Culminating Projects in Education Administration and Leadership   Department of Educational Leadership and Higher Education

12-2014

Factors of Sustainability for S.T.E.M. Themed Magnet Schools

Penelope S. Olson Howard
St. Cloud State University

FACTORS OF SUSTAINABILITY FOR S.T.E.M. THEMED MAGNET SCHOOLS

by

Penelope S. Olson Howard

A Dissertation

Submitted to the Graduate Faculty of

St. Cloud State University

in Partial Fulfillment of the Requirements

for the Degree

Doctor of Education

December, 2014

Dissertation Committee:
John Eller, Chairperson
Roger Worner
Frances Kayona
Kay Worner

FACTORS OF SUSTAINABILITY FOR S.T.E.M. THEMED MAGNET SCHOOLS

Penelope S. Olson Howard

The STEM concept is a means of providing an alternative, interdisciplinary program using inquiry and project based learning or other forms of advanced learning methodology. According to Thomas & Williams (2010), an educational concentration on the sciences and technology is not a new initiative; it was first introduced during the second half of the twentieth century. By the 1980s, it quickly became an educational trend that prompted governmental support for STEM programs (Thomas & Williams, 2010).

As recently as 2009, President Obama promoted his goal of moving United States students to a top international ranking among comparable nations by providing 100 million dollars to train STEM teachers in content understanding and teaching skills that give students a competitive edge (The President's Math and Science Teachers Initiative, 2011). STEM supporters are convinced that with quality K-12 educational programming in mathematics & science, including the integration of technology and engineering, United States students will surpass other nations as leaders in the global market for jobs in STEM related fields (Brown, Brown, Reardon & Merrill, 2011).

Although the literature is replete with research studies and reports that outline the history, implementation, and characteristics of magnet schools, as well as the evolution of the STEM movement, little was found on sustainability of STEM programs operating as magnet schools across the nation. Successful implementation and public reporting of school improvements specific to student performance and enrollment are important, but do not ensure sustainability of a program (U.S. Department of Education, 2008).

This study examined multiple program elements identified from the literature that school administrators report lead to sustainability of STEM themed magnet schools. Study results reported on the current impact and predicted future impact that select program elements have on sustainability of specialized, STEM themed magnet programs.

This study was designed to support the importance of sustaining STEM themed programs in schools. Whether the program is offered as a magnet school with integration goals or as a specialized school program, specifically for choice options, the concept needs to be continued to address the academic needs of students in the 21st century. "It is time to move beyond slogans and make STEM literacy a reality for all students" (Bybee, 2013, p. 102).

ACKNOWLEDGMENTS

DEDICATION

This dissertation is dedicated to my family. Thank you for your support and encouragement throughout the entire journey. It was a challenging process that tested my perseverance and provoked intellectual curiosity. To my spouse, Jimmy, who never questioned my resolve and desire to achieve this goal. Your love and unwavering belief in me helped me realize my academic dream. To my children, Jim and Mary, you each exemplified support in your own special way, and together, provided my inspiration. Jim, your parallel journey pursuing a Ph.D. was inspiring beyond words. Mary, I needed your ongoing encouragement and demonstrative "You can do it Mom" messages of support. I am so incredibly proud of both of you. Finally, a "shout-out" to my new daughter-in-law, Sara, and extended family (siblings, nieces, nephews) for believing in me and supporting my late career goals.

TABLE OF CONTENTS

LIST OF TABLES

Table   Page

LIST OF FIGURES

Chapter I

INTRODUCTION

STEM Education in the U.S.

Mid-twentieth century literature is rich with research-based studies and reports regarding the magnet school movement and its impact on desegregation efforts and student achievement (Barr & Parrett, 1997). It is from this era that STEM education arose. STEM education is an acronym for the cross-discipline approach to teaching: science, technology, engineering and mathematics. In the United States' school systems, the implementation of STEM can vary greatly (National Research Council, 2011). There are many configurations of STEM education, including public school district magnet schools that are offered as either a district program or at one or more identified schools within a district (Hutton & VandenBurg, 2011). An examination of history, reports and studies most influential on the magnet school movement and subsequent STEM initiative are included in the literature review of chapter two.

A magnet school program as characterized by the researcher is an area of curricular specialty focused on one or more unique program aspects that attracts students from neighboring school districts to a specialty school with distinctive goals. STEM education is one type of specialized program that may be delivered as a magnet school

option (Hutton & VandenBurg, 2011). The STEM concept gained great popularity in the final decade of the twentieth century and has continued as a popular educational approach into the initial years of the 21st century (Bybee, 2010).

The STEM concept is a means of providing an alternative, interdisciplinary program using inquiry and project based learning or other forms of advanced learning methodology. According to Thomas and Williams (2010), an educational concentration on the sciences and technology is not a new initiative; it was first introduced during the second half of the twentieth century. By the 1980s, it quickly became an educational trend that prompted governmental support for STEM programs (Thomas & Williams, 2010). As recently as 2009, President Barack Obama promoted his goal of elevating United States students to a top international ranking among industrialized nations by allocating 100 million dollars to train STEM teachers in content understanding and teaching skills that could provide students with a competitive edge (The President's Math and Science Teachers Initiative, 2011). STEM supporters are convinced that with quality K-12 educational programming in mathematics and science, including the integration of technology and engineering, United States students will surpass other nations as leaders in the global market for jobs in STEM related fields (Brown, Brown, Reardon & Merrill, 2011).

Historical Overview of Magnet Schools

According to Blank (1989), the decade of origin of the magnet school movement was in the 1960s. It served as an initiative to address the racial inequities in public education during a time of political conflict and violence in the United States. Prior to

the 1960s, Bybee (2010) reported that the United States was already moving toward significant education reform on both a national and international level. It was the 1950's Supreme Court *Board of Education* ruling, which mandated all American schools to eliminate segregation practices and provided an early context for school desegregation plans, that eventually led to the evolution of magnet schools (Steel & Levine, 1994). The mid–twentieth century era of profound changes in education put an end to dual school systems based on race, and dismantled practices that prohibited equitable educational opportunities for black students (Steel & Levine, 1994). The Civil Rights Project of 2011 (Tefera, Frankenberg, Siegel-Hawley & Chirichigno, 2011) confirmed that the magnet school concept continues in districts across the country and is one of the first and largest, voluntary approaches for successfully desegregating schools.

In the early 1970s, research and evaluation studies depicted magnet schools as the most promising solution for addressing desegregation concerns in school districts serving students in urban communities (Blank, 1989). As noted by Barr and Parrett (1997), this led to the school choice movement—a strategy employed by many school districts to attract minority and white parents to integrated, theme based, magnet schools. Once the magnet school model became widely accepted as a viable approach to address and reduce desegregation, the number of districts offering magnet school options increased nearly two-fold between 1982 and 1991, and student enrollment in such schools during that time period nearly tripled (Smrekar & Goldring, 1999). By the early 1990s, as declared by Steel and Levine (1994), 1.2 million students were enrolled in a magnet program, primarily in diverse urban public school districts throughout the United States.

The magnet school movement grew in popularity. This was much in part to its success as a voluntary approach to addressing racial balance in schools, but also for the unique, specialty programs that were created and successfully implemented (Hendrie, 1998). Sustainability of these types of theme based programs requires careful attention to continuous improvement, community support and outreach, and alignment with the school district vision (U.S. Department of Education, 2008).

Statement of the Problem

Although the literature is replete with research studies and reports that outline the history, implementation, and characteristics of magnet schools, as well as the evolution of the STEM movement, little was found on sustainability of STEM programs operating as magnet schools across the nation. Successful implementation and public reporting of school improvements specific to student performance and enrollment are important, but do not ensure sustainability of a program (U.S. Department of Education, 2008).

Therefore, this study was conducted to determine the program elements that school principals perceive lead to sustainability of STEM themed magnet schools. An illustration of critical program elements as reported in the literature include: unique curriculum or program structure, funding sources, impact on student achievement and community partnerships.

Rationale for the Study

Magnet schools with specialty programs are designed to attract students from outside a sponsoring district, offer alternative programs, and enhance student learning (Klauke, 1988). Once a unique themed based, magnet program is established,

sustainability can be challenging for many reasons: lack of funding sources, staff interest and motivation, and on-going support from school district administration and the community (U.S. Department of Education, 2008). This research study was designed to determine the impact a program's operational elements, geographic location, grade configuration and student achievement have on sustainability of STEM themed magnet schools.

While there is extensive literature related to the history and background of magnet schools and the evolution of the STEM movement, the research associated with sustainability of STEM themed magnet schools is limited. The purpose of the study is to examine operational elements related to magnet schools offering a STEM program, and ascertain principals' perceptions regarding those elements that have the greatest impact on program sustainability.

Research Questions

The following research questions guided this study:

1.   How do principals of select magnet schools rank program elements of STEM programs in relation to their impact on school sustainability?

2.   What are the differences in program elements reported as essential for sustainability of STEM themed magnet schools reported by principals based on geographic location, administrative structure, grade level configuration, and length of time in operation?

3.   What program elements of magnet schools do principals perceive as the greatest challenges to sustainability of STEM schools in the next three to five years?

4.   What is the impact of STEM themed magnet schools on student achievement as perceived by principals?

Conceptual Framework

The conceptual framework for this study was designed by the researcher using research from the literature related to successful magnet schools and STEM programs. Publications from professional organizations were also secured to identify factors that are used to evaluate successful magnet schools that operate with a specialty program focus. Significant references include the Magnet Schools of America (MSA) strategic plans from 2011 and 2013, notably their essential pillars of observable factors that define any successful magnet school. Another source was a report from the U.S. Department of Education (2008), that outlines a three phase guide for successful development and sustainability of magnet schools. Additionally, the National Resource Council (2011) identified the specific factors of teacher development, partnerships and school characteristics necessary to enhance STEM education.

The nine elements are built into the conceptual framework to guide the study on sustainability of STEM themed magnet schools. A visual reference of the theoretical framework is provided in Figure A.

Figure A. Nine Elements of STEM School Sustainability

Instrumentation

A quantitative methodology was employed using an on-line survey to measure principals' perceptions of factors that impact program sustainability of STEM themed magnet schools. "Surveys represent one of the most common types of quantitative, social science research. In survey research, the researcher selects a sample of respondents from a population and administers a standardized questionnaire to them" (Barribeau et al., 2012, p. 1). The survey instrument and administration protocol were developed by the researcher using the conceptual framework. The conceptual framework guided the study's parameters for determining the impact operational program elements have on program sustainability.

The survey instrument was checked for validity by either a minimum of four practicing administrative colleagues from the researcher's current place of employment

or from the researcher's doctoral studies cohort at St. Cloud State University, St. Cloud, MN. Additionally, the survey was pre-examined by another cohort class of students in August 2013 for purposes of feedback on the survey format and questions. This trial survey administration, referred to as pilot testing, provided an opportunity to test the survey instrument and make adjustments to the document prior to conducting the study (Slavin, 2007).

Study Participants

A select group of principals employed in STEM themed magnet schools were invited to participate in the study. Upon completion and approval of the survey instrument by the Institutional Review Board (IRB), it was sent electronically to the study participants with an introduction explaining the purpose of the study and the importance of their response. Multiple follow-up e-mail contacts to study participants were made at two-week intervals to ensure a high response rate. A minimum of five e-mail or phone call attempts were made to secure completed on-line surveys from the study participants within six weeks.

Data Analysis

Participant responses were downloaded into an excel spreadsheet and imported into the Statistical Package for the Social Sciences (SPSS) for analysis. Survey results provided the data to answer the essential questions asked of study participants about program elements that impact sustainability of a STEM themed magnet school. Responses to the two open-ended questions were summarized and reported in table format.

<u>Assumptions</u>

The assumptions of this study were as follows:

1.   Study participants will make every effort to complete the survey

accurately and honestly.

2.   Survey responses received from study participants will accurately reflect

their professional perceptions.

3.   The STEM themed magnet schools selected for the study represent varied

geographic areas of the United States and grade configurations.

<u>Limitations</u>

Roberts (2010) refers to limitations of a study as the constraints or areas that the

research/er is unable to control. The limitations of this study were as follows:

- This study was voluntary and limited to the number of respondents who

  chose to complete the on-line survey within the response window.

- The responses were limited by the experience, knowledge and perception

  of the study respondents as they pertained to the survey questions.

- The survey relied on the study respondents to self-report their

  interpretation of the questions.

- The study was limited by the degree to which the identified school

  principal or administrative designee agreed to participate in the study and

  responded openly and honestly to the survey questions.

<u>Delimitations</u>

Delimitations refer to the boundaries or scope of a study as determined by

the researcher (Roberts, 2010). The following were delimitations of this study:

- Survey responses were accepted during the months of December 2013 and January 2014.

- Survey responses were limited to study participant perceptions relative to factors the lead to sustainability of a STEM themed magnet school.

- The survey sample was limited to STEM themed magnet schools that are included in the Magnet Schools of America (MSA), Directory of Magnet and Theme Based Schools, 11th edition, published in July 2012.

- Standardized student achievement measures used to report principal perceptions on effectiveness of STEM themed magnet schools were limited to mathematics and reading.

<u>Terms and Definitions</u>

There are many pertinent terms used in this study that will benefit the reader in fully understanding the study's purpose, literature review, methodology, findings and recommendations for future use. Roberts (2010) suggests that terms should be defined operationally based on how they are used in the study to avoid any misinterpretation for the reader. Most of the terms below include a cited source, unless the definition was created by the researcher for purposes of this study.

Alternative School – A school that promotes a different focus of learning using programs that are non-traditional, including Montessori, non-graded, and open school (Barr & Parrett, 1997).

Conventional Schools – One of the many school or program options available in

urban school districts that is distinguished as a traditional neighborhood school

(Barr & Parrett, 1997).

     Defacto segregation –A reference to a school situation in which student

attendance is predominately one race based on the composition of the neighborhood

(Auster, 1965).

     Desegregation Plan – A formalized system for establishing a racial & ethnic

balance in some or all schools within a school district. Typically, the schools are located

in urban areas. There are three types of desegregation plans including voluntary,

mandatory, or controlled choice (Steel & Levine, 1994).

     Integrative STEM Education – Connections in learning between two or more

STEM subjects or between at least one STEM subject and other curriculum content areas

(Sanders, 2009).

     Intradistrict-choice – Students select schools of choice within a given public

school district (Cookson, 1994).

     Interdistrict-choice – Students cross school district boundary lines to attend

schools in neighboring districts. Tuition funds follow the student and transportation is

typically provided (Cookson, 1994).

     Instructional Practices and Distinctive Curriculum – One aspect of the

theoretical framework that defines the unique curriculum and instructional practices of

STEM schools in this study.

     Magnet Schools – The largest set of choice-based schools in the nation that

typically have special themes or curricular focuses that attract a diverse student

population for the purposes of improving racial integration of schools (UCLA Civil

Rights Project, 2003)

Program Elements – Refers to the operational aspects of theme based magnet schools that were identified from the literature review and included in the conceptual framework.   These program elements provided the basis for the survey questions.

Program Recognition –Refers to merit awards and recognition of teachers and principals for exceptional performance at a magnet school (Magnet School of America, 2011).

Program within a School Magnet – A select portion of the student body participates in the magnet aspect of the school that includes only those students who where accepted into the program (Steel & Levine, 1994).

Programs of Choice – Students attend either the assigned school or another school within the district or outside the district. This type of program is also referred to as open enrollment (Steel & Levine, 1994).

STEM Education – "A standards-based, meta-discipline residing at the school level where all teachers, especially science, technology, engineering, and mathematics (STEM) teachers, teach an integrated approach to teaching and learning, and where discipline-specific content is not divided, but addressed and treated as one dynamic, fluid study" (Merrill & Daughtery, 2010).

Specialty Schools- Typically, this type of school, is non-magnet and attracts students due to unique instructional approaches or distinctive curricula (Steel & Levine, 1994).

Schools of Choice – This type of program, sometimes referred to as programs of choice, allows students to attend their home schools or another school within the

district or another neighboring district (Steel & Levine, 1994).

STEM Themed Magnet School – A specialty program that is choice-based and includes a Science, Technology, Engineering and Mathematics theme that is developed and operated as a magnet school.

Sustainability – Maintain full operation of any K-12 configured magnet themed school over multiple years with adequate funding and staffing resources to deliver the overall intent of the specialized program.

Whole School-Dedicated Magnet – A school with a specialized curriculum or other unique program option that is designed for participation of all students who attend the magnet themed school (Steel & Levine, 1994).

Dissertation Structure

The dissertation is organized into five, clearly defined chapters that are formatted to assist the reader in understanding all aspects of the study on factors related to sustainability of STEM themed magnet schools. Each chapter will vary in content and length based on the specifics necessary to explain the study, highlight the literature, outline the methodology and report findings and recommendations.

Chapter one, Introduction, outlines the purpose of the study and the research questions. It also provides an illustration of the conceptual framework of program elements used to guide the study. A list of essential terms are defined to assist the reader in gaining full understanding of the context relative to the specific nature of the study on sustainability of STEM themed magnet schools. Chapter two, The Review of Related Literature, contains a broad review of the literature pertaining to the history of magnet

schools and the evolution of STEM programs. Chapter three, Methodology, provides an

overview of the quantitative methodology that will be used to collect and analyze the

participant responses from an on-line survey instrument. Chapter four, Research and

Findings, will report the findings on STEM school sustainability from the study's

administered survey. Chapter five, Conclusions & Recommendations, will summarize

the key findings from the quantitative study and provide recommendations for further

study.

Chapter II

REVIEW OF RELATED LITERATURE

The literature review is divided into two sections: magnet schools and STEM education. The first section includes: the history of magnet schools and its evolution through the last decades of the 20th century; problems and challenges associated with magnet schools; and lastly, an historical outline of the milestones and successes with magnet schools. The historical perspective addresses early notable events and landmark federal court rulings that led to the magnet school movement, and early implementation challenges, and the varied types of magnet schools and themes that surfaced as the movement gained momentum.

Section two of the literature review is about the STEM movement, distinctively the origin of the concept, characteristics of STEM programs, and the future of STEM education as a means of improving academic learning systems and preparing students for 21st century careers that may not exist today. The final section of the review places emphasis on the current STEM initiative in American schools.

THE MAGNET SCHOOL MOVEMENT

Historical and Political Context

Initial research and implementation of magnet schools centered on common school themes for specialized schools that typically incorporated the fine arts and performing arts, general academics, the sciences and other themes that aligned with more traditional school programs (U.S. Department of Education, 2008).

The concept of specialty themed schools dates back to the early 20th century and resembled aspects of the magnet school movement that emerged decades later after the Civil Rights Movement in the mid-twentieth century. These programs provided a distinctive methodology or unique content approach (Steel & Levine, 1994). The history of such distinctive school programs that preceded the magnet school movement is reported by Steel and Levine's study:

> Magnet schools have their roots in the concept of district-wide specialty schools, such as the Bronx School of Science, the Boston Latin School, Chicago's Lane Tech, and San Francisco's Lowell High School, some of which have been in existence since the turn of the century. Like their forebears, magnets offer special curricula, such as a math-science or performing arts programs, or special instructional approaches, such as individualized education, open classrooms, or ungraded schools. (Steel & Levine, 1994, p. 32)

Many reports in the literature refer to significant landmark court rulings that set the stage for desegregation efforts and the birth of the magnet school movement in the 1970s. The *Brown v. Board of Education* Supreme Court ruling in the mid-1950s, overturned the *Plessy v. Ferguson* constitutional decision from 1896 that approved the "separate but equal" principle (Cookson, 1994). Educational equality was finally being addressed as school districts implemented desegregation plans to end the "separate but

equal" educational system (Fruchter, 2007, p. 7). Cookson (1994), associate provost at

Adelphi University at the time, and author of numerous books on educational policy,

reported, "The Supreme Court found that during the end of the nineteenth century,

separate was not equal and that minority students in the United States were being

deprived the right of equal protection under the law" (Cookson, 1994, p. 27). Tefera,

Siegel-Hawley & Orfield (2011), confirmed that the "separate but equal" principle was a

violation of the United States Constitution and that the *Brown v. Board of Education*

Supreme Court decision was pivotal to the advancement of racially integrated, public

schools. Although the "separate but equal" principle was in sharp opposition to the

school choice initiative, it presided as the Supreme Court ruling for over fifty years

determining educational practices for blacks and whites (Betts, Rice, Zau, Tang &

Koedel, 2006).

