of gender, minority status, and number of semesters enrolled in Math Lab, for the sample. In addition, this chapter presented the results of the two ANOVAs utilized to address the research questions. There were differences in mathematical growth among students enrolled three semesters and those enrolled one semester in Math Lab. However, results of the hypotheses tests do not support the influence of gender or ethnicity on the differences found in the hypothesis one testing. The final chapter explores the findings in connection to the literature, implications for action, and recommendations for future research, and conclusions.

CHAPTER 5

INTERPRETATION AND RECOMMENDATIONS

Introduction

A positive aspect of NCLB is the requirement that schools now take a deeper look at *each* student. No longer can the focus solely be on the students who score in the top achievement levels. "If nothing else, NCLB has created an unprecedented focus on the reading and math abilities of the previously marginalized students" (Guilfoyle, 2006, p. 2). The previously marginalized student is the focus of a support program developed in District A. It is imperative that the data gathered from students enrolled in support programs be analyzed in order to make informed decisions about whether or not the support programs are worthwhile to continue. The first part of this chapter provides an overview of the problem, the purpose statement, research questions, and methodology. The second part of this chapter addresses the major findings, implications for action, and recommendations for further research.

Study Summary

Overview of the Problem

As noted in chapter one, research has been conducted related to math support programs and student mathematics growth, but very little research exists related to dual enrollment in grade-level mathematics and a mathematics support program, like Math Lab, at the middle school level. District A, a suburban school district southeast of Kansas City, Missouri, implemented Math Lab during the 2005 - 2006 school year. The purpose of the Math Lab program was to provide support to students who had previously been enrolled in below grade-level mathematics. Now that these students were being held accountable for grade-level mathematics, District A recognized the need to provide support for them within the school day. The Math Lab program has evolved over six years; however, District A has not studied the effectiveness of the program.

Purpose Statement

As stated in chapter one, the purpose of this study was to determine if a difference exists in mathematical growth, as measured by a difference in scale score on the mathematics portion of the MAP, among students who enrolled in Math Lab zero, one, two, three, or four semesters. The second purpose of this study is to determine if the difference in mathematical growth, as measured by the change in scale score, is affected by ethnicity. The third purpose of the study is to determine if the difference in mathematical growth, as measured by the change in scale score, is affected by gender.

Review of the Methodology

This quasi-experimental quantitative study involved three middle schools (grades 7 and 8) in District A. The researcher utilized student data from sixth, seventh, and eighth grades for three cohorts of students from 2005 through 2010. For the purposes of the study, the ethnic groups were identified as minority (Asian, Black, Hispanic, and Native American/Alaskan Native) and non-minority (White). Archived data from the PowerSchool Student Information System in District A was used for the study (PowerSchool, Version 6.1). The dependent variable being analyzed was mathematical growth. The dependent variable was measured as the difference in scale score from sixth grade to eighth grade on the mathematics portion of the MAP. The independent variables in the study were number of semesters enrolled in Math Lab, gender, and ethnicity. Two

two-factor ANOVAs were utilized and a Tukey's Honestly Significant Difference (HSD) was selected for the follow-up post hocs.

Major Findings

The researcher investigated the differences in mathematical growth among students who enrolled in Math Lab zero, one, two, three, or four semesters. The data analysis revealed a significant difference in the mathematical growth among students enrolled in Math Lab three semesters and students enrolled in Math Lab one semester. The mean growth of students enrolled in Math Lab three semesters was higher than the mean growth of students enrolled in Math Lab one semester. The results for the interaction effects for enrollment by ethnicity and for enrollment by gender were not significant among students enrolled in Math Lab zero, one, two, three, or four semesters.

One finding was students enrolled in Math Lab zero semesters had a higher mean score than student enrolled in Math Lab one semester. Per a Math Lab instructor in District A, the primary reason for this result might have been students who were enrolled in zero semesters of Math Lab were not identified by the recommending teachers as requiring additional mathematics support, thus those students were believed to have the ability to be successful in grade-level math without additional support (personal communication, February 10, 2011). Therefore, it might not be surprising they had a higher mean growth score than students enrolled for one semester.

Another finding revealed that students enrolled in Math Lab three semesters displayed the greatest mean mathematical growth. During personal communication with a Math Lab instructor, a solid rationale was not provided. Her only response related to the fact that it might have taken the recommended students three semesters to catch up to their non-recommended peers (personal communication, February 10, 2011).