   These significant Supreme Court rulings are critical precursors to understanding

the introduction of magnet schools. They were the next movement in the transformation

of the American education system**,** that emerged in the late 1960s and early 1970s.

According to Cookson (1994), the passing of the federal desegregation court ruling

resulted in the redesign of the American education system by forcing districts to create

racially blended schools in urban areas. During the early years after the 1954 landmark

Supreme Court decision, most of the focus to correct the racial inequities in schools was

on the South, according to Frankenburg and Lee (2002). As a result, the majority of

racially balanced schools by the early 1970s were in the southern states.

   An early choice concept that preceded the magnet school movement in the 1960s

as described by Frankenberg and Siegel-Hawley (2008), was the "Freedom of Choice"

plan. Many southern United States schools embraced this plan as a means of holding off

federally mandated desegregation. McPherson (2011), referred to the purpose of

voluntary transfers that occurred with the "Freedom of Choice" plan as giving parents an

option regarding which school to send their child. McPherson suggests that the negative

impact of the "Freedom of Choice" approach resulted in "segregated learning conditions,

the creation of private schools, and the continuance of racial tension in public schools"

(McPherson, 2011 p. 468). Carey (2006), revealed his position on the historic role of

voluntary transfer that occurred with the "Freedom of Choice" method as the only means

of achieving racial balance in schools at the time.

> The use of voluntary transfers as a sole tool for furthering desegregation
> is a return to the Supreme Court's 1896 separate but equal ruling in *Plessy
> v. Ferguson* and a backdoor dismissal of *Brown v. Board of Education.*
> Voluntary desegregation was the central statement of Plessy.   If the two
> races are to meet upon terms of social equality, the court said in that case,
> it must be the result of natural affinities, a mutual appreciation of each
> other's merits and a voluntary consent of the individuals. (Carey, 2006, p. 54)

It was at this time, efforts to decrease segregation were becoming evident in

areas outside the South using solutions that moved students between city and suburb to

eliminate racial inequities (Tefera et al., 2011). Frankenburg and Lee (2002), noted that

achieving educational equality was particularly challenging for large urban cities with

high minority rates, because of the 1974 Supreme Court ruling that eliminated forced

busing plans established to transport students between neighboring urban and suburban

areas.

As urban school districts attempted to avoid mandatory, desegregation plans to

integrate schools, the magnet school concept was gaining interest as a voluntary means

of desegregating school communities (Rossell, 2005). Chen (2007) suggested that

magnet schools provided options for parents to explore alternative programs within the

public school system. This author noted that families were now able to take advantage of

theme based specialized school programs outside their school attendance area, typically

not bound by an academic selection process.

It was in the late 1960s and early 1970s that the magnet school concept used

today was formed as a means to counter forced busing for school desegregation purposes

(Barr & Parrett, 1997). The magnet school concept was fundamentally designed to

attract students from vast racial backgrounds to an alternative educational program that

would result in racially balanced school settings (Blank, 1989). Instead of forced busing

to a school in an unfamiliar neighborhood, families could now choose a new program at

a specific theme based magnet school. The effort was to slow the "white flight" of

students from outlining suburban school districts to private schools (Barr & Parrett,

1997). Cookson (1994), referred to the "white flight academies" as an alternative for

parents who panicked with the forced busing mandate and wanted to avoid sending their

child to a school with predominately African-American students; therefore, they

established private, all-white schools. "Despite the Court's decision, de facto segregation

continued, north and south, because America's neighborhoods are segregated by race

and class" (Cookson, 1994, p. 27).

It was believed that the negative attitudes associated with desegregation would

lessen as federal judges and school district officials began introducing schools of choice.

This introduction was in an effort to voluntarily attract white and minority families to

integrated schools (Barr & Parrett, 1997). The theory, according to a report by the U.S.

Department of Education (2004), was simplistic. "Create a school so distinctive and appealing – so magnetic – that it will draw a diverse range of families from throughout the community eager to enroll their children even if it means having them bused to a different and, perhaps, distant neighborhood. To do so, the school must offer an education option – a specialty –that is not available in other area schools." (U.S. Department of Education, 2004, pp. 1-3)

Magnet schools emerged as a result of the political turbulence brought on by school desegregation in the 1960s and early 1970s (Barr & Parrett, 1997). Smrekar and Goldring (1999), reported that after the federal courts declared magnet schools a viable option of desegregation through school choice, the number of magnet schools across the country grew at a rapid rate. They were designed to promote voluntary desegregation by allowing students to pursue an alternative school program, in lieu of mandatory forced busing plans (McPherson, 2010). By the early 1980s, approximately one-third of urban school districts sponsored at least one magnet school program (Blank & Archbald, 1992). The concept continued into the 21st century with 31 states reporting magnet schools in 2005-2006, constituting over two million students enrolled in a specialty magnet program (Frankenberg & Siegel-Hawley, 2008). According to Michelson, Battio and Southworth (2008), over three percent of students attending a public school in the United States are enrolled in a magnet program.

Klauke (1988), declared that magnet schools counteracted racial segregation through open access to schools outside the established school district boundaries and offered parents an opportunity to voluntarily enroll their child in a neighboring school. As the attraction of magnet schools centered around a specialized program, the options

continued to expand. They were heralded by educational leaders and politicians at the local, state and national level as the answer to urban reorganization, reform and innovation (Blank & Archbald, 1988). Klauke (1988) asserted that the alternative concept needed to be perceived by constituents as a viable, established program, located in a neighborhood that is closely aligned with the stability of regular schools within a system. He further described the magnet school concept as an innovative approach that must not be viewed as a passing educational fad or short-term initiative by parents, community and staff.

Since the 1990s, magnet schools have offered a range of unique, specialized programs, structures and curriculum, and many are in the areas of mathematics and science (Toch & Linnon, 1991). These specialized schools are considered 'theme based' and when specifically focused on science, technology, engineering and mathematics, schools are coined as having a STEM concentration. STEM started as a response to a national concern regarding students' low academic performance at an international level in the sciences and technology (Thomas and Williams, 2010). The literature includes multiple reports on approaches and strategies that contribute to program sustainability of magnet schools. The United States Department of Education, Office of Innovation and Improvement (2008), in their comprehensive report, outlined four steps for sustaining a successful, magnet program, Creating and Sustaining Successful K-8 Magnet Schools (Figure B).

Sustaining Success: Keeping the Doors Open *(Creating and Sustaining Successful K-8 Magnet Schools; Innovations in Education)*	
Adopt a Continuous Improvement Model	Successful magnets focus on progress, using data-based decision-making to make change and monitor results.
Build Win-Win Partnerships	They develop mutually beneficial relationships with organizations and community members to establish a broad base of supporters.
Develop Community Outreach	They promote their value by educating the public about the school's mission, achievements, and needs.
Align With a District Vision	They lead school reform efforts, incubate best practices, and contribute to the health of the district by collaborating with other schools.
	(U.S. Department of Education, 2008, p. 5)

Figure B. U.S. Dept. of Education's Steps to Sustaining Success

The first magnet school opened in 1968 at a small elementary school in Tacoma, Washington (Rossell, 2005). In an attempt to search for alternatives to forced busing, McCarver Elementary School submitted a proposal and was funded $200,000 from a Federal Title III grant to implement what they coined the "Exemplary Magnet Program." When the magnet school opened, the minority enrollment exceeded 60 percent and within a few short months the percentage of minority students attending the school dropped sharply (Rossell, 2005). The author proclaimed that within two years of implementation, the minority enrollment at McCarver was consistently below 50 percent. By 1990, McCarver Elementary School became a popular option for parents pursuing an alternative educational program. As a result, there were waiting lists for future school enrollment.

In 1969, only one year after the opening of the first magnet school on the West coast, a second magnet school opened on the East coast at the William Monroe Trotter School in Boston, MA (Rossell, 2005). This was another example of attracting white students to a predominately black school by offering a unique, curricular program. Located in Beantown's poor Roxbury section of the city, the school was built as a "showcase for new methods of teaching – enough of a showcase, it was hoped, to attract white children to a black neighborhood for their schooling" (Rossell, 2005, p. 45).

During the early years of urban school desegregation plans, Rossell (2005) confirmed that there was dispute. One highly publicized conflict over busing was in the Charlotte-Mechlenburg School District. The large urban school district, located in North Carolina, was mandated by a federal court decision to bus students across the city to ensure racial balance in their schools. This case landed with the Supreme Court in 1971 and resulted in a ruling that forced districts to implement desegregation plans to racially balance their schools (Rossell, 2005). It was the Supreme Court decision and continued resistance to forced busing that spurred many districts into offering magnet schools as a voluntary option for integrating students (Howell & Peterson, 2002).

The magnet concept continued to grow, and by the mid-1970s, as reported by Kafer (2005), magnet schools had surfaced in most urban cities around the country due to desegregation mandates and the availability of federal funds that prompted schools to create attractive, alternative programs that were based on choice. Multiple studies and reports refer to the surge of urban school districts across the country in the early 1970s that were developing unique program options to attract students as a response to federal desegregation mandates. Donald Waldrip, founder of Magnet Schools of America

(MSA), referred to the first "super" high school in Dallas, Texas that was designed to attract a highly diverse population of students from around the city; opening its doors at all hours and even extending programs to adults (Waldrip, 2000). Around the same time, during the beginning years of the 1970s, a performing and visual arts school opened in Houston, Texas. It was then that the term "magnet school" was first coined to symbolize students attracted to a particular school of choice (Kafer, 2005). It was a metaphor that defined schools created to "attract" students from other attendance areas (Chen, 2007). The "magnet" term was extensively used and by 1975, schools of choice accessing federal funds were commonly referred to as magnet schools (Waldrip, 2000).

In the early 1980s, after a decade since the emergence of magnet schools, Steel and Levine (1994) reported that the courts shifted from exclusive reliance on required desegregation through mandatory reassignments of students to neighboring schools, to voluntary plans that would open opportunities for families to elect another school based on unique program qualities. This new federal change in legislation was enacted to promote an increase in voluntary transfers, and to acknowledge parent interests and satisfy their requests for greater options (Steel & Levine, 1994). Smrekar & Goldring (1999), noted the impact federal courts had on the expansion of magnet schools when they accepted the concept as a method of desegregation.

As desegregation has diminished as a public school priority, the magnet school movement sustained its momentum with a shift toward school choice as the basis for the alternative program option (Rossell, 2005). The U.S. Department of Education (2008), declared magnet schools as more than a solution to desegregation mandates. A more diverse student population was just the beginning of what magnets could accomplish

because, as one researcher has noted, magnet schools were the offspring not just of the

search for racial and ethnic equity in public education, but also of the quest for improved

teaching and learning. Their theme-based approach promoted many of the factors

associated with effective schools, chiefly, innovation in program and practice, staff and

curricular coherence, increased parent and community involvement, and greater student

engagement. "In the best of magnet schools, this adds up to higher student

achievement." (U.S. Department of Education, 2004, p. 3).

Even though the overall purpose of the program has changed, diversity continues

to be a significant factor in continued magnet school success (Ackerman, 2013). With

the 2007 Supreme Court decision in *Parents Involved in Community Schools v. Seattle

School District No. 1*, it is more challenging for districts to maintain racially balanced

schools (Coffee & Frankenberg, 2009). The 2007 Supreme Court ruling referred to as

the PICS decision, states that "schools may no longer use an individual student's race or

ethnicity as a sole factor in assigning students to a particular school site" (Coffee &

Frankenberg, 2009, p. 1).

Theme Based Models and Programs

An important historical aspect of the magnet school movement in the

literature, is its early expansion through the development of varied, enriching program

themes. The research is extensive with studies and reports on the varied types and

concentrations of magnet school programs available in school districts across the

country.

This evolution is evident in purpose and design from the earliest programs to

magnet schools operating today in the 21st century. Hausman and Brown (2002),

affirmed that magnet schools are the most common offering of school choice in the U.S. public school system. They are made available to families to promote diversity, enhance academic achievement and provide program options to address a range of individual interests and talents. According to The Civil Rights Project, Race in American Public Schools documented by Frankenberg and Lee (2002), among choice-based schools, magnet school programs offer the largest option of multiple themes and alternative curriculums to elicit students from diverse communities.

The most common magnet school themes in the early years of implementation were focused on specific areas that included the arts, sciences and general academics (U.S. Department of Education, 2008). According to Steel and Levine (1994), program models from the beginning of the concept were typically designated as either a school-wide magnet approach or a smaller school-within-a-school program that would impact only a limited number of students. The structure of the magnet school program was usually determined by the type of desegregation plan the school district adopted (Rossell, 1990). By the 1980s, nearly 60 percent of urban school district programs across the country offered whole school magnets (Steel & Levine, 1994).

Rossell (2005) reported on a less common magnet school option, referred to as a dedicated magnet school program. In this type of program there is no attendance zone and all students who have volunteered to attend, are either from within the school district boundaries or from a neighboring school district. Rossell (2005) also reported that no students are assigned to the school due to their place of residence. The research suggests that dedicated magnets were less popular because the option often did not fully address a school district's desegregation goals.

The terms 'alternative schools' and 'schools of choice' are frequently used interchangeably to define magnet schools. Regardless of the term used to describe a magnet school, they are public schools that are distinguishable by either distinct themes or methodologies (Smrekar, 2009). One common theme approach is to focus on a particular subject area such as foreign language, math or science (Smrekar & Goldring, 1999). Klauke (1998), discussed the special curricular emphasis or other unique program features that attracted families to these often smaller, personal learning environments designed to help school districts meet racial quotas. According to Cookson and Shroff (2012), over 300 magnet high schools are currently in operation with themes that include both career and academic courses of study. The types of specialty programs created include a range of offerings in the sciences, arts, bilingual programs and special education (Cookson & Shroff, 2012).

Magnet schools are not limited by grade configuration, type of program or location (Merritt, Beaudin, Cassidy & Myler, 2005). The majority of magnet school attendance areas encompass multiple school districts, and initially were located in urban settings to address the racial imbalance of students in neighboring districts. Once a magnet school was established, it was open to students in other districts—the program was available to any family who applied. Therefore, schools needed to have the resources and expertise among the staff to address the needs of a wide range of students (Merritt et al., 2005).

Challenges Associated with Magnet Schools

While many of the research reports in the literature touted the successes of new and growing magnet schools in the early decades of implementation, many reported the problems and on-going challenges as well. The following captures these reported recurring issues.

Lagging expectations and performance. Based on work by Barr and Parrett (1997), early magnet schools were often reported as substandard and did not fulfill the expectations of a specialized program. In Berkeley, CA, over 20 alternative schools were identified by a similar problem and in Boston, MA, principals revealed that magnet schools were still underdeveloped after two years of implementation. It was often not until second and third generation students, did a trend appear in program model improvement. The most distinguishable change was in schools that embraced a career focus (Barr & Parrett, 1997).

The U.S. Department of Education found that nearly half of the schools accessing federal resources between 1989 and 1991 did not fulfill the government guidelines for a magnet school, as reported by Walrip, Marks and Estes (1993). The Civil Rights Project of 2008, as reported by Frankenberg and Siegel-Hawley (2008) found that 42 percent of magnet school programs were in compliance with federal desegregation guidelines. Schools reported on student achievement gains with their unique programs, although the programs were often not fulfilling the intent of the federal desegregation legislation. The Civil Rights Project published in 2008 also noted that the non-compliance schools were not using quality controls to monitor appropriate use of federal resources to fund their magnet program (Meeks, Meeks & Warren, 2000). As a

result, the data comparing achievement results of magnet schools with typical public

schools were inconsistent (Meeks et al., 2000). In some cases, according to Merritt et al.

(2005), schools did not fulfill the federal expectations because they lacked the skills

necessary for operating and managing alternative programs. They relied too heavily on

students' ability to make the curriculum connections instead of being deliberate about

planning a program with interdisciplinary approaches (Merritt et al., 2005).

According to Howell and Peterson (2002), findings related to the impact on

student achievement were not reliable because of the select population of students drawn

to magnet schools, resulting in inflated achievement gains. Goldring and Smrekar

(2002), reported similar findings stating that studies on the effectiveness of magnet

schools were inconsistent based on comparison studies of magnet schools operating as

either a public or private school program. A high percentage of schools from 1989

through 1991 that accessed federal grants did not have defined objectives that aligned

with government expectations for magnet schools. Therefore, achievement data results

were inconsistent and unable to be compared with traditional public schools (Meeks,

Meeks, Warren, Tefera, Frankenberg, Siegel-Hawley & Chirichigno, 2011). Cookson

(1994), in regard to the unreliable outcomes of magnet schools, said:

> The magnet school is a two-edged education sword; it helps a few students
> but has little or no impact on the educational system as a whole.   Because
> of the nature of research on magnet schools, we have little idea of their
> impact on student achievement or on education redesign. (Cookson, 1994,
> p. 77)

Transportation. Another problem cited in the literature was ensuring reliable

busing for out-of-district students. Transportation is an important factor in parents'

ability to access out-of-district choice programs. If not provided, student enrollment in

specialized magnet programs is typically reduced (Steel & Levine, 1994). This aspect of

the magnet movement according to Barr and Parrett (1997), nearly ended the concept

due to complications in effective, timely transportation of students across attendance

lines. Without transportation, enrollment in out-of-neighborhood schools was

considerably reduced (Barr & Parrett, 1997). In The Civil Rights Project released in

2008, the authors Frankenberg and Siegel-Hawley (2008) found that attendance

improves and racial isolation decreases when school districts establish transportation as a

priority for their magnet school program. In doing so, they guarantee that out-of-

neighborhood students are able to attend the school of their choice.

During the early years of the magnet movement, districts began looking

creatively at transportation systems that would address the need to transport students to

the appropriate neighboring school districts (Barr & Parrett, 1997). In most cases, the

results were positive; however, based on a report by Cookson (1994), forced busing

resulted in violent, racial friction in several large cities**.** One example cited in the

literature**,** was the political turmoil in the early 1970s regarding court dictated racial

integration plans that created forced busing in the Boston School District. This was the

first reported "forced busing with magnet options" (Rossell, 2005, p. 46). Many parents

objected to a racial quota system used to determine which school a student attends

(Ferrara, 1995).

> It seems a strange cure for racism to make race the basis for assigning children to
> their schools. The result is not to make racial differences the same as any other
> individual differences, but to make them the basis for the way people are treated.
> This seems to be the opposite of the result desired by all opposed to racism. Is it
> any wonder, then, that busing, which is implicitly racist, has not increased racial
> acceptance in Boston, but rather increased racial prejudice among some victims?
> (Ferrara, 1995, p. 2)

Decades later, according to Toppo (2004), some students attending magnet schools continued to take long bus rides to attend their school of choice, but the purpose of cross district busing shifted away from a racial equity initiative to a drive to find quality, alternative programs. Then in 2008, with the U.S. economic downturn and shortage of resources, many school districts considered reducing transportation for their magnet school students, knowing that the majority of families relied on busing to transport their child to a neighboring school district (Frankenberg, Siegel-Hawley & Tefera, 2011). "In a time of rising gas prices and diminishing school budgets, transportation has been on the chopping block at many school board meetings across the country" (Coffee & Frankenberg, 2009, p. 6). Nonetheless, in a report by Frankenberg and Siegel–Hawley (2012), nearly 70 percent of districts in 2011 were continuing to offer free transportation to magnet school students.

Socioeconomic disparities. Another reported area of concern with the magnet school program is the inequities associated with the socioeconomic status of families. Archbald (2004) reports that socioeconomic disparities that are created with the magnet school concept are a continuing concern. The author's work asserts that desegregation efforts associated with school choice has an extensive history that does not fully address the social-class issue. Case studies from districts with magnet-based choice plans, report less recruitment of low-income students. The intent of the magnet school model was to promote voluntary desegregation by allowing students to pursue an alternative school program while also promoting greater desegregation through voluntary means (McPherson, 2010). Smreker and Goldring (1999), support Archbald's concerns, indicating that these types of programs can add to the divide among socioeconomic

levels because middle class families are more aware of educational opportunities and have the resources to pursue alternative options.

Hausman and Goldring (2000), cited Moore and Davenport (1990), and concluded that neighborhood schools are experiencing higher percentages of disadvantaged students due to the flight of higher achieving students to magnet schools. Toch and Linnon (1991), contended that although magnet schools have been known to attract the high-achieving students, analysis is lacking on the impact their achievement has on the average academic achievement of students in the remaining neighborhood schools.

Admission criteria. There are many reports on the socioeconomic and racial disparities that have occurred due to admission criteria. Early magnets were established based on civil rights mandates that were typically void of selective admission processes, compared with current day magnet school programs that are established around program opportunities and academic achievement standards, instead of federally mandated desegregation requirements (Tefera et.al, 2011). Once admission processes started to be employed, ratio quotas were typically used to make admission decisions. Over the years, most schools have abandoned this form of selection process as desegregation mandates were lifted (Rossell, 2005). This process to select students was counter to early specialty schools according to Blank and Archbald (1992), that used stringent performance measures to identify and serve only a select pool of high-achieving students. The primary difference of magnet schools from early specialty schools is that students are attracted to magnet schools based on interest in a particular content or career aspiration as opposed to ability level or aptitude (Blank & Archbald, 1992).

Barr and Parrett (1997) reported on the use of admission exams to select students, and concluded that over fifty percent of secondary magnet schools and nearly twenty-five percent of elementary magnet schools utilized some form of a selective process such as open enrollment, lottery or interview to limit enrollment (Barr & Parrett, 1997). Based on a report by Siegel-Hawley and Frankenberg (2012), schools utilizing an open, non-competitive selection process are more diverse than schools using only competitive entrance standards. When schools use selective admission criteria according to Cookson (1994), they provide opportunities for a limited population, and overall, minimize the impact on achieving racial equity and balance. Cookson refers to the various admission systems that schools use to admit a select population of students. They range from holding auditions to student interest by lottery. They employ admission procedures to attract a diverse population of students that will voluntarily reduce racial and ethnic segregation. When legal issues have arisen, they usually have been related to admission processes that entice a select population of high performing students (Hendrie, 1998).

Toch and Linnon (1991), confirmed that students who do not get accepted at schools using select entrance requirements are often left in mediocre schools with teachers who were not hired by the highly competitive schools. "These inequities are often compounded by confusing or unfair admission policies that handicap poor students" (Toch & Linnon, 1991, p. 5). Magnet schools are typically viewed as more attractive to middle class families; according to Archbald (2004), they attract more regular attendance area students and a lower than desired percentage of low-income families from other neighborhoods. In addition to low-income, according to Chen

(2007), English as a Second Language and Special Education are other student populations that are often underrepresented in magnet schools.

Magnet schools that access federal funds favor a non-competitive selection process (Siegel-Hawley & Frankenberg, 2012). "Nearly 80 percent of Magnet School Assistance Program (MSAP) awardees employed lottery admissions procedures, and approximately 30 percent were governed by open enrollment policies. By contrast, just 16 percent considered test scores in their admissions procedures, while roughly 18 percent factored in GPA" (Siegel-Hawley & Frankenberg, 2012, p. 18).

Funding. Numerous studies report on the impact funding has had on the implementation and sustainability of magnet school programs. According to a U.S. Department of Education publication (2008), funding priorities for magnet schools are in the areas of professional staff development, theme based curriculum materials and updated technology as necessary requirements to continue attracting families and meeting the needs of current constituents. Rossell (1990) reports equipment as the most significant cost to the magnet school budget, followed by teacher training. These two budget expenditures are typically one-time costs associated with starting up a new program.

The start-up cost for a magnet program in the late 1980s, as reported by Rossell (1990), was approximately $500,000—that included staffing, equipment, supplies, and staff training. The National Center for Education Statistics (2001), found that expenditures per student, are on average about 10 percent higher at magnet schools than traditional schools.

As reported by Merritt et al. (2005), some types of programs (depending on the theme and grade levels served) are more costly than others. Specifically, Merrit referenced science themed schools as more costly due to the on-going expenses for consumable materials and updated equipment. Additional staffing is the norm with nearly three-fourths of magnet schools having been allocated additional allowances to adequately staff the program (National Center for Education Statistics, 2001). Merritt et al. (2005), refers to the funding challenges that magnet schools are forced to address.

Lack of funding has been an insurmountable obstacle for many a magnet school project. Magnets typically have smaller classes than other public schools and therefore require more teachers than would a traditional public school with the same number of students. It is not uncommon for magnet school expenditures to cost on average $10,000 to $12,000 per capita. "Some reports indicate, however, that added costs are more frequently found at the high school level and that magnet elementary schools can actually be run less expensively than their traditional counterparts." (Merritt et al., 2005, pp. 77-78)

Smrekar and Goldring (1999), confirmed that most magnet schools are funded through state desegregation resources or the federal Magnet Schools Assistance Program (MSAP). The norm is that magnet schools have more access to resources than traditional public schools. The resources may be in the areas of per-pupil allocations or staffing (Steel & Levine, 1994). Barr and Parrett (1997) note that the cost for new and developing specialized magnet schools is almost always higher than a sustained magnet or traditional program due to start up expenses. According to Rossell (1990), the initial start-up cost for a magnet program can have a significant impact on a district's budget,

as additional funds are pulled to support the new program. This drain on the overall
organization's budget can negatively impact the morale of staff at other sites within a
district, because the magnet program is perceived as the preferred program. In result,
some magnet schools are relying more heavily on business partnerships. This focus on
professional and career preparation often requires unique facility needs and specialized
materials and equipment; these incremental expenses can be absorbed by local
companies (Barr & Parrett, 1997).

The actual impact the level of funding has on the success of a magnet program is
limited according to Rossell (1990). Merritt et al. (2005), refers to the importance of on-
going funding streams as essential for program sustainability. In some schools, when
state and federal funds are limited or reduced, long-term sustainability may rely heavily
on efficiencies found with facility and energy costs to reduce overall program expenses.
Fiscal limitations at the state level cause concern according to Rossell (2005). As
desegregation becomes a secondary goal, magnet programs become a target when
resources are limited and programs need to be reduced or eliminated. Carr (2012),
reported in an interview with Richard D. Kahlenberg (senior fellow and writer of
education and civil rights at The Century Foundation), that federal funds available to
magnet schools started to decline after 1989. During peak years, federal funds available
to magnet schools approximated $114 million.

Rossell (2005), refers to funding as a concern to the sustainability of magnet
schools, but equally emphasizes mandates from the court system as a legitimate concern.
Though finances will always be a magnet school's primary concern, the greatest threat to
the magnet system going forward is the same as that which gave magnets their early

jump start, the courts. Even the No Child Left Behind Act's requirement that school districts adopt a voluntary desegregation plan, may conflict with legal precedents set in most federal appeals courts (Rossell, 2005, p. 2).

<u>Milestones and Successes of Magnet Schools</u>

In this section, the many milestones and successes of the magnet school model will be highlighted, including: program growth, community and business partnerships, parent relationships and student achievement.

<u>Participation and growth rate.</u> Early magnet school growth according to Klauke (1988), reflected fulfilled racial quotas met through voluntary participation by students outside the home district attendance boundaries. Most major urban cities reported success with magnet schools as a means to address desegregation (Toch & Linnon, 1991). In 1981, there were over 1,000 magnet schools on record in the United States and were reported as a popular trend in school choice (Rossell, 2005). As reported by Steel and Levine (1994), by the 1991-92 school year, the number of magnet program offerings exceeded 3,000 across the country. The program types during this expansion period were primarily in the areas of math, science, technology or world language (Smrekar & Goldring, 1999).

During an almost ten year span from 1982 to 1991, student enrollment in magnet programs across the country tripled (Chen, 2007). The majority of programs were located in many of the nation's largest urban school systems (Hausman & Goldring, 2000). At the turn of the 21st century, magnet school programs were continuing to grow

in numbers and popularity, according to the U.S. Department of Education (Smrekar &

Goldring, 1999).

By 2006, magnet schools could be found in 31 states (Frankenberg & Siegel-

Hawley, 2008). During the 2008-2009 school year, a report from the National Center for

Education Statistics reported magnet school enrollment exceeded two million students as

represented across the entire nation (Keaton, 2012). This statistic surpassed charter

school enrollments, which held magnet schools as the leading school choice option

available to parents (Siegel-Hawley & Frankenberg, 2012). The most recent count of

magnet schools across the nation according to Ackerman (2013) is approaching 4,000.

Kafer (2005) reported the largest concentration of magnet schools according to the U.S.

Department of Education in Illinois and California, with Illinois having the highest

percentage of students from any state attending a magnet school.

Federal funding was significant to the growth of magnet schools, since the

concept was initially supported as a voluntary means of desegregating schools (Rossell,

2005). School districts that proposed a magnet school primarily to reduce racial isolation

typically accessed funds to initially establish and sustain the school program through

state desegregation resources. Smrekar and Goldring (1999) report that in addition to

desegregation funds, the majority of magnet schools are provided resources through the

Magnet Schools Assistance Program (MSAP), which is a federally funded program that

provides two-year grants to qualifying school districts.

According to the U.S. Department of Education (2008), during the magnet school

movement of the 1970s into the early 1980s, funding was provided through the

Emergency School Aid Act, a federal funding resource that preceded the authorization of

the Magnet Schools Assistance Program (MSAP) in the mid–1980s. The initial purpose

of the Magnet Schools Assistance Program (MSAP) when first authorized in 1985 was

to "reduce, eliminate, or prevent minority group isolation and provide instruction in

magnet schools that would substantially strengthen students' knowledge and skills"

(U.S. Department of Education, 2004, p. 1). Kim and Sunderman (2004), revealed that

the actual funds dedicated to magnet school programming through the Emergency

School Aid Act (ESEA) between 1976 and 1984 amounted to $30 million. Later funding

from 1985 to 1991 came from the federal Magnet School Assistance Program (MSAP)

with allocations of nearly $750 million dedicated to 117 school districts in support of

their programs. Within three years, an additional $200 million was allocated to another

21 school districts throughout the nation. By 1994, over $950 million in federal funds

had been spent on the magnet initiative as a viable, alternative means of supporting the

school choice movement (Howell & Peterson, 2002). The role of the federal government

through court mandates and financial support "played a significant role in the

development of magnet school programs that promoted both equity and excellence in

United States public schools" (Kim & Sunderman, 2004, p. 9).

Partnerships. The magnet school movement according to Barr and Parrett (1997),

opened opportunities for local businesses to partner with public education in new

innovative ways. This new found relationship between businesses and local schools

provided prospects for school-to-work partnerships, adopt-a-school programs and other

approaches to enhance the educational system in urban areas (Barr & Parrett, 1997). A

Minnesota Department of Education (MDE) report entitled Magnet Schools; A Guide to

Minnesota Magnet School Choice (2008), refers to three elements that are essential to

the success of any magnet school: "community involvement, service learning and partnerships" (MDE report, 2008, p. 7).

According to Rapley (2011), sound connections and relationships with the community are essential for sustaining support for magnet programs and securing on-going funding. The author stressed the importance of local involvement and buy-in by the local experts from a myriad of professions, including: physicians, engineers and industry leaders to keep the magnet programs in area school districts at the forefront. Barr and Parrett (1997) stated that it is typical for a magnet school program to be adopted by a local business or program, with a portion of the costs to sustain the program absorbed by that local business or program. In some cases, use of specialized equipment and facilities at professional businesses are made available to students at the magnet school. Rapley (2011) reports that the importance of investment by local professionals and businesses is especially true for STEM magnet schools where the community can easily support the school's initiatives to relate STEM learning to the real world and create student interest in pursuing STEM related careers.

Magnet schools with a concentration on professional career preparation incur greater costs than typical public schools. A significant portion of additional costs are dedicated to facility upgrades and specific equipment necessary to address the specialized focus of the magnet program (Barr & Parrett, 1997). Rapley (2011) advocates for the use of a specialty magnet school model with a focus on STEM to increase opportunities for funding. District administration must look for alternative funding sources and partnerships with businesses and the community to create and sustain innovative STEM programs.

Unique Qualities. Merritt et al. (2005), cites magnet schools as distinguishable from traditional public schools based on the self-selecting element. Magnet programs allow parents to be very deliberate in their decision about the public school their child attends. The author continues by stressing the importance of program appeal to ensure a critical population of new enrollees. Toch and Linnon (1991), declared that the Bush Administration during the early years of the 21stcentury urged districts to access public funds to promote school choice. New schools were encouraged to break away from traditional models and increase program options.

According to the U.S. Department of Education (2008), a view of magnet schools today reveals broad curricular specialties and educational programs that mirror the highly individualized, unique interests of the community, with consideration given to available resources within the district boundaries. Merritt et al. (2005), addresses the qualities that distinguish a magnet program from a traditional school program. Magnet school proponents tout the improved instructional approaches employed and the benefit to other schools when those approaches are shared within the district (Chen, 2007).

The compelling quality of a magnet school based on work by Merritt et al. (2005), lies in its ability to deviate from the standard school district offerings by presenting a totally unique approach that showcases an educational theme and directs all resources towards delivering an in-depth focused program. This cannot be done by simply adding on to an existing school theme or focus, or by limiting the specialty offerings to a small faction of the student population. It must be substantial, distinguishable and fully aligned with the mission of the program (Merritt et al., 2005). Toch and Linnon (1991), refer to the distinct qualities of magnet schools that make them

important educational models. They highlight the small, close-knit setting and a shared mission as attractive alternative qualities to the full-size comprehensive high school.

Parent relationships. Hausman and Goldring (2000), reported on the importance of establishing home-school relationships, as parents who send their children to magnet schools are usually highly involved and satisfied with the school program. The role of parents and local community stakeholders are essential for implementing and promoting neighborhood magnet schools. Attention paid to parents and others who are invested in the program can inform improvement efforts and program evaluation (U.S. Department of Education, 2004). Magnet programs clearly promote better home-school connections with families and typically, the parents are more committed to their child's school of choice. Parents who choose the magnet school path, are generally involved and highly satisfied with the program (Hausman & Goldring, 2000).

Waldrip (2000) believes that if a magnet school truly attracts families voluntarily, the school will succeed simply because "those in attendance want to be there" (Waldrip, 2000, p. 2). According to (Smrekar & Goldring, 1999), opportunities for communication and involvement between home & school are heightened in magnet schools. The authors contend that in the specific areas of parent involvement and communication between home and school, many research studies found that magnet schools performed better than non-magnet schools in those areas (Smrekar & Goldring, 1999). Black (1996, p. 35) refers to magnet schools as a "powerful draw for parents" and backs her assertions with numerous research studies, particularly in the areas of quality programming and reduction of racial isolation.

Based on success with parent involvement in magnet schools, the U. S.

Department of Education (2004), supports the use of parents as a valuable asset for a

review and revision process of existing magnet themes to promote its continued

existence. School choice through magnet school options allows families to come

together for a shared purpose (Hausman & Goldring, 2000). A national study conducted

in 1983 reported that the quality of magnet schools was directly related to the

effectiveness of the administrative leadership, alignment of the school theme with the

curriculum and staffing, district policies around commitment to the program, and

flexibility with procedures (Blank, 1989). Cookson (1994), suggests that the element of

choice refers to a feeling of superiority among some parents.

> Schools of choice may not be objectively better than other schools, but there is a
> sense of being special. The very fact that families chose this school provides
> them with a sense of ownership. Choice schools can appear to be selective and
> thus adopt some of the cultural characteristics of academically and socially
> superior schools. (Cookson, 1994, p. 88)

Academic achievement. Academic achievement has become the foremost goal of

magnet schools, while still promoting diversity and equitable learning opportunities for

students (Siegel–Hawley & Frankenberg, 2012). Blank and Archbald (1992) reported

that districts with magnet schools typically report higher levels of student achievement.

In another study by Barr and Parrett (1997), the authors noted that student achievement

was favorable in magnet schools, particularly in the most diverse, large and poverty

ridden urban areas. Frankenberg and Siegel-Hawley (2008), stated similar findings with

achievement, but acknowledged that measuring the impact of magnet schools posed

challenges due to the methodologies used to collect the data. "Students in magnet

schools did score higher on science, reading, and social studies than did students in

comprehensive public schools" (Gamoran, 1996, p. 43). Although Gamoran found that specialized magnet high schools included in his study performed significantly higher than standard public high schools, the author noted that the study was difficult to generalize across all types of magnet schools due to the broad variation of magnet school programs that were offered at the time, and the population of students who elect to attend (Gamoran, 1996).

Klauke (1988), reported that achievement of minority students attending a magnet school improved without a negative impact on achievement levels of white students. Goldring & Smrekar (2002), praised achievement benefits from students attending a magnet school compared to samples of student achievement levels from other public and private schools. The content areas cited in the study were in the areas of reading and history. Goldring and Smekar (2002) referenced a study by Crain (1992), where students in a New York City magnet school successfully increased reading scores. Blank & Archbald (1992), found that "studies comparing magnets to non-magnets with similar student characteristics show that student outcomes are higher in magnet schools" (Blank & Archbald, 1992, p. 6). The authors report that magnet schools are making a positive difference in student achievement in many schools and districts across the nation; still, limited studies have been done to determine the effectiveness of magnet schools as a large scale educational innovation.

Attendance and participation. Student attendance and participation are reported higher in magnet schools and the environment among racial groups is generally harmonious as evidenced from the work of Doyle & Levine (as cited by Meeks et al., 2000). Flaxman, Guerrero, & Gretchen (1999), reported that magnet school students

outperformed non-magnet school students in multiple areas based on a longitudinal study of over 1,000 students in four school districts.

Musumecci and Szeczypkowski (1991) found that those who spent a longer period of time in magnet schools had better promotion rate and enrolled in more college prep courses than those who spent only a relatively brief period of time. In general, on all measures of academic success, behavior, attendance, and participation in school activities, the long-term magnet school students outperformed short-term (or non-magnet) counterparts (Flaxman, Guerrero, & Gretchen, 1999, p. 1).

According to the work of Siegel-Hawley & Frankenberg (2012), over 80% of magnet schools that accessed MSAP grants reported an increase in achievement scores after receipt of federal funds. The authors also purport that magnet schools are not only charged with carrying out the initial purpose of the program (in regards to achieving racial balance and equity) but also, are forerunners of academic excellence in the continued 21st century magnet school movement.

Frahm (2010) reported on Cobb's achievement of student research from Connecticut's most racially diverse and poor cities. He revealed that those students who attended "racially integrated magnet high schools made greater gains in reading and math than did students in traditional city schools" (Frahm, 2010, p. 1). Professor Roslyn Michelson, from the University of North Carolina-Charlotte studied hundreds of racially integrated schools and reported positive academic findings. There is strong evidence to suggest that attending a racially and socioeconomically diverse school has positive effects on math and reading and other areas, such as science (Michelson et al., 2008). "Diverse schools foster academic achievement, break the intergenerational transmission

of racial misunderstanding and hostility and prepare students for citizenship and work in

a pluralistic democratic society that is part of a global economy" (Michelson et al., 2008,

p. 5).

THE STEM MOVEMENT

This final section of the literature review is devoted to the STEM movement,

Including its history, as well as the contextual need and the future demand for its

programming.

Historical Context

The Soviet Union's launch of Sputnik in 1957, heightened the awareness of

science and technology in the United States (Thomas & Williams, 2010). According to

Means, Confrey, House & Bhanot (2008), it was competition heightened by the Cold

War and the race to early space exploration, that brought about the emergence of focus

on mathematics and science in the late 1950s and early 1960s. These politically

motivated forces spurred the United States to aggressively embrace STEM education.