The final major finding was the decline in the mean mathematical growth of the students with four semesters of Math Lab. A current Math Lab instructor in District A indentified three major factors may have led to the lower means for the fourth semester. First, Math Lab students may be released from the program if exit criteria are met, thus the higher scoring students are no longer enrolled for a fourth semester. The same is true for students who are enrolled in an additional support class or health. They may be removed for a semester to take the additional class; therefore, some of the higher performing students are not enrolled for a fourth semester. Third, the MAP is administered half way through the fourth semester resulting in students only having three full semesters of Math Lab instruction prior to the MAP (personal communication, February 10, 2011).

Findings Related to the Literature

This section links the results of the current study to previous studies related to mathematics intervention programs and student achievement studies. Comparing the results of this study to those reviewed in chapter two revealed some similarities and differences.

The results of this study provided evidence that students enrolled for three semesters in Math Lab experienced more growth than those who had one semester of Math Lab. This indicates enrollment in the Math Lab intervention program is contributing to the students' mathematical achievement. These results are consistent with Maxwell's (2010) findings, which indicate students who participated in an intervention program scored higher in math than students who did not participate. However, these results contrast with the findings of Opalinski (2006) study. The results of his study revealed no statistically significant difference in mathematical achievement for the pooled population or for any individual subgroup. Also in agreement with the current study were the results of Haymon's (2009) study which indicated no significant difference in the mean mathematical score between the treatment group who attended summer school and the comparison group who did not attend summer school.

A study with the closest parallel to the intervention program implemented in District A was conducted by Johnson (2008). Although his study focused on dually enrolling students in algebra and support class, multiple similarities exist between the program in Johnson's study and the Math Lab program in District A. Both provide support for students who are struggling in math with a support class for an entire year. The students do not have to wait to fail to be a part of the program. Previewing is one of the tools used in both programs. In addition, both Math Lab and the Math Intervention program in Johnson's study were offered as an additional course within the school day and both had a smaller class size. Johnson found that students enrolled in a math intervention program had a statistically significant greater gain from the pretest to the posttest as opposed to the control group. Johnson's findings support the research which suggest dual enrollment in a math class and a support class positively impacts a student's mathematical growth.

In the current study, when examining the effects of ethnicity, the results revealed that ethnicity does not affect the mathematical growth among students enrolled in Math Lab zero, one, two, three, or four semesters. The findings of the current study agree with the results of Roukema's (2005) study. Roukema found ethnicity did not affect the difference between participants and non-participants.

The current study found the interaction effect for enrollment by gender was not significant indicating that gender does not affect the mathematical growth among students enrolled in Math Lab zero, one, two, three, or four semesters. While the findings of Mross' (2003) study do not include a non-participant group, the results of his study indicate gender does not affect mathematical growth, which reasonably aligns with the findings of this study that suggest gender did not affect the difference between the participants and non-participants. Conversely, Brown (2003) found significant improvement from year one to year two of the intervention program implemented in the Long Beach Unified School District when taking into account intervention level and gender. The male students decreased the percent of students scoring below the average proficiency and increased the percent of students performing above the average proficiency level. While this study only analyzed participants from year one to year two of an intervention program, a difference in mathematical growth did exist between male and female students.

Conclusions

Implications for Action

As discussed in chapter one, districts must make tough programming decisions that impact student learning. The findings of this study show that students enrolled in Math Lab, whether two, three or four semesters, have demonstrated greater mathematical growth than a student enrolled zero semesters. Although the mean mathematics MAP scores were not significantly different, they are headed in the right direction. Math Lab positively impacts the mathematical growth of students enrolled. The researcher would recommend counselors work diligently to ensure every student that is recommended for Math Lab be enrolled in at least three semesters.

However, imperfections appear to exist in the recommendation process. The researcher discovered students already at the proficient level were enrolled in seventh grade Math Lab. Based on personal communication with a current District A Math Lab teacher these students may have been on the lower end of proficient range, but she acknowledged the Math Lab placement process from sixth to seventh grade is not consistent. The inconsistency and lack of specific criteria could have led to the current situation. With eighteen different elementary schools, approximately fifty sixth grade teachers, and no definitive criteria to follow, it is inevitable that students needing Math Lab might not be enrolled and students already proficient could be enrolled. Although a criterion for placement in Math Lab exists, a stricter, uniform criterion might be helpful. The researcher recommends a representative group of sixth grade teachers, along with the Math Lab teachers, and a member of IOT (Instructional Operating Team) collaborate to create a draft of the criteria to be submitted for approval from the District A IOT.

Similarly, the seventh to eighth grade recommendation process is inconsistent. Students already at the proficient level were enrolled in eighth grade Math Lab. Again, the inconsistency and lack of specific criteria led to the current situation. Once more, a criterion for placement in Math Lab exists, but a stricter, more uniform criterion might be considered. The researcher recommends the Math Lab instructors, a representative group of seventh and eighth grade math teachers, and a member of IOT create enrollment criterion to be submitted for approval from the IOT in District A.

A final implication relates to special education (SPED) students. Some SPED students are allowed to enroll in Math Lab. However, this may not be the least restrictive environment for these students as determined by their IEP. The researcher recommends Math Lab instructors and Special Education coordinators establish a possible criteria that requires all students entering Math Lab also be enrolled in a non-modified seventh grade or eighth grade math class.

Recommendations for Future Research

The first recommendation is to replicate the study but add an additional qualitative component to create a mixed methods research design. A qualitative approach would allow a researcher to capture the students' perspective of pros and cons of the intervention program and to determine the students' perception of the effects of the program on their mathematical achievement. Student interviews would afford the participants an opportunity to share his/her perspective.

The second recommendation is to replicate the study using additional dependent variables. Additional dependent variables could include grade point average (GPA), mathematics course grade, or end of course assessments. These added variables might provide an additional component to measure mathematical achievement related to more specific course objectives.

The third recommendation is to replicate the study at the high school level in District A. District A offers a similar intervention program for high school students. It would be beneficial for the district to have data related to the high school recovery math when making decisions related to programming.

A fourth recommendation is to conduct the study using a longitudinal design. The study would follow the same students to determine the longitudinal effects of enrollment in middle school Math Lab on the students' high school End of Course Assessments, GPA, or to determine other math-related success.

Concluding Remarks

The study examined if there was a difference in mathematical growth, as measured by a difference in scale score on the mathematics portion of the MAP, among students who enrolled in Math Lab zero, one, two, three, or four semesters. The data was further analyzed to determine if the difference in mathematical growth, as measured by the change in mathematics MAP scale score, is affected by ethnicity or gender. Analysis of data revealed a significant difference for the main effect of enrollment by semester among students enrolled in Math Lab three semesters and students enrolled in Math Lab one semester. Students enrolled in Math Lab three semesters scored higher than students enrolled in Math Lab one semester.

Math education continues to be a national issue. Due in part to the NCLB requirements, districts and schools must put innovative programs in place in order to assist students who are struggling to meet the proficiency goal. District A must continue to seek ways to build on the current growth of the Math Lab students and continue to move forward in order to reach the goal of 100% proficient by 2014. Intervention programs should support the current grade-level expectations and take students at their current mathematics achievement level and support them academically. This is crucial regardless of the type of program that is utilized. School and districts must maximize the support programs in order to attain AYP and to reach the goals established under NCLB.

By helping students reach proficiency, we not only meet the goals established under NCLB, we prepare students to use mathematics comfortably throughout their lives.