This reactive response according to Thomas & Williams (2010) is consistent with

history. STEM education has always moved to the forefront in step with historical events

that potentially threaten our national defense or our international economic position. An

immediate response to one such threat was the passing of the National Defense

Education Act (NDEA), a bill created to fund educational improvements in mathematics

and science (Drew, 2011). New math emerged as one of the reforms from the NDEA and

the National Science Foundation (NSF) in an attempt to transform the teaching of

mathematics. Many more reforms were funded by the NDEA, as the search for new,

effective approaches were sought (Drew, 2011.) This mid-twentieth century event that

challenged America's global position with technology, is an early example of the

influence politics has had on educational decisions in history.

The STEM movement was beginning to gain attention during the emergence of

the magnet school movement in the 1960s and 1970s as evidenced from the literature.

Thomas & Williams (2010), refer to STEM as an educational trend that picked up

momentum over the decades based on the economic and social issues of the time. It was

in the early 1990s that the National Science Foundation (NSF) began referring to

programs that incorporated the academic content areas of science, mathematics,

engineering and technology as: 'SMET'. The acronym lacked appeal and quickly

changed to STEM (Science, Technology, Engineering & Mathematics) as reported by

Sanders (2009). Since that time according to Bybee (2010), the term has been used as a

"generic label for any event, policy, program, or practice that involves one or several of

the STEM disciplines" (Bybee, 2010, p. 30).

When STEM was initially introduced, according to Bybee (2010), it gained the
attention of many groups concerned about the 'eroding' academic performance of United
States students. The concerns were legitimate. Based on 2007 measures from Trends in
International Mathematics and Science Study (TIMSS), though the United States was
once a leader in STEM, they lost their place some time ago (Alvarez, Edwards & Harris,
2010); as of 2011 the U.S. ranked 22nd in science, and 31st in math among peers in
comparative countries around the world (Burke & McNeill, 2011). The STEM
phenomenon is not a new initiative (Thomas & Williams, 2010). The authors stated that
it's been a century since schools first identified issues pertaining to the political,
economic and social topics associated with STEM education.

The Need for STEM

Since its century old inception, funds dedicated to STEM education have been allocated to research and development to identify effective instructional practices that promote student-centered, engaging instruction. In fact, the earliest evidence of specialized STEM high schools began shortly after the turn of the 20th century, with the founding of the Stuyvesant High School, which was a manual training school for young males. It was established in 1904 to prepare students with specific technical skills needed to enter the workforce–not an institution for highly gifted and talented students (Thomas & Williams, 2010).

Current practices in many introductory science classes continue to rely on lectures, memorization of facts and step-by-step laboratory sessions instead of stimulating sessions that include reflection and opportunities for interactive instruction (Dancy & Johnson, 2008). The United States Congress identified STEM as an important educational initiative over 30 years ago, yet the challenge to fully implement in mainstream classrooms and address the underrepresentation of women, minorities and persons with disabilities continues to be an important challenge that has not been fully resolved (Alvarez, Edwards & Harris, 2010).

The National Research Council (2011) reported a significant portion of United States students that left high school unprepared for college level classes in the math and sciences; that refueled a push for STEM education. The need for STEM education documented by the National Research Council (2011), reports that up to 85% of the U.S. gross domestic product over the past five decades is due to advancements in STEM education. Burke & McNeill (2011) reported that highly skilled STEM employees in the

workforce are necessary to ensure competition in the global market. Roughly 40% of students exiting STEM high schools are prepared for college-level instruction in mathematics (National Research Council, 2011). As a result, the demand for STEM has increased.

The United States is compelled to maintain a competitive edge and stay ahead of international security threats. No longer can the American education system fail to meet the critical needs with a federal approach that does not address the underlying issue of substandard academic performance in our schools (Burke & McNeill, 2011). Supporters of STEM education believe that the infusion of the four disciplines will better prepare students for advanced studies and careers in STEM fields with the goal of raising the United States back to top ranking among other countries (Brown et al., 2011). According to Wilson & Harsha (2009), this country is ready for broad based STEM reform as pressure continues to escalate at both the national and international levels. The authors stress that an immediacy to expanding STEM is needed to ensure innovation in the highly technological fields of the future.

By the beginning of the 21st century, few still understood the meaning behind STEM education and the impact a concentrated focus on science, technology, engineering and mathematics could have on our global economy (Sanders, 2009). As illustrated by Brown et al. (2011), the lack of understanding about STEM education is regarding the intended integrated approach to teaching the disciplines as one course of study that involves all teachers. Although many define STEM by the content areas represented in the acronym, the true intent is to provide a meshing of the four disciplines into a single, standards-based dynamic approach (Brown et al., 2011). A summary

report by the National Research Council (2011), refers to the interrelation of STEM

fields and the importance of those connections in a successful program. Hughes (2009),

emphasized that models must be practical and able to guide students towards STEM

fields. Many well-intentioned advocates for STEM education have failed to bring it to a

practical application threshold that will prepare students for real world application in the

fields of science, technology and engineering (Hughes, 2009).

Current STEM Implementation and Models

As reported in a publication by the National Research Council (2011), STEM

education occurs in some capacity in most United States schools; however, the level of

effectiveness with implementation varies significantly. Although supportive and with

positive intentions, many educators and school institutions have failed to fully

implement the model and produce educated, highly prepared students that potential

employers are seeking (Hughes, 2009). Sanders (2009) refers to an integrative STEM

approach that moves away from traditional pedagogy and challenges the conventional

methods of training educators to teach STEM education. "Too many students lose

interest in science and mathematics at an early age, and thus make an early exit from the

so-called STEM pipeline" (Sanders, 2009, p. 22).

The National Research Council (2011) classified STEM programs in one of four

general categories**,** and acknowledged that elements of STEM education are evident in

most schools today. Those large-scale categories are described as elite or selective,

inclusive, career and technical focused, and comprehensive with STEM offerings. Adam

Gamoran, as cited in Successful STEM Education (2011), states that short-term

responses to the effectiveness of each type of STEM model is not currently available.

However, research is being conducted to determine which school model and

instructional approaches will produce the greatest efficacy and results. Hutton &

VandenBurg (2011), described the five most common forms of STEM school models

found within the K-12 program in Figure C.

STEM School Models	
Public Magnet School	Many districts have created STEM schools that function as magnets for an entire district or portion of a district. These magnets frequently have admissions criteria and limited space and are, therefore, not available to all students.
Charter STEM School	Several charter schools have adopted STEM themed curriculum in whole or in part. Charter schools are still public schools and do not charge admission. Unfortunately, due to disparities in charter school building funding, charters rarely have facilities that allow for high-level science and technology instruction.
Private STEM Schools	Many independent schools have high-level science programs. A few even have STEM centers. Depending on available funding, STEM instruction may be basic or advanced., but it is not unknown for these institutions to include electron microscopes and genetic engineering labs at the K-12 level.
Vocational STEM	In some districts, STEM has been used to reinvigorate and modernize vocational-technical education. This is an appropriate recognition that technology has fundamentally changed based professions such as auto mechanics and construction. These fields can be made more attractive to students by incorporating STEM principles and modern equipment.
STEM for All	We use this term to denote a public STEM school that is neither magnet nor charter, but is a fundamental part of a single feeder system. With this approach, every student has access to, and will participate in, some STEM education. And for those students who wish to focus on STEM, there are non of the typical barriers, such as a lottery or admissions tests.
Hutton & VandenBurg (2011, p. 19)	

Figure C. STEM School Models

Smaller STEM schools as reported by Alvarez et al. (2010), established

purposely as magnet schools, are often more intimate—not only due to size, but because

of the type of learning environment available to students. These factors can positively

influence the career choices that are initiated by the students and provide an alternative

avenue for the underrepresented student population, in an effort to move the United States back to the position of world leader in STEM education (Alvarez et al., 2010).

Brown et al. (2011), described successful STEM programming as an interrelated, experiential model involving all four disciplines and is required for every student. In light of this and countless supporting literature, this study's researcher refers to STEM education as a standards-based program with curriculum that is delivered as a fluid, fully integrated unit of study. Studying and conducting research on ways that students learn, and gaining an understanding of integrated curriculum are critical components of a successful STEM reform movement (Dancy & Johnson, 2008). The STEM acronym stands for a specific educational methodology according to Hughes (2009) that blends the elements of technology and engineering into the core curriculums of science and mathematics.

The National Research Council (2011), reports that STEM programs vary significantly in schools across the United States, which raises concern about the effectiveness and quality of this type of specialty school as a broad based reform movement. In spite of reported inconsistencies, there is evidence in the literature of many successful STEM schools that are currently in operation. An example of a STEM school that is highly successful, according to a former principal of Thomas Jefferson High School for Science and Technology in Alexandra VA, is when the four disciplines are taught to all students using an interdisciplinary model (Christie, 2007). As a top-ranked STEM magnet school, academic criteria is used to select students because it is so highly competitive (Fleming, 2012).

At Nashville's Hume Fogg Academic Magnet High School for example, "academic strength has trumped diversity as a goal in recent years" (Fleming, 2012, p. 3). At these high quality schools, teachers expose students to project-based, hands-on learning, and work collaboratively developing quality lessons that include real life problems and experiences. Large segments of time for planning and learning are built into the school schedule to ensure the desired outcomes of the program (Christie, 2007). Fleming (2012), speaks to the shift from desegregation to choices with high academic expectations. "If you aren't getting to the core of teaching or learning, it doesn't matter how you're organized or the classes you offer. It's less about the form and more about the quality of instruction" (Fleming, 2012, p. 3).

One aspect of STEM education that makes it unique from other types of academic study is literacy, because proficiency in that discipline bolsters an individual's well-being and promotes the nation's role in maintaining a competitive global economy (National Research Council, 2011). Another distinguishable trait is the school schedule, which typically incorporates expanded blocks of time for interdisciplinary study and time for teachers to plan together (Christie, 2007). Cavanaugh (2008) references a strategy that has been used in recent years to promote STEM type magnet schools—the targeting of school-wide populations through changes in graduation requirements that increase the number of science and math courses all students would be required to take to earn a high school diploma. He reports that between 1989 and 2006, states increased on average, the course requirements for math (.8 course credits) and science (.7 course credits) necessary for successful completion of high school. By the 2007-2008 school

year, a minimum of 35 states required at least three years of science and math and 48

states had implemented some type of technology standards (Cavanagh, 2008).

<u>Future of STEM Education</u>

      As STEM programs continue to evolve, their success will depend largely on

the ability of educational policymakers to align the programs to the needs of today's

workforce (Cavanaugh, 2008). STEM is education reform, meant to strengthen the focus

on mathematics and the sciences to prepare students for careers in technology and

engineering (Wilson & Harsha, 2009). Cavanaugh (2008), affirmed the need for

educational leaders to be looking ahead to the careers of the future, particularly in

technology fields and healthcare, that will require employees who are highly literate

and skilled in the STEM areas.

      STEM education is one of many school choice reform initiatives that have been

in existence for years, with substantial resources dedicated to STEM research and

improvement initiatives. The National Science Foundation (NSF) that was created in

1950 has expended over $22 billion to STEM research and development to improve the

highly focused educational model (Dancy & Johnson, 2008). Real reform according to

Drew (2011), must bring about change in eight distinctive areas to improve STEM

education. Those changes the author reports, are in the areas of: leadership, evaluation,

teacher improvement, high academic expectations, committed mentors and role models,

a high value on a college education, commitment to closing the achievement gap and

revitalization of university research.

      Bybee (2010) asserts that the greatest impact for furthering STEM education in

today's educational market, requires a change in process that is clearly understood and

implemented by those directly involved and impacted by the reform movement. There

are specific elements of the change process that must be employed if the desired goals of

any broad based educational reform are to be reached. STEM education with a "20/20

vision" (Bybee, 2010, p. 6), may be the answer to current challenges and issues ahead of

our nation. As early as the 1950s, the nation faced serious political challenges with

potential global impact and it responded with a significant curriculum reform movement.

It is the belief of many researchers that now is the time to move beyond the slogan and

implement the fundamental purpose of STEM education (Bybee, 2010). STEM

education that is truly integrated with a strong infusion of technology literacy will

motivate young learners and sustain their curiosity about learning throughout their K-12

education (Sanders, 2009).

If STEM education is to be a response to the need for better prepared students for

our technological workforce, parents and teachers must join together in a shared belief

that every child has the potential to learn mathematics and science, and that these subject

areas need to be taught to all students. This belief, as stated by Drew (2011), must also

be shared with students regardless of affluence, gender or ethnicity. Cavanagh (2008)

proclaims that policymakers will need to align programs with the specific needs in the

workforce that are slated to expand in the future. Examples of those career options are in

the areas of healthcare and technical support services that will require students to be

educated in the core areas of literacy and the sciences. Some labor experts, believe that

educational decision makers need to do a better job of communicating careers that are on

a growth trajectory thus allowing on-going discussion between educators and workforce

personnel to occur (Cavanagh, 2008).

Thomas and Williams (2010) reported on the impact of the America COMPETE Act that was signed into law by President George W. Bush in August of 2007 for the purpose of promoting excellence in technology, education and science. The bipartisan support for the Act was necessary for the United States to proceed competitively into the 21st century with a critical focus on innovation. Components of the COMPETE Act address the following areas: strengthen K-12 math and science education, expand undergraduate and graduate science and engineering programs and increase funding for basic research in the physical sciences (Tapping America's Potential, 2008). According to Burke & McNeill (2011), the United States can no longer afford to underperform other countries in science, technology, engineering and mathematics if they are going to compete in a global market. Other federal programs, like: Educate to Innovate, were created to catapult the United States to the top in science and mathematics (Burke & McNeill, 2011).

During recent years, when the United States feared that countries such as China and India may surpass the American economy, funding streams started to shift towards STEM Education (Friedman, 2005). As the United States moves further into the 21st Century, as asserted by Trilling and Fadel (2009), the demand for specialized themed schools that focus on STEM education will continue, along with a push for creativity, invention and innovation as students prepare for a future in careers that do not yet exist.

SUMMARY

The literature review included studies and reports on the early years of the magnet school movement beginning with landmark federal court mandates that forced desegregation of public schools, to a 21st century focus on accountability, school choices and preparing students for future careers in an ever-changing, technological world. Claire Smrekar, associate professor of education at Vanderbilt University, Nashville, TN. has researched magnet schools for decades and proclaims that this is a pivotal time for school districts and educational leaders to clearly define the role of magnet schools (Smeaker, 2009). Magnet schools of today have evolved from voluntary solutions to achieving racial balance in urban and later suburban school districts to choice options for meeting the rigorous academic goals that ultimately improve student achievement and prepare students for a new future (Fleming, 2012).

While the researcher has reported on literature pertinent to the study—specifically, the history of the magnet school movement, problems as well as successes within the magnet school movement and the evolution and future need for STEM education—evidence pertaining specifically to the sustainability of STEM themed magnet schools is limited. Therefore, this study will examine the factors that the researcher determined lead to program sustainability of STEM themed magnet schools.

Chapter III

METHODOLOGY

Introduction

"Building local capacity for a national purpose" is necessary for ongoing

sustainability and continuous improvement of STEM schools (Bybee, 2010). STEM

education as an innovative approach for providing interdisciplinary instruction in the

areas of science, technology, engineering and mathematics is supported by the literature.

This type of program is becoming increasingly prevalent in public schools across the

nation and is reported as a successful means of preparing students for future careers in

the 21st century. "As diversity continues to increase among the United States population

and since many STEM professionals are nearing retirement, this initiative has never been

more important for the economic success of the country" (Alvarez et al., 2010, p. 27).

Many STEM programs operate under the auspices of a focused magnet school,

which typically access state desegregation funds to support specialty programs for

attracting students to a particular school (Rapley, 2011). Sustainability of any specialty,

school program is a challenge due to factors that include ongoing funding streams,

maintaining district and community support and evidence of student achievement (U.S.

Department of Education, 2008).

Purpose of the Study

The focus of the study was to identify program elements of STEM themed magnet schools that lead to program sustainability. For purposes of this study, the researcher defined program sustainability of any magnet themed school as the maintenance of full operation over multiple years with adequate funding and staffing resources to deliver the overall intent of the program. Specifically, the research study examined operational elements gathered from the literature and determined those program elements as perceived by principals that had the greatest impact on sustainability of STEM themed magnet schools.

Conceptual Framework Informing
    Research Design

A conceptual framework provides the basis of any study for framing the research questions. It is the lens that allows for a narrow or exact view of a study (Roberts, 2010). "Like a microscope, it narrows your field of vision, thus helping you limit the scope of your study" (Roberts, 2010, p. 129). Through an in-depth review of the literature on theme based magnet schools that included programs classified as STEM, the most prevalent program elements were identified. The primary literature sources included research studies, journal reports, and publications from professional educational organizations. The researcher applied those sources as a foundation for the conceptual framework that was used to devise the survey instrument and guide the study. The nine components of the conceptual framework and a brief description of each is provided as follows:

- Outreach and Marketing (*resources for promotional and recruitment efforts*)

- Instructional Practices and Distinctive Curriculum *(specialized program offerings and delivery system that are unique to STEM education)*

- Staff Development and Training *(opportunities and resources for on-going staff learning)*

- National/State Leadership *(support and guidance from organizations that promote STEM magnet programs)*

- Program Recognition *(awards and publications to promote STEM programs)*

- School Board/District Leadership/Support *(policies and district operational structure that supports the program)*

- Funding sources *(revenue for staffing, facility adjustments, instructional materials and supplies)*

- Community Partnerships *(business and agency relationships with the STEM magnet schools)*

- Student Achievement *(availability of standardized achievement data in reading and mathematics)*

Research Questions

The following research questions will guide this study:

1.   How do principals of select magnet schools rank program elements of

STEM programs in relation to their impact on school sustainability?

2.   What are the differences in program elements reported as essential for

sustainability of STEM themed magnet schools reported by principals

based on geographic location, administrative structure, grade level

configuration, and length of time in operation?

3.   What program elements of magnet schools do principals perceive as the

greatest challenges to sustainability of STEM schools in the next three to

five years?

4.   What is the impact of STEM themed magnet schools on student

achievement as perceived by principals?

Study Participants

The population for this study was comprised of 38 principals of STEM themed

magnet schools that were listed in the 2012 Magnet Schools of America (MSA)

directory. Criterion sampling was used to limit the scope of this study by examining only

magnet school programs with a STEM theme. The schools reflected various grade

configurations and geographic regions across the United States. According to Patton

(1990), criterion sampling is used to examine a population that meets a prescribed set of

criteria. Criterion sampling can be used in both qualitative studies and quantitative

studies using survey research.

The sample schools were selected from Magnet Schools of America (MSA), which is a large national organization that supports magnet school programs across the United States. The mission of Magnet Schools of America that guides the organization's work, centers on leadership and innovative instructional programs that promote choice, equity, diversity, and academic excellence for all students (Magnet Schools of America, 2013.) The large majority of STEM schools affiliated with the Magnet Schools of America organization published in the 2012 directory are located in the southeast region of the United States representing 14 states (WV, DC, VA, NC, SC, KY, AR, LA, TN, MD, MS, AL, GA, FL). For this study, nearly 64% of the STEM school respondents were located in the southeast region of the country.

Human Subjects Approval

Once the research committee approved the dissertation proposal, the researcher completed the required application for the St. Cloud State University Institutional Review Board (IRB). The human subjects review process is critical to ensure that the rights of individual subjects are protected through informed consent (Slavin, 2007). "One major provision of human subjects regulations requires that subjects be informed of any risks involved in the study and that they be instructed that they are free to withdraw from the project at any time" (Slavin, 2007, p. 234.) In the IRB application, the researcher described the exact details, ethical implications, and procedures that were proposed to be implemented to protect the participants and the data that would be gathered during and after the study. The application was submitted to the IRB for its consideration and feedback. Upon receiving approval from the IRB, the study was launched and completed within the parameters described in this chapter.