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APPENDICES

APPENDIX A: MEETING THE REQUIREMENTS OF AYP

Table E1

Meeting the Requirements of Adequate Yearly Progress

Step	AYP requirement
1	Subgroups, schools, and districts must meet the testing participation rate of 95%
2	Subgroups must meet the minimum cell size requirement in order to be evaluated for AYP.
3	• A school or district must have enough students scoring proficient or above to meet or exceed the Annual Proficiency Target. The school or district is required to meet the Annual Proficiency Target in the aggregate (all students) and for up to nine subgroups of students. • Only those students who have been enrolled a "Full Academic Year," in a building and/or district will be included in the calculation for the corresponding summary level. • The school or district's performance in relation to the established Annual Proficiency Target is determined by looking at the percent of students who score in the Proficient or Advanced levels on the grade-level MAP.
4	• Schools must have an attendance rate of at least 93% or demonstrate improvement from the previous year in order to meet the additional indicator target. • At the high school level, schools must have a graduation rate of at least 85% or demonstrate improvement from the prior year in order to meet the additional indicator target.
5	Although not required by NCLB, the confidence interval calculation is used by DESE to account for the error inherent in making AYP classifications of 'met' or 'not met'.
6	If a school or district does not meet AYP using the calculations in steps one through five, the growth model calculations are applied to determine if AYP is met.
7	If a school or district does not meet the Annual Proficiency Target for each subgroup, a provision called Safe Harbor allows another opportunity for the school or district to make AYP. Safe Harbor is NOT applied to the growth calculation.
8	A safe harbor confidence interval is not required by NCLB, but if a school or district does not meet AYP using Safe Harbor, a 75% confidence interval is applied to determine if AYP is met

Note. Adapted from 2010 DESE report, Understanding Your AYP. Retrieved December 12, 2010.

APPENDIX B:
NCLB REQUIRED ACTION FOR SCHOOLS IN NEED OF IMPROVEMENT

Table F1

NCLB Required Action for Schools in Need of Improvement

	Years Not Making AYP			
Action	2	3	4	5
Develop 2-yr improvement plan	X			
School transfer options	X	X	X	X
Supplemental education services		X	X	X
Corrective actions			X	X
District initiate restructuring plan				X

Note. Adapted from U.S. Department of Education, NCLB Toolkit for Teachers, 2004

APPENDIX C:
MATHEMATICS ABBREVIATED ACHIEVEMENT-LEVEL DESCRIPTORS

Mathematics Abbreviated Achievement-Level Descriptors

Grade 6

Below Basic

Students compare and order integers, positive rational numbers, and percents; describe patterns in tables and pictures; identify properties of 2-D and 3-D shapes; identify acute, obtuse, or right angles; identify transformations of 2-D shapes; identify equivalent algebraic expressions using the associative property; read and interpret line and circle graphs.

MAP score range: 495–627.

Basic

Students generate equivalent forms of percents, fractions and decimals; determine a rule for a geometric or numeric pattern; use coordinate geometry to construct and identify 2-D shapes using ordered pairs; use models to compare and explain probabilities; estimate and interpret data in graphs.

MAP score range: 628–680.

Proficient

Students add/subtract positive rational numbers; identify least common multiple and greatest common factor; estimate quotients; determine rate of increase; analyze rates of change; use variables; compare spatial views of 3-D objects; construct polygons; describe transformations; determine area of rectangles; measure angles; convert within a system of measure; interpret and complete a table based on probability; compare/explain data; calculate measures of center.

MAP score range: 681–720.

Advanced

Students estimate and convert measurements; describe solutions to algebraic equations; recognize similarities between 2-D shapes; use properties of basic figures to draw conclusions about angle size; determine area of triangles; solve elapsed time problems; apply formula for perimeter; estimate area of a figure using a coordinate grid; interpret stem-and-leaf plots; determine appropriate data collection methods and questions; interpret data to solve problems. MAP score range: 721–845.

Grade 7

Below Basic

Students place integers on a number line; identify shapes from a group of 2-D shapes based on a common property; transform 2-D shapes; analyze precision and accuracy using measurement tools; identify unit of measure for volume; interpret bar graphs; use representations of data from bar graphs, circle graphs, stem and leaf plots, and box-and-whisker plots; predict outcomes using probability.

MAP score range: 510–639.

Basic

Students multiply and divide positive rational numbers; identify bases and exponents of numbers in exponential form; recognize equivalent numerical representations; solve 2-step problems; use variables to solve inequalities and equations; analyze patterns represented numerically or graphically; read and interpret graphs.

MAP score range: 640–684.

Proficient

Students' read/write numbers up to hundred-millions place; compare integers, rational numbers, percents; perform operations with mixed numbers; use circle graphs to recognize relationship of

parts to whole; solve fraction/decimal/percent problems; solve proportion/scale problems; use models to solve problems; model with equations; describe and classify 2-D/3-D shapes; apply spatial reasoning to estimate area; solve time problems; solve area problems; calculate measures of center.

MAP score range: 685–723.

Advanced

Students calculate totals involving percents in multi-step problems; extend non-linear patterns; model with inequalities; apply the relationship of corresponding and similar angles; use scale factors on a grid to dilate shapes; describe corresponding angles and sides of similar polygons; solve problems using time conversions; find circumference and area of circles; make conversions using proportions.

MAP score range: 724–860.

Grade 8

Below Basic

Students generalize numeric patterns; generalize relationships between attributes of 2-D shapes; identify the results of subdividing 3-D shapes; identify 3-D figures using a 2-D representation; solve problems involving area; use scales to estimate distance; interpret graphs; find the mean value of a data set; select graphical representations of data; interpret data; make conjectures based on theoretical probability.

MAP score range: 525–669.

Basic

Students perform operations with rational numbers; solve and interpret one-step linear equations; extend geometric patterns; generalize patterns to find a specific term; identify relationships in 3-D objects; calculate the theoretical probability of an event; interpret a scatter plot to determine the relationship between two variables.

MAP score range: 670–709.

Proficient

Students identify equivalent representations of a number; identify mental strategies to solve problems; solve multi-step equations; use symbolic algebra; identify transformations; classify angles; create similar polygons; use coordinate geometry; solve problems involving area; identify appropriate units of measure; convert standard units within a system of measurement; interpret graphic organizers; calculate measures of center.

MAP score range: 710–740.

Advanced

Students estimate the value of square roots; write numbers using scientific notation; solve two-step inequalities; analyze slope and intercept in linear equations; apply the Pythagorean Theorem using coordinate geometry; identify polygons based on their attributes; identify coordinates of vertices of a transformed polygon; use a protractor to measure angles; solve problems involving surface area; select, create, and use appropriate graphical representation of data.

MAP score range: 741–885 (DESE, 2007, p. 9)

APPENDIX D: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

Document Provided to Intended Researcher by:

Signature________________________ Date: Jan. 25, 2010
(Building Principal for District Employee
or SLC Staff for Out-of-district Researchers)

INSTRUCTIONAL OPERATIONS TEAM
School District

REQUEST FOR PERMISSION TO CONDUCT RESEARCH/GATHER DATA
IN THE SCHOOLS
TO MEET A COURSE REQUIREMENT

DIRECTIONS: The applicant should complete this form, obtain the necessary approval and signatures, and return to:
Associate Superintendent of Instruction & School Leadership

It may take up to three weeks for requests to be processed; please plan accordingly in order to meet course deadlines.

1. **Please describe concisely the basic concepts and goals of your proposed project, and include an explanation of how the project meets a course requirement within the field of education.**
   The research conducted in this clinical research study will answer the following questions:

   1. Is there a difference in the mathematical growth of Math Lab participants and Non-Math Lab participants measured by scale score and achievement level as determined by math MAP results?
   2. Is there a difference in the mathematical growth of Math Lab participants and Non-Math Lab participants measured by scale score and achievement level as determined by math MAP results based on gender and ethnicity?

2. **List the names of all data collection instruments you intend to use and enclose a copy of each with this application. Also, enclose a copy of each parent/student consent form. Please describe in detail the distribution, implementation, and collection methods you intend to use in your data collection.**

A data collection instrument will not be used in this study. Data collected will be demographic information and Math MAP test scores. This information will be collected utilizing Pearson Inform.

3. **Give the names of the School District public school(s), you intend to involve to meet the project requirements. Are there certain demographics required for the project (ie: grade level, gender, etc.)**

The study will be conducted using data from all three middle schools in School District , , and .
Demographics required include-names (to aide in organizing & sorting data-will not be utilized when analyzing the study), grade level, gender, and ethnicity.

4. **What amount of time would be required of staff or students in the schools in order to meet project requirements?**

The data collection process from each middle school would be a minimal requirement of time.

5. **Are there any other school records you would require (for example, achievement test scores or attendance?). If so, please provide a detailed explanation of your process to code such records to ensure confidentiality.**

Yes, I would like access to the Math MAP test scores (scale score and achievement level) of a cohort group of students. I would like to analyze the 2005-2006, 6th graders through their 8th grade year of the MAP testing (2007-2008). These years have been selected because of the consistency in staffing, software and program expectations of the Math Lab during this period of time. The names will be used to set up the initial statistical database, but will be coded once database is established. School names will only be utilized in background of research. A comparison will not be made between the three middle schools.