Instrumentation

       A survey instrument was developed by the researcher based on information reported in the literature review regarding operational elements deemed necessary to sustain a highly successful, fully integrated STEM themed magnet program (Appendix A). A survey was used to gather "opinions, behaviors or characteristics of a population of interest" and was a useful tool for finding out differences among various subgroups on key variables (Slavin, 2007). The categories included in the survey were aligned with the research questions and the conceptual framework to ensure clarity and accurate responses. The survey instrument was tested for validity and reliability before administering to the participants in the study using a thorough review process. "A pilot test serves as a trial run of the study, done for the sole purpose of testing the instrument and identifying any issues that need to be addressed before the actual study is conducted" (Slavin, 2007, p. 107).

       Initially, the pilot survey was reviewed by a professor at St. Cloud State University for accurate formation of questions and response methods to ensure appropriate construction of the instrument. The survey was then administered to a cohort of doctoral students for feedback, specifically on clarity of questions, understanding of terms and length of the survey. This final examination of the instrument was undertaken to insure precise alignment to the research questions and validate survey construction. The completed version of the survey was specific and concise, thus increasing the accuracy of the participant responses. After review by the dissertation committee, the survey was submitted to the IRB office for approval.

Research Design

      The study was quantitative in nature using a survey research design. In quantitative research, "researchers collect data that are primarily numerical and result from surveys, tests, experiments, and so on" (Roberts, 2010, p. 142). A selection of 38 principals at STEM themed magnet schools in the United States were invited to participate in this study by completing an on-line survey. These schools were secured from a listing of STEM themed magnet schools published in the Magnet Schools of America (MSA), Directory of Magnet & Theme-Based Schools, 11th Edition published in July 2012. A STEM school, for purposes of this study, is defined as any school that includes the elements of science, technology, engineering and mathematics in their magnet program. This study represents a select population of STEM themed magnet schools based on their affiliation with Magnet Schools of America, as of July 2012.

      According to Roberts (2010), the population is a description of the participants and the rationale for their selection. In this study, the researcher used a population of STEM themed magnet schools that were current members of a large national organization of magnet schools. The principal from each site was asked to participate in the study by completing an on-line survey instrument, Survey Monkey. The schools included in the study display varied grade level configurations and geographic locations as reported in the Magnet Schools of America 2012 directory as a STEM school. Survey questions were designed to determine the operational elements respondents perceived as having the greatest impact on program sustainability currently, and in the next three to five years.

The initial questions pertained to respondent demographics and characteristics of the STEM schools they served. The next set of questions focused on the impact specific program elements had on current sustainability and projected sustainability in the next three to five years as perceived by the school administrators. Questions related to the impact of student achievement on STEM school sustainability were limited to reading and mathematics due to the availability of standardized achievement data in these two content areas. Literacy makes STEM programs unique because proficiency in that discipline bolsters students' well-being and promotes the nations' role in maintaining a competitive edge globally (National Research Council, 2011). The question format varied throughout the survey based on the types of responses that most accurately addressed the research questions. Respondents were asked to rank questions about the importance of program development and operational elements they believed led to program sustainability and the greatest challenges faced in sustaining a program in the next three to five years. A section for comments to support participant responses was provided.

Data Collection

An initial e-mail was sent to the potential respondents explaining the study and requesting their participation (Appendix B). Included in the e-mail was a link to the on-line survey and information on an incentive for voluntary participation in the study. A minimum of three e-mail attempts in one to two week intervals were made to each potential respondent to secure a completed on-line survey. After four weeks, up to five phone contacts were attempted to reach individual principals who had not yet responded to the on-line survey. Throughout the data collection period, the researcher reviewed

every STEM school website to ascertain contact information and details about their

themed based magnet school program.

The survey response window closed after six weeks with an 86.8% response rate.

This resulted in 33 of the 38 identified schools responding to the survey. Only those

surveys that were fully completed were included in the data analysis. Due to the limited

sample of magnet schools in the study, a high response rate was necessary to validate the

findings. An incentive was offered to survey participants who responded within the

timeline. Respondents were invited to enter a drawing for a $100 gift card. Researchers

do not expect to receive a response from all sample members due to professional

conflicts or personal reasons, and others "simply refuse to participate in the study, even

after the best efforts of the researcher to persuade them otherwise" (www.ucdavis.edu,

"Evaluating samples," para. 3).

Data Analysis

After the survey instrument was administered and responses collected, the data

were carefully tabulated and analyzed to allow for accurate, non-biased reporting of the

findings. The Statistical Package for the Social Sciences (SPSS), was used to analyze

the data and interpret the findings. Descriptive statistics were employed to analyze the

data and report the findings. These types of statistical analyses according to Slavin

(2007) "are simply convenient ways of summarizing characteristics of data in a form

everyone can understand and use" (p. 241).

SUMMARY

The purpose of this doctoral dissertation was to identify program elements of STEM themed magnet schools that principals report lead to program sustainability. A conceptual framework was developed from an in-depth review of the literature on successful magnet schools and STEM programs. The framework was then used to create an on-line survey instrument to determine principal perceptions of program elements that lead to sustainability. Principals at 38 STEM themed magnet schools were selected for the study. All the STEM themed magnet schools invited to participate in the study are listed in the 2012 Magnet Schools of America directory. A minimum of five e-mail or phone call attempts to study participants were made to secure a high response rate. "Whether data are collected through face-to-face interviews, telephone interviews, or mail-in surveys, a high response rate is extremely important when results will be generalized to a larger population" (www.ucdavis.edu, "Evaluating Samples", para. 6). Participant responses were analyzed and reported in chapter four to determine any common themes regarding sustainability of STEM themed magnet schools. A summary of the findings, conclusions and recommendations are reported in chapter five.

CHAPTER IV

RESULTS

Study Purpose and Overview

Magnet schools are the largest choice-based educational system today according to Siegel-Hawley and Frankenberg (2012). The authors reported that magnet schools were initially conceived in the 1970s for the purposes of integration and promotion of innovative instructional practices. The early concept was based on voluntary or mandatory transfer of students to neighboring schools to meet school district desegregation goals (Rossell, 1990).

In the 1990s, STEM education was introduced by the National Science Foundation as a promising, systemic response to global economic competition (Sanders, 2009). As reported by the National Research Council (2011), STEM school programs are found in a variety of school structures. "The schools of interest are typically characterized by specific attention to the STEM disciplines, often for a targeted population, such as highly talented students or students from underserved groups" (National Research Council, 2011, p. 7). Thus, magnet schools that are driven as unique educational option programs are compelled to tighten the process for planning, training and accountability. The U.S. Department of Education reported that integral to any magnet school's success, regardless of the theme, is planning, implementation, phasing

and integrity of the vision and mission when confronted with challenges that could jeopardize program sustainability (U.S. Department of Education, 2008).

The purpose of this study was to examine principal perceptions of program elements of STEM themed magnet schools that lead to program sustainability. Specifically, the research study examined program elements gathered from the literature and determined which elements principals reported as having the greatest impact on program sustainability. Publications from professional organizations were reviewed to identify the program elements used to evaluate successful magnet schools that operate with a specialty theme focus on STEM education. Significant references include the Magnet Schools of America (MSA) strategic plans from 2011 and 2013, notably their essential pillars of observable factors that define any successful magnet school. Another reference was a report from the U.S. Department of Education (2008) that outlines a three-phase guide for successful development and sustainability of magnet schools. Additionally, the National Resource Council (2011) identified the specific factors of teacher development, partnerships, and school characteristics necessary to enhance STEM education. Brief explanations of the program elements identified from the literature and included in the conceptual framework are provided.

- Outreach and Marketing *(resources for promotional and recruitment efforts)*

- Instructional Practices and Distinctive Curriculum *(specialized program offerings and delivery system that are unique to STEM education)*

- Staff Development and Training *(opportunities and resources for on-going staff learning)*

- National/State Leadership *(support and guidance from organizations that promote STEM magnet programs)*

- Program Recognition *(awards and publications to promote STEM programs)*

- School Board/District Leadership/Support *(policies and district operational structure that supports the program)*

- Funding sources *(revenue for staffing, facility adjustments, instructional materials and supplies)*

- Community Partnerships *(business and agency relationships with the STEM magnet schools)*

- Student Achievement *(availability of standardized achievement data in reading and math)*

Research Methodology and Questions

This study was conducted using a non-experimental, quantitative research methodology. Slavin (2007) conveyed that this type of study involves a research design in which the researcher "measures or observes subjects without attempting to introduce a treatment" (p. 83). The research method adopted for this study was an on-line survey employing Survey Monkey. The instrument consisted of 18 questions posed to the study participants. These questions were based on four research questions related to program elements leading to sustainability of STEM themed magnet schools, and they guide this study:

1.	How do principals of select magnet schools rank program elements of

	STEM programs in relation to their impact on school sustainability?

2.	What are the differences in program elements reported as essential for

	sustainability of STEM themed magnet schools reported by principals

	based on geographic location, administrative structure, grade level

	configuration, and length of time in operation?

3.	What program elements of magnet schools do principals perceive as the

	greatest challenge to sustainability of STEM schools in the next three to

	five years?

4.	What is the impact of STEM themed magnet schools on student

	achievement as perceived by principals?

Data Collection

An initial e-mail was sent to the potential respondents explaining the study and

requesting their participation. A minimum of three e-mail attempts in one to two week

intervals were made to each potential respondent to secure a completed on-line survey.

After four weeks, up to five phone contacts were attempted to reach individual principals

who had not yet responded to the on-line survey. Throughout the data collection period,

the researcher reviewed every STEM school website in the study sample to collect

contact information and demographic details about their school program.

Data Analysis

Survey data were reviewed and analyzed to address each of the four research

questions. The Statistical Package of Social Sciences (SPSS) was used to analyze the

data set. According to Slavin (2007), this is the most commonly used statistical tool for educational research studies. The findings from this study are reported using tables and supportive narrative to supplement the data displayed in each table. For ease of interpretation, rankings assigned by the respondents to each program element were reverse scored or coded.

According to DeCoster (2004), reverse coding is a procedure that may be applied when it is important to have high value questions with the same construct reflected by high scores on the item. In this case, the value was reversed so that the responses were all oriented the same way. For example, if the respondent ranked the most important element with a one, this was reverse coded so that the rank of one became a rating of nine. In this way, a high rating indicates a high level of importance, and a low rating indicates a low level of importance. The reverse coding was undertaken for the two main survey questions, "Rank order the importance of the following program development and operational elements that you believe have contributed to sustainability of your STEM magnet school program" and "Rank order the program elements that you predict to be future challenges to sustaining your STEM magnet school program in the next three to five years."

Population

The respondents for this study included 33 principals of STEM themed magnet schools. Criterion sampling was used to limit the scope of this study by examining only STEM schools affiliated with Magnet Schools of America. The sample schools were listed in the 2012 MSA directory as a magnet school with a STEM themed program.

Criterion sampling is useful for revealing program weaknesses and identifying areas of

systemic improvement (Patton, 1990).

The participants were asked to complete an on-line "STEM School Sustainability

Survey." There were 41 schools initially selected to participate in the study. Upon

further review of the individual schools, three were eliminated because they did not meet

the selection criteria for the study. To meet the selection criteria, schools were listed in

the Magnet Schools of America, 2012 directory as a STEM themed magnet school. The

three schools eliminated were no longer operating as a STEM themed magnet school at

the time of the study. A total of 38 schools met the selection criteria and were invited to

participate in the study. This chapter reports the results from the 33 survey respondents,

which amounted to a response rate of 86.8%. Respondents had the option of not

answering every question; therefore, the response rate displayed for Tables 4 and 23

represent 32 and 31 responses, respectively. Six of the survey questions provided

demographic information about the respondents and the schools. The principals or

designees who participated in the study will be referred to as respondents or school

administrators throughout this chapter.

DEMOGRAPHIC FINDINGS

Tables 1-6 display demographic information about the school administrators and

the STEM school they serve. The data are reported using frequency counts and

percentages on questions pertaining to the position of the respondent, years served in

current position, involvement with the development of the STEM program, number of

years operating as a STEM school, grade configuration, and geographic location in the

United States.

Table 1 represents the percentage of respondents serving as the current principal

or (as recorded by the survey respondents) either an assistant principal or STEM magnet

school coordinator. Participants responded with either a Yes or No indicating if the

respondent was currently serving in the principal role.

Table 1

Percentage of Respondents Reported by Current Role as Principal

Current Principal	N	%
Yes	24	72.7%
No	9	27.3%

The majority of the respondents reported they were current principals at their

STEM themed magnet school 72.7% *(N =24)*. Approximately one-fourth of the

respondents or 27.3% (*N* =9) indicated that they were not serving as the principal.

Those respondents reported they were serving in another administrative capacity as an

assistant principal or magnet program coordinator of their STEM school.

Although the study was designed for the school principal, administrative

designees' responses were included after multiple unsuccessful attempts were made to

secure completed surveys from select sample school principals. Surveys completed by

administrative designees were included in the study to ensure a higher response rate.

The job description of the administrative designee was either assistant principal or STEM or magnet school coordinator.

Data reported in Table 2 revealed the length of time survey respondents had served in their current role as a school administrator. The survey respondents indicated the choice that reflected their years of service in the role.

Table 2

Percentage of Respondents Reported by Years in Current Position

Years in current position	N	%
Less than 1 year	1	3.0%
1-2 years	7	21.2%
3-5 years	15	45.5%
6-9 years	4	12.1%
10 or more years	6	18.2%

The study participant responses ranged from less than one year to ten or more years. Over three-fourths or 75.8% (N=25) of the school administrators reported that they have served in their current role for three or more years. Only one of the school administrators reported having served in their current role for less than a year.

In Table 3, school administrators reported their involvement in the development of the STEM themed magnet school program, to which they serve as principal or another administrative role.

Table 3

Percentage of Respondents Reporting Involvement in the Development of the Current
Program

Involved in development	N	$\%$
Yes	25	75.8%
No	8	24.2%

Table 3 reports that 75.8% (N=25) of study respondents were involved in the

development of the STEM themed magnet school in which they currently served as

principal or administrator. Less than one-fourth or 24.2% of the respondents indicated

that they were not involved in program development.

Table 4 reports the length of time the selected STEM themed magnet schools had

been in operation. Responses on the survey ranged from schools that were in their first

year of implementation, to schools that had been operating for ten or more years as a

STEM themed magnet school.

Table 4

Percentage of Respondents Reporting on the Number of Years the Current STEM
School has been in Operation

Number of years in operation	*N*	*%*
First year of implementation	2	6.3%
2nd year	0	0.0%
3rd year	9	28.1%
4th year	6	18.8%
5-9 years	11	34.4%
10 or more years	4	12.5%

Respondents reported that 93.7% (*N*=30) of the STEM themed magnet schools had been in operation for three or more years. Only two of the school administrators indicated first year of implementation.

Table 5 represents the percentage of STEM magnet schools in the study by grade configuration. Study respondents were provided with several options and were asked to choose the one that best reflected their student populations. Multiple grade configurations were included on the survey to assist respondents in selecting the one structure that most closely represented their school's student population. The choices and descriptions of the grade configurations are provided below.

- Elementary: The school includes students in grades K-6.

- Primary: The school includes students in grades 1–3.

- Intermediate: The school includes students in grades 4–6.

- K—8: The school includes students in kindergarten through grade 8.

- Middle School/Jr. High: The school includes students in grades 5–8.

- High School: The school includes students in grades 9–12.

- Other: Respondents were provided this option if the configuration of their school did not fit into one of the survey categories. If respondents selected this choice, they were requested to provide a clarifying comment about their school configuration.

Table 5

Percentage of Respondents Reported by Grade Configuration of their STEM School

Grade configuration	*N*	*%*
Elementary	**10**	**30.3%**
Middle school/junior high	**10**	**30.3%**
High school	**8**	**24.2%**
Other	3	9.1%
Intermediate	1	3.0%
K-8	1	3.0%

Note: The three highest represented grade configurations are in boldface.

Table 5 data reveal that 84.8% (*N*=28) of the respondents served in elementary, middle/junior high or high school configured schools. The remaining grade configurations accounted for 15.1% (*N*=5) of the schools in the study. Study respondents were asked to identify the regions in which their schools were located. Respondents could select from among one of the five regions presented. The purpose of clustering the states by region was to identify regional differences in responses on factors that impact program sustainability. The geographic areas were determined by using the National Geographic's five-region map. This map is commonly used to cluster states by geographic location in the United States (National Geographic.com, 2014). The five regional choices on the survey were:

- Northeast States – NE, NH, MA, VT, RI, NJ, PA, CT, NY, DE

- Southeast States – WV, DC, VA, NC, SC, KY, AR, LA, TN, MD, MS, AL, GA, FL

- Midwest States – ND, SD, NE, KS, MN, IA, MO, WI, IL, IN, OH, MI

- Southwest States – AZ, NM, OK, TX

- Western States – WA, OR, CA, NV, UT, CO, WY, MT, ID, HI AK

Table 6 reports the results of participant responses related to the geographic location of their schools by U.S. region.

Table 6

Reported Locations of STEM Schools by Geographic Region

U.S. region	*N*	*%*
Northeast	3	9.1%
Southeast	**21**	**63.6%**
Midwest	5	15.2%
Southwest	2	6.1%
Western	2	6.1%

Note: The region with the largest percentage of respondents is in boldface.

Table 6 data report that 87.9% (*N*=29) of the STEM themed magnet schools were located in the states classified as Northeast, Southeast and Midwest regions of the United States. The largest representation of schools participating in the study were located in the Southeast with 63.6% (*N*=21), the Midwest with 15.2% (*N*=5), and the Northeast with 9.1% (*N*=3).

The demographic findings for this study indicate that the majority of the respondents serve as the school principal and were involved in the development of the STEM program at their site. A high percentage of the respondents reported the grade configurations of their STEM schools as elementary, middle school/junior high or high school. These three grade configurations accounted for over eighty percent of the STEM schools included in the study. The geographic location of the largest population of STEM schools in the study exceeded sixty percent and were from the Southeast region

of the United States.

FINDINGS BY RESEARCH QUESTION

Research Question One

In research question one, differences in school administrator responses were examined to determine which program elements they deemed as most important to current sustainability of STEM themed magnet schools. "How do principals of select magnet schools rank program elements of STEM programs in relation to their impact on school sustainability?"

The respondents were asked to rate a series of elements on the basis of each element's impact on school sustainability. Descriptive statistics were then employed to calculate average ratings and percentage of responses by each rating (1-9) for the nine program element.

In Table 7, the average rating and rank of importance for each program element is displayed. A nine-point scale (9 = highest; 1 = lowest) is used to represent the level of importance for sustainability.

Table 7

Average Reported Rating of Program Elements and their Importance to the
Sustainability of a STEM Themed Magnet Program

Program Element	Avg Rating	Rank of Importance
Instructional Practices & Distinctive Curriculum	**7.30**	**1**
Staff Development & Training	**6.88**	**2**
Funding sources	**6.61**	**3**
Community Partnerships	5.27	4
School Board/District leadership/support	5.03	5
Student Achievement	4.73	6
Outreach & Marketing	4.09	7
Program Recognition	2.79	8
National/State Leadership	2.30	9

Note: In the average rating column, a low average indicates a low level of importance, whereas a high average indicates a high level of importance. The top three selected program elements in that column are presented in boldface.

As reported by respondents, the highest average rated program elements are Instructional Practices and Distinctive Curriculum (7.30), Staff Development and Training (6.88), and Funding Sources (6.61). Examples to clarify the intent of each program element were initially provided with the conceptual framework. Instructional Practices and Distinctive Curriculum refers to specialized program offerings and delivery systems unique to a STEM themed program. Staff Development and Training

refers to opportunities and resources for on-going staff learning while Funding Sources includes revenue for staffing, facility needs, and instructional materials and supplies. The average ratings of the two lowest priority program elements are Program Recognition (2.79) and National/State Leadership (2.30). Program recognition includes awards and publications to promote the STEM themed or specialized magnet schools, while leadership at a state or national level refers to any affiliation with organizations that support STEM magnet programs.

Table 8 was provided to illustrate the relative strength of each program element by displaying the percentage of respondents who selected each rating (1-9). In the program elements where a high percentage of respondents gave an average rating, the overall ranking program element importance was impacted. The higher the percentage of respondents with a high rating for each of the nine program elements, the greater the level of importance for program sustainability.

Table 8

Percentage of Respondents by Rating for each Program Element and their Importance
Level to Sustainability of a STEM Program

Program Element	Rating								
	1	2	3	4	5	6	7	8	9
Instructional Practices & Distinctive Curriculum	0%	0%	3%	3%	9%	18%	12%	21%	**33%**
Staff Development & Training	0%	9%	3%	0%	3%	12%	27%	27%	**18%**
Funding Sources	3%	0%	9%	6%	6%	18%	18%	15%	**24%**
Community Partnerships	0%	9%	15%	24%	9%	6%	15%	12%	9%
School Board/District leadership/support	3%	9%	12%	18%	18%	18%	0%	18%	3%
Student Achievement	18%	6%	6%	15%	18%	6%	15%	6%	9%
Outreach & Marketing	0%	15%	30%	15%	24%	6%	6%	0%	3%
Program Recognition	27%	30%	12%	15%	3%	6%	6%	0%	0%
National/State Leadership	48%	21%	9%	3%	9%	9%	0%	0%	0%

Note: On the nine point rating scale, a low rating of an element indicates a low level of importance, whereas a high rating indicates a high level of importance. The three highest rated program elements with a value of nine are in boldface.

The three highest rated program elements (rating=9) for sustainability of a STEM program were Instructional Practices and Distinctive Curriculum (33%), Funding Sources (24%), and Staff Development and Training (18%). Eighty-four percent of the respondents assigned a high rating (6–9) to both Instructional Practices and Distinctive Curriculum, and Staff Development and Training. Only 75% of the respondents gave a high rating (6–9) to Funding Sources. Community Partnerships and Student Achievement each received 9% of the highest rating by respondents. These two program elements yielded an overall high rating (6 – 9) of 42% and 36%, respectively. Due to the high percentage of respondents who assigned an average rating (4 – 5), to

these two program elements, they ranked fourth and sixth on importance to program sustainability. The three lowest rated program elements were National/State Leadership, Program Recognition and Outreach and Marketing with 85% or more of the study respondents assigning a low or average rating (1 – 5). Forty-eight percent of the respondents assigned the lowest rating of one to National/State Leadership and 27% assigned the lowest rating of one to Program Recognition.

The next data set displays a summary of the narrative responses by the school administrators regarding the impact the top three rated program elements have on sustainability of a STEM themed magnet school. Study respondents were asked to describe the impact of the top three elements they identified as most important to sustaining their program. Open-ended response boxes were provided for the respondents to comment on each of the three most important program elements for sustainability.

The information in Table 9 displays the supporting comments from the respondents' ratings reported in Tables 7 and 8.

Table 9

Reported Impact of Top 3 Rated Program Elements Important to Sustainability

Program Elements	Impacts
Instructional Practices & Distinctive Curriculum	Attracts/retains students
	Classes implement inquiry with STEM theme
	Community buy-in
	Innovative curriculum
	Creates unique and enriched experiences
	Meets needs and interests of students
	Leads to rigorous curriculum
	Transitions to choice programs at secondary level
Staff Development & Training	Create a vision
	Critical for maintaining high standards
	Critical for high functioning staff that will stay
	Develop programming and partnerships
	Necessary for proper implementation of STEM curriculum
	Provided by community partners
	Provides time necessary to learn complexities of STEM concepts
	Push teachers to capacity of skill
	Use state-level training
Funding sources	Produces committed staff
	Used for equipment/technology
	Used for professional development
	Provided through federal dollars, grants, community partnerships
	Used to fund special programs that appeal to new and current students
Community Partnerships	Grown vertically into high school and undergraduate programs
	Provide funding, expertise in field, extracurricular opportunities
	Teacher engagement
	Improves practice
	Provides sustainable funding sources beyond grants
School Board/District leadership/support	Offer strong leadership, vision and guidance
	Provide funding and staff
Student Achievement	Admission to competitive colleges
	Attracts/retains students
	Builds a reputation
	Builds positive school culture
Outreach & Marketing	Educates parents on proper choice for children
	Used to bring in diversity
Program Recognition	Builds a reputation
National/State Leadership	None

*Respondents were asked to include comments on their highest three program areas important to sustainability.

School administrator responses describing the impact on the highest three program elements that led to sustainability of a STEM themed magnet school are reported in Table 9. Examples of comments directed at Instructional Practices and Distinctive Curriculum were "attracts/retains students" and "meets needs and interests of students." Among comments that supported the importance of Staff Development and Training were "critical for maintaining high standards," "push teachers to capacity of skill," and "necessary for proper implementation of STEM curriculum." Funding Sources comments from respondents included "provided Federal dollars, grants and community partnerships" and "produces committed staff."

Research Question Two

In research question two, school administrator responses related to the importance of program elements for sustainability were examined by geographic location, administrative structure, grade level configuration and length of time in operation. "What are the differences in program elements reported as essential for sustainability of STEM themed magnet schools reported by principals based on geographic location, administrative structure, grade level configuration, and length of time in operation?"

Respondents answered closed-ended questions that provided demographic information about their school and administrative role. The highest three program elements reported in research question one were then compared by each of the descriptive questions and displayed in the tables.

Table 10 displays the average rating of each program element's level of

importance to the sustainability of a STEM themed magnet program by United States

geographic locations. The average rating by program element was reported for each of

the five geographic locations using the nine point rating scale (1=lowest; 9=highest).

Table 10

Average Rating of Program Element's Importance to the Sustainability of the STEM
Program by Geographic Location

Program Elements	Midwest	Northeast	Southeast	Southwest	West
	$N = 5$	$N = 3$	$N = 21$	$N = 2$	$N = 2$
National/State Leadership	2.60	3.00	2.05	4.50	1.00
School Board/District leadership/support	4.00	6.00	4.95	5.50	6.50
Outreach & Marketing	3.80	3.33	4.43	3.50	3.00
Instructional Practices & Distinctive Curriculum	6.60	7.00	7.33	9.00	7.50
Student Achievement	4.00	4.67	5.19	3.00	3.50
Program Recognition	2.40	1.33	3.00	2.50	4.00
Community Partnerships	6.40	6.00	4.81	6.00	5.50
Funding sources	7.60	5.67	**6.52**	6.50	6.50
Staff Development & Training	**7.60**	**8.00**	**6.71**	4.50	7.50

Note: A low average rating indicates a low level of importance, whereas a high average rating
indicates a high level of importance. The highest average rated program element for the Midwest,
Northeast and Southeast is in boldface.   The top three rated program elements for the largest region
are in boldface.

Instructional Practices and Distinctive Curriculum was rated first, second or third in importance as a priority program element for sustainability across all five regions. Specifically, the average ratings for this program element were between 6.60 and 9.00 using a one to nine rating scale (9 = highest). In the Southeast, with the largest percentage of respondents, (63.6%), Instructional Practices and Distinctive Curriculum (7.33) was the highest rated program element, followed by Staff Development and Training (6.71) and Funding Sources (6.52). Staff Development and Training, and Funding Sources ranged from 4.50 to 8.00 in the other geographic regions, whereas, Instructional Practices and Distinctive Curriculum was consistently rated among the highest program element of importance to sustainability, independent of geographic location. In the largest represented U.S. region of the Southeast, Student Achievement rated fourth (5.19), which was higher than the other regions. Student Achievement rated between sixth and ninth on importance to sustainability in the other regions.

Table 11 was provided to present respondents' ratings on the importance of each program element by administrative structure at the school. The data set displayed in the table sorts survey responses by number of administrative positions at the school. This information was analyzed to determine any differences in responses on sustainability based on the administrative structure at the STEM school site.

Table 11

Average Rating of Program Element's Importance to the Sustainability of the STEM Program by Number of Administrative Positions Other than Principal

Program Elements	0	1	2	3	4	5	6
	$N = 3$	$N = 6$	$N = 9$	$N = 5$	$N = 6$	$N = 3$	$N = 1$
National/State Leadership	3.67	1.17	2.67	1.20	3.50	1.67	2.00
School Board/District leadership/support	4.67	4.83	4.56	6.20	4.33	6.33	6.00
Outreach & Marketing	3.67	3.67	3.89	5.60	4.50	3.00	3.00
Instructional Practices & Distinctive Curriculum	**8.33**	**7.83**	**7.67**	**6.40**	**6.83**	**7.67**	4.00
Student Achievement	2.67	5.17	4.44	3.80	5.00	**7.67**	5.00
Program Recognition	3.33	3.83	2.11	3.00	2.33	3.33	1.00
Community Partnerships	5.00	5.00	6.00	5.60	4.67	3.33	**9.00**
Funding sources	**7.67**	**6.00**	5.44	**7.00**	**8.00**	6.33	**8.00**
Staff Development &Training	**6.00**	**7.50**	**8.22**	**6.20**	**5.83**	5.67	**7.00**

Note: A low average indicates a low level of importance, whereas a high average indicates a high level of importance. The highest three average ratings for each administrative structure are in boldface.

Instructional Practices and Distinctive Curriculum, Staff Development and Training, and Funding Sources were rated one of the top three priority elements in the majority of the administrative structures. Instructional Practices and Distinctive

Curriculum, and Staff Development and Training were rated first or second in five of the seven administrative structures.

Subsequently, the study examined participant responses grouped by grade level configuration of their buildings. Responses were disaggregated to assess whether or not there were differences based on the grades represented at the STEM themed magnet schools. Table 12 delineates the average rating of each program element's importance level to sustainability. The higher the rating, the greater the level of importance respondents reported for sustainability.

Table 12

Average Rating of Program Element's Importance to the Sustainability of the STEM Program by Grade Configuration

Program Elements	Elementary	Middle	High	Intermediate	K-8	Other
	$N = 10$	$N = 10$	$N = 8$	$N = 1$	$N = 1$	$N = 3$
National/State Leadership	2.40	1.90	2.25	1.00	5.00	3.00
School Board/District leadership/support	4.80	4.40	6.62	2.00	4.00	5.00
Outreach & Marketing	3.30	5.10	4.12	5.00	3.00	3.33
Instructional Practices & Distinctive Curriculum	7.10	**7.70**	**7.12**	9.00	8.00	6.33
Student Achievement	4.50	5.20	4.75	7.00	1.00	4.33
Program Recognition	3.30	2.20	2.87	3.00	2.00	3.00
Community Partnerships	5.50	4.80	4.50	6.00	7.00	7.33
Funding sources	6.50	6.60	**7.12**	4.00	6.00	6.67
Staff Development & Training	**7.60**	7.10	5.62	8.00	9.00	6.00

Note: A low average indicates a low level of importance, whereas a high average indicates a high level of importance. The highest rated program element for elementary, middle and high school are in boldface.

Staff Development and Training (7.60) was rated by elementary principals as the program element most important to sustainability. High school principals reported

Instructional Practices and Distinctive Curriculum (7.12) and Funding Sources

(7.12) as the highest rated program elements, and middle school principals rated

Instructional Practices and Distinctive Curriculum (7.70) as the highest program

element. Both elementary and middle school respondents rated Funding Sources as the

third most important program element for sustainability.

In the following three tables, each of the three highest rated program elements

from Table 7 are displayed based on level of importance by grade configuration. Those

highest ranked program elements were Instructional Practices and Distinctive

Curriculum, Staff Development and Training, and Funding Sources. The average rating

for each of the three program elements were reported using the rating scale (1=lowest;

9=highest). Study respondents were asked to indicate the grade configuration at their

STEM themed magnet school as a possible variable that may impact program

sustainability. The purpose was to report any differences in impact of sustainability

based on grade configuration among respondents who assigned a high rating (6–9).

Table 13 was provided to illustrate any variance in respondents' ratings to the

importance of Instructional Practices and Distinctive Curriculum by grade configuration

and how it impacted the overall average rating for that program element. The table

displays the percentage of respondents who assigned an overall high rating (6–9).

Table 13

Percentage of Respondents Rating the Importance of Instructional Practices and Distinctive Curriculum to the Sustainability of the STEM Program by Grade Configuration

Grade	Rating			
Configuration	6	7	8	9
Elementary	20%	**10%**	**10%**	**40%**
Middle school	10%	**10%**	**40%**	**30%**
High school	38%	**13%**	0%	**38%**

Note: The percentage of respondents with a rating of seven, eight or nine are in boldface.

The percentage of middle school principals who reported a rating of seven, eight or nine on the importance of Instructional Practices and Distinctive Curriculum to program sustainability was 80% (*N*=8), followed by elementary principals with 60% (*N*=6) and high school respondents with 51% (*N*=4). Over one – third (38%) of the high school principals assigned a rating of six to this program area, which lowered the overall high rating of importance to sustainability for high school principals.

Table 14 was provided to illustrate any differences in respondents' ratings to the importance of Staff Development and Training by grade configuration and how it impacted the overall average rating for that program element. The percentages of respondents who assigned a high rating (6–9) are displayed.

Table 14

Percentage of Respondents Rating the Importance of Staff Development and Training to the Sustainability of the STEM Program by Grade Configuration

Grade Configuration	Rating			
	6	7	8	9
Elementary	20%	**20%**	**40%**	**20%**
Middle school	10%	**30%**	**30%**	**20%**
High school	13%	**38%**	**13%**	0%

Note: The percentage of respondents with a rating of seven, eight or nine are in boldface.

The percentage of elementary and middle school administrators who reported a rating of seven, eight or nine on the importance of Staff Development and Training to program sustainability each totaled 80% (N=16). The percentage of high school administrators reporting a rating above six was 51% (N =4). Thirteen percent of the high school principals assigned a rating of six to this program area, which resulted in an overall lower rating on importance to sustainability than elementary and middle level administrators.

Table 15 was provided to illustrate any differences in respondents' rating to the importance of Funding Sources to sustainability of STEM themed magnet schools by grade configuration, and how it impacted the overall average rating for that program element. The percentages of respondents who assigned a high rating (6–9) are displayed.

Table 15

Percentage of Respondents Rating the Importance of Funding Sources to the
Sustainability of the STEM Program by Grade Configuration

Grade	Rating			
Configuration	6	7	8	9
Elementary	30%	**10%**	**10%**	**30%**
Middle school	10%	**20%**	**10%**	**30%**
High school	13%	**38%**	**25%**	**13%**

Note: The percentage of respondents with a rating of seven, eight or nine are in boldface.

The percentage of elementary school administrators who reported a rating of seven, eight or nine on the importance of Funding Sources to program sustainability was 50% (*N*=5). The percentage of middle school respondents was 60% (*N*=6). High school respondents rated this program element the highest of the three grade level configurations (76%; *N*=6). Thirty percent of the elementary school administrators assigned a rating of six to this program area, which impacted the overall high rating of importance to sustainability.

The study then examined participant responses by length of time the school has been in operation as a STEM themed magnet program. There were five response choices on the survey ranging from first year of implementation to programs that had been operating for ten or more years. Responses were disaggregated to assess whether there were differences based on the length of time the program has been operating.

Table 16 presents the average rating of each program element's importance level to the sustainability of a STEM themed magnet school by length of time in operation. The higher the average rating of program elements, the greater the level of importance respondents reported for sustainability.

Table 16

Average Rating of Program Element's Importance to the Sustainability of the STEM Program by Length of Time in Operation

Program Elements	1st Year	3rd Year	4th Year	5-9 Years	10+ Years
	$N = 2$	$N = 9$	$N = 6$	$N = 11$	$N = 5$
National/State Leadership	3.50	1.78	3.00	2.18	2.20
School Board/District leadership/support	7.00	4.00	4.17	5.73	5.60
Outreach & Marketing	2.50	4.33	4.83	3.64	4.40
Instructional Practices & Distinctive Curriculum	5.50	7.56	6.67	**7.45**	**8.00**
Student Achievement	4.50	4.11	3.83	5.36	5.60
Program Recognition	1.00	2.89	2.83	2.73	3.40
Community Partnerships	6.00	6.33	6.00	4.55	3.80
Funding sources	7.00	6.11	**7.00**	6.45	7.20
Staff Development & Training	**8.00**	**7.89**	6.67	6.91	4.80

Note: A low average indicates a low level of importance, and a high average indicates a high level of importance. The highest average rating for each category by length of time in operation is in boldface.

The highest average ratings by importance of program elements for schools in the first and third year of operation were Staff Development and Training with respective values of (8.00) and (7.89). Programs in the fourth year of implementation

reported Funding Sources of highest importance with an average rating of 7.00.

Programs in operation for five to nine years, or ten or more years reported Instructional

Practices and Distinctive Curriculum of highest importance with average ratings of 7.45

and 8.00, respectively. Funding Sources in all categories by length of time in operation

rated consistently high. The range of average rating for this program element was from

6.11 to 7.20, which placed it no lower than fourth in importance to sustainability in all

categories.

In the following three tables, each of the three highest ranked program elements

from Table 7 are displayed based on level of importance by length of time in operation.

Those highest ranked program elements are Instructional Practices and Distinctive

Curriculum, Staff Development and Training, and Funding Sources. The average rating

for each of the three program elements is reported using the rating scale (1-9), with one

the lowest and nine the highest. The purpose was to report differences in the impact of

sustainability based on years in operation. Staff Development and Training was rated

high in the early years of implementation. The importance of Instructional Practices and

Distinctive Curriculum, and Funding Sources were rated higher in schools that had been

in operation for ten or more years.

Table 17 was provided to illustrate any differences in respondents' rating to the

importance of Instructional Practices and Distinctive Curriculum to sustainability of

STEM themed magnet schools by number of years in operation and how it impacted the

overall average rating for that program element. The table represents the percentage of

respondents who assigned an overall high rating (6–9).

Table 17

Respondents' Rating Percentages on the Importance of Instructional Practices and Distinctive Curriculum to the Sustainability of the STEM Program by Years in Operation

Years in Operation	Rating 6	7	8	9
1st – 3rd year	18%	**9%**	**27%**	**27%**
4th – 9th year	18%	**18%**	**12%**	**35%**
10+ years	20%	**0%**	**40%**	**40%**

Note: The percentage of respondents with a rating of seven, eight or nine are in boldface.

The percentage of respondents who reported their program was in the first to third year of operation and assigned a rating of seven, eight or nine on the importance of Instructional Practices and Distinctive Curriculum for program sustainability was 63% (*N*=7). The assigned rating for programs in the fourth to ninth year of operation was 64% (*N*=11), while programs in operation for ten or more years had a rating of 80% (*N*=4). Only 20% of the respondents who had programs in operation for ten or more years assigned a rating below eight, indicating the relative importance of this program element for long term sustainability.

Table 18 was provided to illustrate any differences in respondents' ratings to the importance of Staff Development and Training to sustainability of STEM themed magnet schools by number of years in operation and how it impacted the overall average rating for that program element. The table displays the percentage of respondents who assigned an overall high rating (6–9).

Table 18

Respondents' Rating Percentages on the Importance of Staff Development and Training
to the Sustainability of the STEM Program by Years in Operation

Years in	Rating			
Operation	6	7	8	9
1st – 3rd year	9%	**27%**	**27%**	**36%**
4th – 9th year	18%	**24%**	**35%**	**12%**
10+ years	0%	**40%**	0%	0%

Note: The percentage of respondents with a rating of seven, eight or nine are in
boldface.

The percentage of school administrators who reported their program in the first
to third year of operation and assigned a seven, eight or nine on the importance of Staff
Development and Training for program sustainability was 90% (N=10). The assigned
rating for programs in the fourth to ninth year of operation was 71% (N=12) and
programs in operation for ten or more years had a rating of 40% (N=2). An additional
18% of the respondents with programs in the fourth to ninth year of operation assigned a
rating of six, which impacted the overall rating of importance to sustainability.

Table 19 was provided to illustrate any differences in respondents' ratings to the
importance of Funding Sources to the sustainability of a STEM themed magnet school
by years in operation. The table displays the percentage of respondents who assigned an
overall high rating (6–9).