6. **Give the name of each person who will enter the schools. For non-district employees, please provide existing background checks for individuals or a plan to ensure background checks are in place prior to entry in schools.**

Tressa Wright, Math Lab Instructor

7. **What is the date you wish to begin?** February 15, 2010

8. **By what date do you anticipate being finished?** December 2010 .

9. **Please obtain the signature of your instructor responsible for this assignment and attach a copy of the assignment guidelines.**

Signature: Susan K Rogers, Ph.D.

Position: Associate Professor

University/College/School/Department/Division: Baker School of Education

10. **Name of applicant (please print)** Tressa D Wright

Tressa D Wright
Signature **Address**

Math Lab Instructor /
Position/Status

1/25/2010
Date **Phone Number**

Approved 2008

Approved 2008

APPENDIX E: APPROVAL TO CONDUCT RESEARCH

Research Request

to: Tressa Wright 02/09/2010 10:05 AM

History: This message has been replied to and forwarded.

Good morning, Tressa,

IOT reviewed your request for research yesterday at our weekly meeting. There was a great deal of discussion about the importance of the study. Stan will make an appointment with you to go over the IOT requests back to you and discuss the acquisition of the data as well as discuss the results of the program he has been collecting over the past few years. We look forward to the results of your study.

Feel free to contact me if you have questions.

APPENDIX F: IRB FORM

BAKER UNIVERSITY

SCHOOL OF EDUCATION
GRADUATE DEPARTMENT

Date: 12/13/2010

IRB PROTOCOL NUMBER _______________
(IRB USE ONLY)

IRB REQUEST
Proposal for Research
Submitted to the Baker University Institutional Review Board

I. Research Investigator(s) (Students must list faculty sponsor first)

Department(s) **School of Education Graduate Department**

Name	Signature	
1. Susan Rogers	Susan K Rogers	Major Advisor
2. Margaret Waterman	Margaret Waterman	Research Analyst
3. John Laurie		University Committee Member
4. Dr. Amy Gates		External Committee Member

Principal Investigator:
Tressa Wright ____________________
Phone: 816-509-9231
Email:
Mailing address:

Faculty sponsor: Dr. Susan Rogers
Phone: 913-344-1226
Email: srogers@bakeru.edu

Expected Category of Review: __x_Exempt ___ Expedited ___Full

II: Protocol:

THE EFFECTS OF MATH LAB ON STUDENT MATHEMATICAL GROWTH IN THREE SUBURBAN MISSOURI MIDDLE SCHOOLS

Summary

In a sentence or two, please describe the background and purpose of the research.

The purpose of this study was to determine if a difference exists in mathematical growth, as measured by a difference in scale score on the mathematics portion of the MAP, among students who participated in Math Lab zero, one, two, three, or four semesters,. The second purpose of this study was to determine if the difference in mathematical growth, as measured by the change in scale score, is affected by ethnicity. The third purpose of the study was to determine if the difference in mathematical growth, as measured by the change in scale score, is affected by gender.

The study is being conducted in the three District A middle schools where research related the mathematics support program-Math Labs has not been conducted. The findings could provide pertinent results to facilitate informed decision-making for the School District.

Briefly describe each condition or manipulation to be included within the study.

The independent variables of the study are participation in Math Lab (0, 1, 2, 3, or 4 semesters), gender (male or female), and ethnicity (categorized as minority and non-minority).

What measures or observations will be taken in the study? If any questionnaire or other instruments are used, provide a brief description and attach a copy.

The research study includes a dependent variable of mathematical growth, as measured by a difference in scale score from sixth grade to eighth grade on the mathematics portion of the MAP. No questionnaires or other instruments will be utilized in the study.

Will the subjects encounter the risk of psychological, social, physical, or legal risk? If so, please describe the nature of the risk and any measures designed to mitigate that risk.

Subjects will not encounter any psychological, social, physical, or legal risks in this study.

Will any stress to subjects be involved? If so, please describe.

Subjects will not experience stress during this study. All data collected is historical.

Will the subjects be deceived or misled in any way? If so, include an outline or script of the debriefing.

Subjects will not be deceived or misled in any way during this study.

Will there be a request for information, which subjects might consider to be personal or sensitive? If so, please include a description.