Table 19

Respondents' Rating Percentages on the Importance of Funding Sources to the
Sustainability of the STEM Program by Years in Operation

Years in Operation	Rating			
	6	7	8	9
1st – 3rd year	27%	**18%**	**18%**	**9%**
4th – 9th year	18%	**12%**	**12%**	**35%**
10+ years	0%	**40%**	**20%**	**20%**

Note: The percentage of respondents with a rating of seven, eight or nine are in
boldface.

The percentage of school administrators who reported their program in the first

to third year of operation and assigned a seven, eight or nine on the importance of

Funding Sources for program sustainability was 45% (*N*=5). The assigned rating for

schools in the fourth to ninth year of operation was 59% (*N*=10), while programs in

operation for ten or more years reported a rating of 80% (*N*=4). Twenty-seven percent

of the respondents with programs in the first to third year of operation assigned a rating

of six, which impacted the overall rating of importance to sustainability.

Principal perceptions on importance of program elements to sustainability of

their themed based STEM magnet schools varied by demographic factors. There was

little difference in responses on the importance of program elements by geographic

location and number of administrative positions. When the program elements were

analyzed by grade configuration, Staff Development and Training was rated as most important by elementary principals. Middle school principals rated Instructional Practices and Distinctive Curriculum the highest, whereas high principals rated Instructional Practices and Distinctive Curriculum and Funding Sources as most important to program sustainability.

Research Question Three

In research question three, the differences in school administrator responses regarding program elements reported as future challenges to sustaining a STEM themed magnet school for the next three to five years were examined. "What program elements of magnet schools do principals perceive as the greatest challenge to sustainability of STEM schools in the next three to five years?"

The respondents were asked to rate a series of program elements on the level of challenge they predict those areas will present for sustainability in the future. The program elements were identified from a review of the literature that included research studies, journal reports, and publications from professional educational organizations.

The information in Table 20 displays the average rating for each program element using a nine-point scale (9=highest; 1=lowest) to represent the level of challenge for future sustainability of the STEM Program.

Table 20

Average Rating of Program Element's Level of Challenge to the Sustainability of the
STEM Program

Program Elements	Average Rating	Rank of Challenge
Funding sources	**8.06**	**1**
Instructional Practices & Distinctive Curriculum	**6.21**	**2**
Staff Development & Training	**5.48**	**3**
Community Partnerships	5.42	4
School Board/District leadership/support	4.27	5
National/State Leadership	4.21	6
Outreach & Marketing	4.21	6
Student Achievement	3.82	8
Program Recognition	3.30	9

Note: A low average indicates a low level of challenge, whereas a high average
indicates a high level of challenge. A low rank indicates a high level of importance.
The top three rated program elements are in boldface.

The average respondent rating for Funding Sources was 8.06. This was the

highest rated challenge of all program elements reported by school administrators

necessary for program sustainability in the next three to five years, followed by

Instructional Practices and Distinctive Curriculum (6.21), and Staff Development and

Training (5.48). The two lowest rated challenges of the program elements for

sustainability as reported by respondents in the next three to five years were Program

Recognition (3.30) and Student Achievement (3.82).

Table 21 was provided to illustrate the relative strength of the program elements

by displaying the percentage of respondents that selected each rating (1-9). In the

program elements where a high percentage of respondents gave an average rating, the

overall ranking of importance of the program element was impacted. The higher the

percentage of respondents with a high rating for each of the nine program elements, the

greater the level of importance for program sustainability.

Table 21

Percentage of Respondents Rating each Program Element's Level of Challenge to the
Sustainability of the STEM Program

Program Elements	Rating								
	1	2	3	4	5	6	7	8	9
Funding sources	**0%**	0%	0%	6%	6%	3%	12%	6%	67%
Instructional Practices & Distinctive Curriculum	**0%**	6%	6%	6%	9%	24%	21%	18%	9%
Staff Development & Training	3%	21%	9%	3%	3%	9%	24%	21%	6%
Community Partnerships	3%	12%	9%	9%	9%	15%	24%	18%	0%
School Board/District leadership/support	12%	9%	27%	9%	15%	9%	0%	15%	3%
National/State Leadership	18%	3%	15%	18%	15%	18%	6%	3%	3%
Outreach & Marketing	3%	24%	12%	21%	15%	9%	3%	12%	0%
Student Achievement	39%	9%	3%	9%	12%	3%	6%	6%	12%
Program Recognition	21%	15%	18%	18%	15%	9%	3%	0%	0%

Note: A low rating indicates a high level of challenge, whereas a high rating indicates a low level
of challenge. The two program elements with a rating of one indicating the highest level of
challenge are in boldface.

The program elements respondents indicated as the greatest challenge (rating =

1) to program sustainability in the future were Funding Sources, and Instructional

Practices and Distinctive Curriculum. These program elements were denoted with zero

percent of the respondents giving a rating of one. The second highest rated program

elements that respondents reported as challenges to program sustainability were Staff

Development and Training, Community Partnerships, and Outreach and Marketing.

Only three percent of the respondents gave a rating of one for each of the three program

elements reported as challenges to future sustainability, indicating a high level of

challenge to program sustainability in the next three to five years. Staff Development

and Training implies on-going opportunities and resources for staff learning. Community

Partnerships refers to business or agency relationships with the STEM school that

provides funding or services. Outreach and Marketing refers to resources available for

promotional and recruitment efforts.

The program elements by average low rating (1–4) that are reported as high

challenges to sustainability are Funding Sources (6%), Instructional Practices and

Distinctive Curriculum (18%), Community Partnerships (33%), and Staff Development

and Training (36%). The relative strength of Funding Sources as the greatest challenge is

clearly evident with only 33% of the respondents assigning a rating of eight or below.

Sixty-seven percent of the respondents declared Funding Sources as the least challenging

program element (rating = 9).

The next data set displays a summary of narrative responses by school

administrators on the challenges the highest rated program elements have on

sustainability of a STEM themed magnet school. Study respondents were asked to

describe why the impact of the three highest elements they identified will be challenges

that impact program sustainability in the next three to five years. Open-ended response

boxes were provided for the respondents to comment. The supporting comments are

displayed in Table 22.

Table 22

Reported Impact of Top 3 Ranked Program Elements that Present a Future Challenge to
Program Sustainability

Program Elements	Impacts
Funding sources	Cannot keep technology relevant
	Causes the need to re-evaluate the program annually
	Needed for supplies and staff
	Needed to grow and maintain quality instruction
	No new/additional/consistent funding
	Required for staff training
Staff Development & Training	Hard to keep up with changes of STEM program
	Need funding
	Needed for continued growth
	Requires a paradigm shift
	Staying innovative/cutting edge
	When there is turnover, it is hard to train replacements to that level
Instructional Practices & Distinctive Curriculum	Cost of curriculums
	Difficult to find quality lessons
	Initiatives may fade under new leadership
	Lack of good teachers
	Need strong, consistent definition of STEM
	Need sound practices
	Requirement to include school reforms is difficult
	Staying innovative/cutting edge
Community Partnerships	Challenge to maintain
	Competition with other STEM schools for partnerships
	Creating vision
	Difficult to keep them fresh/new experiences for students
	Difficult with struggling economy

(Table 22 Continues)

(Table 22 Continued)

Student Achievement	Having trouble meeting achievement goals
	Lack of good teachers
	Loss of funding has caused this to drop
	Need to shift focus to develop gifted and talented
	Pressure to maintain high proficiency
School Board/District leadership/support	Concerned about district policy impact
	District has misconceptions about program
	Lack of belief
	Losing attention from district
Outreach & Marketing	No money to put toward promotional materials
National/State Leadership	Testing mandates interfere
Program Recognition	None

Note: Respondents were asked to include comments on their highest three program areas only.

School administrator responses describing the impact on the highest three

program elements that will present challenges to sustainability of a STEM themed

magnet school are shown in Table 22. Comments supporting Funding Sources as a

future challenge to sustainability include "cannot keep technology relevant", "causes the

need to re-evaluate the program annually" and "needed to grow and maintain quality

instruction". Examples of comments supporting Staff Development and Training as a

future challenge to sustainability include "staying innovative/cutting edge" and "requires

a paradigm shift". Respondent comments on Instructional Practices and Distinctive

Curriculum related to "cost of curriculums", "fading initiatives", and "need for

consistent definition of STEM."

Research Question Four

In research question four, the perceptions of the respondents on the impact of

STEM themed magnet schools on student achievement were examined. "What is the

impact of STEM themed magnet schools on student achievement as perceived by principals?"

The study respondents were asked to indicate their opinion on the level of impact their STEM themed magnet school has had on student achievement in the content areas of reading and mathematics. The survey choices ranged from no impact to significant impact. To further examine this research question, respondents reported their opinion of student achievement data from the prior three years as related to district expectations. The response choices ranged from significantly below district expectations to significantly above district expectations. The descriptive statistical analyses used to answer this research question were frequency counts, percentages and cross-tabulations of achievement levels with district expectations.

Table 23 displays the respondents' opinions on the level of impact the STEM themed magnet program had on reading achievement. The number of respondents by level of impact are reported using percentages.

Table 23

Perceived Impact of STEM Program on Reading Achievement as Reported by School
Administrators

Level of Impact	*N*	%
Significant impact	9	**29.0%**
Moderate impact	10	**32.3%**
Some impact	10	32.3%
Little impact	2	6.5%
No impact	0	0.0%

Note: The percentages for significant impact and moderate impact are in boldface.

Based on opinion of the respondents, the percentage of school administrators
who reported that their STEM program had a significant impact or moderate impact on
reading achievement was 61.3% (*N* = 19). Two of the respondents (6.5%) reported their
STEM program had little impact on reading achievement.

Table 24 displays the respondents' opinions on the level of impact the STEM
themed magnet program had on mathematics achievement. The number of respondents
by level of impact are reported using percentages.

Table 24

Perceived Impact of STEM Program on Mathematics Achievement as Reported by
School Administrators

Level of Impact	N	%
Significant impact	15	**46.9%**
Moderate impact	6	**18.8%**
Some impact	8	25.0%
Little impact	3	9.4%
No impact	0	0.0%

Note: The percentages for significant impact and moderate impact are in boldface.

The percentage of school administrators reporting that their STEM program had a significant impact or moderate impact on mathematics achievement was 65.7% ($N = 21$). Three principals (9.4%) reported their STEM program had little impact on mathematics achievement.

The data reported in Table 25 displays a comparison of the respondents' opinions on district expectations for reading achievement with reported student achievement levels of expected student achievement across the entire district where the STEM school is located. The table below shows a cross tabulation comparing the respondents' perceptions of their students' academic achievement compared to school district expectations where the STEM school is located and their expected levels of achievement.

Table 25

Cross-tabulation of Reported Reading Achievement of STEM Students and District
Reading Expectations for All Students

Reading Achievement of STEM Students as Reported by School Administrators	Reading Achievement of Students at STEM School in Relation to District Expectations for All Students				
	Significantly below School District expectations	Below School District expectations	At School District expectations	Above School District expectations	Significantly above School District expectations
Below 20%ile	6%	0%	0%	0%	0%
20%ile - 39%ile	3%	13%	0%	0%	0%
40%ile - 59%ile	0%	13%	**6%**	0%	0%
60%ile - 79%ile	0%	0%	**9%**	**9%**	0%
80%ile or over	0%	0%	0%	**16%**	**25%**

Note: These are "total" percentages, out of the total that responded to both items.
Achievement percentile ranges reported in the categories of at, above or
significantly above school district expectations are in boldface.

Sixty-five percent of the respondents reported that reading achievement at their

STEM school is at, above or significantly above school district expectations for all

students. This represents an achievement range from the 40th percentile to the 80th

percentile or greater. Respondents reporting reading achievement at their STEM school

below or significantly below school district expectations (35%) had reading achievement

levels at or below the 59th percentile.

The data reported in Table 26 displays a comparison of the respondents' opinions

on district expectations for mathematics achievement, with reported levels of expected

student achievement across the entire district where the STEM school is located. The

table below shows a cross tabulation comparing the respondents' perceptions of their

students' academic achievement compared to the school district where the STEM school

is located and their expected levels of achievement.

Table 26

Cross-tabulation of Reported Mathematics Achievement of STEM Students and District
Mathematics Expectations for All Students

Math Achievement of STEM Students	Math Achievement of Students at STEM School in Relation to District Expectations for All Students				
	Significantly below School District expectations	Below School District expectations	At School District expectations	Above School District expectations	Significantly above School District expectations
Below 20%ile	6%	0%	0%	0%	0%
20%ile - 39%ile	3%	9%	**3%**	0%	0%
40%ile - 59%ile	0%	9%	**6%**	0%	0%
60%ile - 79%ile	0%	3%	**6%**	**6%**	**3%**
80%ile or over	0%	0%	0%	**13%**	**31%**

Note: These are "total" percentages, out of the total that responded to both items.
Achievement percentile ranges reported in the categories of at, above or
significantly above school district expectations are in boldface.

Sixty-eight percent of the respondents reported that mathematics achievement at

their STEM school is at, above or significantly above school district expectations for all

students. This represents an achievement range from the 20th percentile to the 80th

percentile or over. Thirty percent of the respondents who reported mathematics achievement at their STEM school below or significantly below school district expectations had achievement levels that ranged between the 20th and 79th percentile. One school reported mathematics achievement between the 20th and 39th percentile as meeting school district expectations for all students. In contrast, another school reported mathematics achievement between the 60th and 79th percentile as meeting school district expectations for all students.

The perceived impact of the STEM program on students' academic achievement as reported by school administrators was higher in mathematics than reading. Over 65% of respondents reported that their STEM program had a significant or moderate impact on students' mathematics achievement, whereas only 61.3% of respondents reported that their STEM school had a significant or moderate impact on reading achievement. When compared with district expectations for student achievement at a STEM school, more respondents reported mathematics achievement at, above or significantly above school district performance expectations.

Additional Findings

Information displayed in the subsequent four tables provides additional analyses to support other elements of this research study. In Tables 27–30, differences in responses on level of importance of the program elements for sustainability were examined by role of the respondent. As displayed in Table 1, the respondents reported their current role as either principal or other administrative position. The findings indicate that 72.7% (*N*=24) of the respondents were serving as the principal and 27.3%

(*N*=9) were serving in another administrative capacity.

Although the study was designed for the primary school leaders or principals, administrative designees' responses were included after multiple unsuccessful attempts were made to secure completed surveys from select sample school principals. Surveys completed by administrative designees were included in the study to ensure a higher response rate. The job description of the administrative designee was either assistant principal or STEM or magnet school coordinator.

Table 27 displays the average rating of each program element's level of importance to sustainability of STEM themed magnet schools by survey respondents' administrative position at the school. The ratings reveal any differences in responses by role as principal or administrative designee.

Table 27

Average Rating of Program Element's Importance Level to the Sustainability of the STEM Program by Administrative Position

Program Elements	Other (N = 9)		Principals (N = 24)	
	Average Rating	Rank of Importance	Average Rating	Rank of Importance
Instructional Practices & Distinctive Curriculum	6.78	**2**	7.50	**1**
Staff Development & Training	6.56	**3**	7.00	**2**
Funding sources	7.00	**1**	6.46	**3**
Community Partnerships	4.89	5	5.42	4
Student Achievement	4.56	6	4.79	5
School Board/District leadership/Support	5.67	4	4.79	5
Outreach & Marketing	4.33	7	4.00	7
Program Recognition	2.56	9	2.87	8
National/State Leadership	2.67	8	2.17	9

Note: A low average indicates a low level of importance, whereas a high average indicates a high level of importance. A low rank indicates a high level of importance. The program elements ranked with a one, two or three are in boldface.

Principals and administrative designees rated Instructional Practices and Distinctive Curriculum (Principals=7.50; Other= 6.78), Staff Development and Training (Principals=7.00; Other= 6.56), and Funding Sources (Principals= 6.46; Other=7.00), as the highest three priority program elements. Funding sources ranked the highest for administrative designees and third for principals. The lowest rated program elements for principals and administrative designees were National/State Leadership (Principals= 2.17; Other=2.67) and Program Recognition (Principals=2.87; Other=2.56).

In Tables 28–30, responses from principals and administrative designees are displayed on the importance of the three highest rated program elements for sustainability from Table 7. This information was included in the study to determine

differences in responses by principal and other administrative role in STEM schools. Although, the pattern of responses is similar, the information was included to assist the reader in determining whether or not differences in responses between the principal and administrative designee could impact the findings of this study.

Table 28 was provided to illustrate the relative strength of the differences in responses for the principal and administrative designee by displaying the percentage of respondents that selected a high rating (6–9) on the importance of Instructional Practices and Distinctive Curriculum for program sustainability. The table displays differences among respondents who assigned an overall high rating (6-9).

Table 28

Percentage of Respondents' Rating the Importance Level of Instructional Practices and Distinctive Curriculum to the Sustainability of the STEM Program by Administrative Position

Current Role	Rating			
	6	7	8	9
Administrative Designee	11%	**11%**	**11%**	**33%**
Principal	21%	**13%**	**25%**	**33%**

Note: The percentage of respondents with a rating of seven, eight or nine is in boldface.

The percentage of principals who recorded a rating of seven, eight or nine on the importance of Instructional Practices and Distinctive Curriculum to the sustainability of STEM programs was (71%; N=18), while administrative designees was (66%; N=6).

Twenty-one percent of the principals assigned a rating of six, which impacted the overall

high rating on importance of Instructional Practices and Distinctive Curriculum to

program sustainability.

Table 29 was provided to illustrate the relative strength of the differences in

responses for the principal and administrative designee by displaying the percentage of

respondents that selected a high rating (6–9) on the importance of Staff Development

and Training for program sustainability. The table illustrates differences among

respondents who assigned an overall high rating (6-9).

Table 29

Percentage of Respondents' Rating the Importance Level of Staff Development and
Training to the Sustainability of the STEM Program by Administrative Position

Current Role	Rating			
	6	7	8	9
Administrative Designee	11%	**33%**	**22%**	**11%**
Principal	13%	**25%**	**29%**	**21%**

Note: The percentage of respondents with a rating of seven, eight or nine is in
boldface.

As revealed in Table 29, 75% (*N*=18) of principals and 66% (*N*=6) of

administrative designees, gave a rating of seven, eight or nine on the importance of Staff

Development and Training to the sustainability of STEM programs. Thirteen percent of

the principals assigned a rating of six, which impacted the overall high rating on

importance of Staff Development and Training to the sustainability of STEM programs.

Table 30 was provided to illustrate the relative strength of the differences in responses for the principal and administrative designee, by displaying the percentage of respondents that selected a high rating (6–9) on the importance of Funding Sources for program sustainability. The table illustrates differences among respondents who assigned an overall high rating (6-9).

Table 30

Percent of Respondents Rating the Importance Level of Funding Sources to the Sustainability of the STEM Program by Administrative Position

Current Role	Rating			
	6	7	8	9
Administrative Designee	22%	**22%**	**22%**	**22%**
Principal	17%	**17%**	**13%**	**25%**

Note: The percentage of respondents with a rating of seven, eight or nine is in boldface.

The percentage of school administrators who gave a rating of seven, eight or nine on the importance of Funding Sources to the sustainability of STEM programs is as follows: current principal (55%; *N*=13), administrative designee (66%; *N*=6). Twenty-two percent of the administrative designees assigned a rating of six, which impacted the overall rating on importance of Funding Sources to the sustainability of STEM programs.

SUMMARY

Data collected from principals or administrative designees at 33 STEM themed magnet schools were carefully analyzed to summarize their perceptions on factors related to program sustainability. Study participants were members of the Magnet Schools of America organization and listed in the 2012 Directory as STEM themed schools. In this study, a quantitative research method using an online survey instrument was employed. Statistical analyses were calculated using frequency distribution of responses when comparing demographics, percentages, and average ratings on factors related to program sustainability and cross-tabulation of achievement levels with district expectations.