Students will not be interviewed. The archived information to be used in this study includes student's name (names will be replaced with randomly assigned numbers), gender, ethnicity, participation in math lab, MAP achievement level and MAP scale score from sixth, seventh, and eighth grade. All data will be kept strictly confidential.

Will the subjects be presented with materials, which might be considered to be offensive, threatening, or degrading? If so, please describe.

No materials will be presented to the subjects for this study.

Approximately how much time will be demanded of each subject?

No time will be demanded of the subjects.

Who will be the subjects in this study? How will they be solicited or contacted? Provide an outline or script of the information which will be provided to subjects prior to their volunteering to participate. Include a copy of any written solicitation as well as an outline of any oral solicitation.

The subjects in this study were sixth, seventh, and eighth grade students in the District A School District from 2005 – 2006 to 2009 – 2010 school years. Students will not be solicited or contacted for this study. The district Instructional Operations Team reviewed and approved the request for access to the archival data to conduct research. The request to conduct research and the approval letter from the District A School District is included.

What steps will be taken to insure that each subject's participation is voluntary? What if any inducements will be offered to the subjects for their participation?

No subjects will be contacted for this study.

How will you insure that the subjects give their consent prior to participating? Will a written consent form be used? If so, include the form. If not, explain why not.

As no subjects will be contacted in this study, written consent is not necessary.

Will any aspect of the data be made a part of any permanent record that can be identified with the subject? If so, please explain the necessity.

All data utilized in the study will be coded for anonymity. No data from this study will be made part of any permanent record.

Will the fact that a subject did or did not participate in a specific experiment or study be made part of any permanent record available to a supervisor, teacher, or employer? If so, explain.

Archived data will be used for this research study. No data from this study will be made part of any permanent record.

What steps will be taken to insure the confidentiality of the data?

To protect anonymity and insure confidentiality the application specialist in District A will randomly assign a number to each student and will randomly assign a letter to each middle school. All data provided to the researcher will remain confidential and will only be utilized by the researcher.

If there are any risks involved in the study, are there any offsetting benefits that might accrue to either the subjects or society?

There are no risks involved in this research study. The benefit of the study is the contribution to the research related to this area as there is limited research related to utilizing double periods of mathematics. The findings of the study could provide pertinent information in regards to retaining or modifying the Math Lab program.

Will any data from files or archival data be used? If so, please describe.

All data in this study is archival data. The archived data used in this study includes student's names (names will be replaced with randomly assigned numbers), gender, ethnicity, participation in Math Lab, middle school attended (each middle school is assigned a random letter), MAP achievement level and MAP scale score from sixth, seventh, and eighth grade.

APPENDIX G: IRB APPROVAL

2-24-2011

Ms. Tressa Wright
School of Education Graduate Department
Baker University

BAKER UNIVERSITY
Own Confidence

RE: IRB: BU-2010-14: The Effects of Math Lab on Student Mathematical Growth in Three Suburban Missouri Middle Schools

Dear Ms. Wright:

The Baker University Institutional Review Board (IRB) has reviewed your research project application (BU-2010-14) and approved this project under the Exempt category. As described, the project complies with all the requirements and policies established by Baker University for protection of human subjects in research. Unless renewed, approval lapses one year after approval date.

1. A Project Status Report must be filed with the IRB annually for continuation.
2. Any significant change in the research protocol must be reviewed and approved by the IRB prior to altering the project.
3. Any change in the investigator(s) named in the original application must be reviewed and approved by the IRB prior to altering the project.
4. Any injury to a subject because of the research procedure must be reported to the IRB immediately.
5. When signed consent forms are required:
    a. the primary investigator must retain the forms until filed,
    b. consent forms must be filed with the OIR with the annual report,
    c. the subject must be given a copy of the form at the time of consent.
6. If this is a funded project, a copy of this letter must be with the grant file.

The Office of Institutional Research (OIR) must be notified when this project is completed or terminated. As noted above, you must provide an annual status report to receive approval for maintaining your project. If your project receives funding which requests an annual update, you must file your annual report at least one month prior to the annual update.

Thanks for your cooperation. If you have questions, please contact me.

Sincerely,

William R. Miller, Ph.D.
Chair, Baker University Institutional Review Board

CC: Susan Rogers, Ph.D., Faculty Supervisor.

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