The goal of Chapter four as purported by Levasseur (2011) "is to present enough information so that people reading your dissertation can understand what you learned about your hypotheses based on your statistical analyses, and can judge the extent to which your findings are valid and generalizable."

Chapter five summarizes the findings of the study, relates findings to the current review of the literature, draws conclusions and offers recommendations for further study on program sustainability of STEM themed magnet schools.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

Chapter five provides a summary report that includes the study purpose and
design, data analyses used to conduct the study, conclusions, recommendations, and
implications for further research. Butin (2010) describes Chapter five as the analysis for
determining how the research supports a larger academic view and impacts further work
based on what has been learned. Conclusions formulated from the study findings
reported in chapter four will be presented. The final section of the chapter reports on
recommendations for the field, and implications for future study about factors leading to
sustainability of STEM themed magnet schools.

Research Purpose and Design

The purpose of this study was to determine the priority program elements that
lead to sustainability of STEM themed magnet schools, as reported by principals and
other administrative leaders. The program elements were identified from an in-depth
review of the literature, and the most prevalent elements were incorporated into a
conceptual framework. The framework then served as the foundation for development
of the survey questions that guided the study.

The survey instrument was created by the researcher using a varied questioning format that was based on the types of responses which most accurately addressed the research questions. The survey instrument was then pilot tested for validity and reliability before administering to the study participants, using a thorough review process. "A pilot test serves as a trial run of the study, done for the sole purpose of testing the instrument and identifying any issues that need to be addressed before the actual study is conducted" (Slavin, 2007, p. 107).

Initially, the pilot survey's questions and response methods were reviewed by a professor at St. Cloud State University (Minnesota) to ensure accuracy and appropriate construction of the instrument. The survey was then administered to a cohort of doctoral students for feedback, specifically on clarity of questions, understanding of terms and length of the survey. This final examination of the instrument was undertaken to ensure precise alignment to the research questions and validate survey construction. The completed version of the survey was specific and concise, thus increasing the accuracy of participant responses. After review by the dissertation committee, the survey was submitted to the IRB office for approval.

Respondents were asked to rank survey questions about the importance of program development and operational elements they believed led to program sustainability and the greatest challenges faced in sustaining a program in the next three to five years. A section for comments to support participant responses was provided. Demographic information about the respondents was secured regarding their administrative roles, numbers of years served at their schools, and their levels of

involvement in the development of the STEM themed magnet schools. The survey instrument was then verified for validity and reliability before being presented to the selected administrative sample through an on-line survey.

The survey was administered initially to the principals at all of the sample sites. The sample school websites were examined to confirm contact information and locate other demographic details about their programs. A two-week follow-up reminder was sent to study participants who had not yet responded. The number of study participant responses was calculated, and a third reminder was sent. After three attempts, responses from other administrators at the site were accepted and included in the findings to ensure a high response rate. Throughout the data collection process, websites of schools included in the study sample were examined to confirm contact information and validate other demographic details about their programs.

The non-principal administrators (administrative designees) who responded to the survey were either serving as the assistant principal or magnet school or STEM coordinator at the sample sites. Thirty-eight principals, representing schools in varied geographic areas of the United States were invited to participate in the study. Thirty-three of the 38 principals or administrative designees (86.8%) responded to the survey.

For purposes of reporting the conclusions and recommendations in this chapter, the principals or administrative designees who participated in the study, will be referred to as school administrators or respondents. The study was conducted using 33 STEM themed magnet schools that were affiliated with Magnet Schools of America (MSA). The schools included in the study were published in the 2012 MSA directory and listed

as STEM themed magnet schools. This method of selecting a cluster of magnet schools with a STEM theme is referred to as criterion sampling. This type of sampling according to Patton (1990) is often used in survey research to examine a population that meets a prescribed set of criteria.

Research Questions

The following research questions were used to guide this study:

1. How do principals of select magnet schools rank program elements of STEM programs in relation to their impact on school sustainability?

2. What are the differences in program elements reported as essential for sustainability of STEM themed magnet schools reported by principals based on geographic location, administrative structure, grade level configuration, and length of time in operation?

3. What program elements of magnet schools do principals perceive as the greatest challenges to sustainability of STEM schools in the next three to five years?

4. What is the impact of STEM themed magnet schools on student achievement as perceived by principals?

Data Analysis

Statistical analysis of survey results allowed the study researcher to identify themes that emerged from the priority program elements assessed. The four research

questions were analyzed by applying descriptive statistical analyses. Frequencies,

percentages, ratings and cross-tabulations were used to interpret the data and report the

findings. Descriptive statistics according to Slavin (2007), provide a basic data analysis

format for general use and understanding.

CONCLUSIONS AND DISCUSSION

The conclusions from the study on sustainability of STEM themed magnet

schools are presented in this section. Conclusions for each of the research questions are

reported and accompanied with supporting research from the literature review.

Additional conclusions from the research findings are provided at the end of this section.

Research Question One

Research question one examined the importance of priority program elements

for sustainability of STEM themed magnet schools as reported by school administrators.

The respondents were asked to rate a series of program elements based on their opinion

of each element's impact on school sustainability. Averages and ratings of the program

elements were calculated to analyze and report the responses on current impact of

sustainability. Open-ended responses were provided for the respondents to describe the

impact their highest rated program elements had on sustainability.

"How do principals of select magnet schools rank program elements of STEM

programs in relation to their impact on school sustainability?"

Based on the average of responses from the rating scale (1 = lowest; 9 = highest), Instructional Practices and Distinctive Curriculum (7.30), Staff Development and Training (6.88), and Funding Sources (6.61) were the highest rated program elements school administrators reported as of greatest importance to program sustainability. When the program elements were examined by percentage of respondents who assigned the highest rating (9=highest), Instructional Practices and Distinctive Curriculum was again rated highest by school administrators. One-third of all respondents reported this program element highest on the scale (1–9) of importance to program sustainability. Funding Sources was rated second highest, and Staff Development and Training was rated third highest by study respondents. Instructional Practices and Distinctive Curriculum was found to be the most important program element for sustainability by highest average rating among the nine program elements, and highest percentage of respondents assigning a rating of nine (9 = highest) to this program element. This finding is consistent with the research reported in the literature. In a U.S. Department of Education publication, it was stated that rigorous and relevant curriculum is essential for engaging students and maintaining a viable mission (U.S. Department of Education, 2008). Another research reference supporting this finding is a report from the 2011 National Research Council on the program criteria for success of a STEM-focused school. The report refers to the importance of effective instructional practices for engaging students in the STEM curriculum content areas by building on their students' backgrounds, while providing new experiences to hold student interest (National Research Council, 2011). Further evidence of this finding is reported in the

work of Merritt et al. (2005). The authors refer to the compelling quality of a magnet

school, which is to deviate from standard offerings by presenting a totally unique

approach that is substantial and fully aligned with the mission of the program (Merritt et

al., 2005).

The second highest average rated program element identified by respondents as

important to program sustainability was Staff Development and Training. This finding is

closely linked to the first priority program element on Instructional Practices and

Distinctive Curriculum, and is supported in the research by Drew (2011). In the author's

book, *STEM the Tide*, Drew stated that evidence of innovative, solid curriculum and

high quality staff development is important to ensure that staff are engaged in on-going

training to improve the curriculum and instructional practices. Drew refers to the

importance of implementing "deep, permanent improvement in STEM education" (p.

204) that requires teachers to transform the way they teach (Drew, 2011).

One of the recommendations cited in an SRI International Project by Means et al.

(2008) was the importance of continuous staff development in STEM schools.

> An effective STEM school will recognize the need for ongoing staff
> development. Professional development is needed to refresh and enhance STEM
> knowledge in relation to changes in the fields. STEM staff also must keep
> abreast with new developments in the learning sciences, both in relation to the
> concepts taught and new approaches to "cyberlearning" in the networked world.
> STEM schools need to consider the organizational and structural changes
> necessary to support continuous professional learning, including building in
> opportunities for joint staff planning, implementation of new initiatives, and
> evaluation. (Means et al., 2008, p. 43)

The third highest average rated program element found from the study findings

was Funding Sources. The research provides several references that support the

importance of on-going, primary funding streams to sustain specialized educational

programs including magnet schools and other programs operating with a STEM theme.

Since the beginning of the magnet school movement according to Siegel-Hawley and

Frankenberg (2012), federal funding has been a priority as a means for creating and

sustaining alternative school options. Siegel-Hawley and Frankenberg's research

suggests that, although priorities have shifted away from creating magnet schools solely

for desegregation purposes to school choice options with unique educational themes,

access to on-going funding sources continues to be essential to maintaining a quality

program. The importance of funding sources as a high priority for program sustainability

is consistent with a report by the National Center for Education Statistics. Expenditures

on average at specialized magnet schools are an additional ten percent higher than

traditional schools (National Center for Education Statistics, 2001).

The findings from research question one were consistent in identifying these

program elements that have the greatest impact on sustainability of STEM themed

magnet schools. The three highest program elements identified by the school

administrators in the study are supported in the literature as high priorities to program

sustainability in choice-based magnet schools that offer a STEM focus.

Research Question Two

Research question two examined the differences in program elements important

for sustainability by descriptive and demographic characteristics of the sample schools.

The respondents were requested to answer four closed-ended questions to gather data for

this research question. Frequency distributions, percentage of responses and average

ratings were employed to report responses specific to geographic location, administrative structure, grade level configuration and length of time in operation.

"What are the differences in program elements reported as essential for sustainability of STEM themed magnet schools reported by principals based on geographic location, administrative structure, grade level configuration and length of time in operation?"

Geographic Location. Across all geographic locations of STEM themed magnet schools included in the study, there were five program elements whose average ratings of importance to sustainability were between 4.00 and 9.00 using a one through nine scale (9 = highest). Those program elements were Funding Sources, Instructional Practices and Distinctive Curriculum, Staff Development and Training, Community Partnerships and School Board/District Leadership and Support.

The geographic location of STEM schools in the study sample reflected all five U.S. geographic regions with the Southwest and Western (*N*=2) the smallest and Southeast (*N*=21) the largest. The findings from the Southeast region were similar to the findings secured from all of the other schools included in the study. In the Southeast region, the average ratings of the top three program elements were Instructional Practices and Distinctive Curriculum (7.33), Staff Development and Training (6.71) and Funding Sources (6.52). The Southeast region comprised 63.6% (N=21) of all study respondents.

Research for this study was limited on the differences in program factors by geographic area that impact sustainability of STEM themed magnet schools. Due to the

range of sample schools in the geographic regions, the researcher was not able to draw conclusions regarding similarities or differences in respondents' answers. Geographic differences in factors that impact program sustainability may be explored in a follow-up study using a larger sample of specialized themed-based schools representing different regions of the United States.

Administrative Structure. Instructional Practices and Distinctive Curriculum, Staff Development and Training, and Funding Sources were rated as the highest priority program elements in the majority of the administrative structures examined in the study. In schools staffed with only a principal, and as many as four additional administrative positions, Instructional Practices and Distinctive Curriculum, and Staff Development and Training were rated the highest priority program elements. Schools with five or six additional administrative positions were not reported due to the limited sample size. This finding suggests that administrative structure has little relationship to priority program elements that school administrators report as important for program sustainability. Themed based magnet schools operating with one school administrator or multiple school administrators reported the same priority program elements.

The literature review for this study did not locate data or findings on the impact of administrative structure on those program elements school administrators reported as important for program sustainability. The scope of a future study could include the relationship between administrative structure and program elements that lead to sustainability of specialized theme schools.

Grade Level Configuration. School administrators representing elementary, middle school and high school grade level configurations, accounted for 84.8% (N=28) of the study respondents. Of the 28 respondents from the three grade level configurations, Staff Development and Training, Instructional Practices and Distinctive Curriculum and Funding Sources, respectively, were rated as the program elements of highest importance to program sustainability.

While research was found in the literature on the percentage of specialized magnet schools by grade configuration, those studies did not reveal information on substantial differences between the importance of specific program elements on sustainability and grade configuration. Future study could examine differences in factors relating to program sustainability by elementary, middle and high school grade configurations of themed based STEM schools.

Length of Time in Operation. The highest average rating by importance of program elements for schools in the first and third year of operation was Staff Development and Training. Schools in the first year or third year of operation had an average rating of 8.00 and 7.89, respectively, using the rating scale (1= lowest; 9=highest). This accounts for 33% (*N*=11) of all respondents. Programs in operation for five to nine years (7.45) and 10 or more years (8.00) reported Instructional Practices and Distinctive Curriculum as the program element of greatest importance for sustainability. These two categories for years in operation accounted for 48.5% (*N*=16) of the sample schools. This finding suggests that the importance of Instructional Practices and Distinctive Curriculum increases in specialized programs that lengthen in operation

over time, while Staff Development and Training slightly decreases as a priority as the length of time the program is in operation increases. There is literature that supports the importance of maintaining unique, instructional programs and practices that continue to attract students year after year.

According to Fleming (2012), the importance of quality staff development is essential to keeping teachers abreast of new, innovative practices and curriculum, particularly during the early years of program implementation. Students enrolled at magnet schools have greater incentive to attend because they're exposed to engaging, specialized curricula that holds their interest (Fleming, 2012). Because of the specialized programs offered at magnet themed schools, teachers during the implementation stages are often allotted additional training to learn the theme and collaborate with other teachers (U.S. Department of Education, 2004).

Research Question Three

Research question three examined the program elements that will be the most challenging for future sustainability as perceived by the school administrators. The respondents were asked to rate a series of elements they predict will be the greatest challenges for sustaining the program in future years. Averages and ratings on the program elements were calculated to determine future impact on sustainability in the next three to five years. Open-ended responses were provided for the respondents to describe why they predict their highest rated program elements will be challenges to sustainability in the next three to five years.

"What program elements of magnet schools do principals perceive as the greatest

challenges to sustainability of STEM schools in the next three to five years?"

Based on average responses from the rating scale (1 = lowest; 9 = highest), Funding Sources (8.06) was the highest reported challenge for future program sustainability, followed by Instructional Practices and Distinctive Curriculum (6.21) and Staff Development and Training (5.48). Funding Sources rated higher by an average of 1.85 than the second highest rated program element.

When the program elements were examined by the percentage of respondents who assigned a rating of one (1=highest level of challenge) for the greatest challenge to sustainability, Funding Sources, and Instructional Practices and Distinctive Curriculum were the two highest rated program elements. None of the school administrators reported Funding Sources at a rating level higher than four, indicating that this program element was believed to be challenging for future sustainability by all survey respondents. A lower rating reflects greater importance related to program sustainability while a higher rating signifies less importance. Twelve percent of the responding principals rated Instructional Practices and Distinctive Curriculum below four, and twenty-four percent of the principals rated Community Partnerships below four. Staff Development and Training was reported as the fourth most challenging program element with one-third (33%) of the principals assigning a rating of one, two, or three. These findings indicate that the majority of responding school administrators predicted that Funding Sources, and Instructional Practices and Distinctive Curriculum will be the greatest challenges to program sustainability for STEM schools in the next three to five years.

Although Funding Sources was identified as the most important program element for future sustainability of STEM schools, it was rated as the third most important for current sustainability, based on findings from research question one. The need for on-going funding sources for STEM schools is consistent with a U.S. Department of Education finding that funding for magnet schools in the areas of professional development, curriculum materials and technology as essential for meeting the needs of current constituents and attracting families in the future (U.S. Department of Education, 2008). Merritt (2005) stated that specialty magnet programs were often abandoned due to a lack of continuing operational funds. The author cited consumable materials and equipment as examples of on-going costs that are required to maintain a quality, specialized magnet program.

Instructional Practices and Distinctive Curriculum was identified as the second most important program element for future sustainability; however, it was identified as the most important program element for current sustainability. The importance of this program element aligned with research findings by Bybee (2013), affirming that quality STEM education reform requires intentional integration of the content disciplines. To maintain a competitive edge, Drew (2011) purports that schools must build strong academic programs that employ research-based approaches for science and mathematics programs to eliminate achievement gaps of majority and minority students.

Staff Development and Training was rated the third highest program element necessary for future sustainability of STEM schools and rated second for current sustainability as determined from the findings in research question one. The research

supports the need for on-going quality teacher training and development. As reported by Meeder (2013), professional development as an effective school improvement strategy must be long-term, embedded in core content responsibilities and guided by collaborative learning models.

Community partnerships was rated the fourth highest program element necessary for current and future sustainability over the next three to five years. For future sustainability, this program element was within .06 for average rating on the scale (1–9) in relationship to Staff Development and Training. This finding implies that school administrators view long-term program partnerships with community organizations and businesses as of high importance for sustainability along with Funding Sources, Instructional Practices and Distinctive Curriculum, and Staff Development and Training.

The importance of community partnerships to sustain specialized programs is supported by the research. Rapley (2011) stressed the necessity of local involvement and buy-in by local experts and professionals to keep specialty, magnet programs at the forefront with community leaders. In a Minnesota Department of Education (MDE) publication (2008), three elements were listed as essential to the continuous success of any themed magnet school—"community involvement, service learning and partnerships" (MDE report, 2008, p. 7). Magnet schools rely on community partnerships to sustain their programs (U.S. Department of Education, 2004). The U.S. Department of Education documented multiple types of expertise or assistance that local schools can secure from local community stakeholders, including facilities, monetary donations for equipment and materials, and access to local experts for direct support in implementing

the school's theme. Carey (2006) reinforced the importance of community connections when suggesting that districts cultivate joint-usage of facilities, such as a library or gym shared by both the school and community. The author expressed that "carefully chosen interface locations can survive for years" (Carey, 2006, p. 55).

Student achievement rated low (3.82) in level of importance to program sustainability in the next three to five years. This rating was the second lowest rating (8 out of 9) on importance to future sustainability as predicted by school administrators. There is literature that supports the importance of student achievement for sustainability of high quality STEM themed magnet schools. As recently as 2013, Magnet Schools of America in its annual report commented on their high standards of academic excellence and performance of magnet schools. The publication reported, "our magnet schools are outperforming other schools across the nation." (MSA Annual Report, 2013, p. 9) Earlier magnet themed schools often lacked consistent measures and were unable to be compared with traditional public schools (Meeks et al., 2011). This inconsistency in reporting and use of data results on the effectiveness of specialty magnet schools may have attributed to the low rating by respondents on the future importance of student achievement for program sustainability.

Research Question Four

Research question four addressed the impact STEM programs have on students' reading and mathematics performance as perceived by the study participants. The respondents were asked to rate the level of impact the STEM themed magnet school had

on student achievement. The survey responses ranged from having no impact to significant impact on student achievement. Respondents also reported their opinion of student achievement data over the past three years in relation to district expectations. These survey responses ranged from having significantly below district expectations to significantly above district expectations for student achievement. Data analyses employed for this research question included frequency counts, percentages, and cross-tabulations of respondents' reporting of achievement levels compared to district expectations.

"What is the impact of STEM themed magnet schools on student achievement as perceived by principals?

Over 61% of respondents reported that their STEM program had a moderate or significant impact on reading achievement. At a level of 65.7%, respondents cited that their STEM program had a moderate or significant impact on mathematics achievement. In relationship to district expectations for reading achievement, 41% of the respondents cited that reading performance was above or significantly above school district expectations. Forty-four percent of the respondents revealed that mathematics performance was above or significantly above school district expectations. These data analyses were completed to determine school administrators' assessments of the perceived achievement impact of STEM themed magnet schools and perceptions of these administrators about their site's reading and mathematics performance in relation to district expectations for achievement of all students.

There is ample research in the literature that supports improvement in student

learning when teaching methodologies are elevated from traditional to active, interactive, student-centered approaches (Handelsman et.al., 2004). These methodological approaches are consistent with practices found in magnet schools that offer specialized themes such as STEM education. When hands-on learning and opportunities for reflection and inquiry-based discussions are promoted, learning is likely to increase. Early magnet school research in the late twentieth century revealed that many magnet schools achieved higher academic results than typical public or private schools (Raywid, 1990). The achievement difference was attributed to the "distinctiveness that is best for certain students, just as other options, including the conventional school program, are best for others. For the magnet school to be successful, the choice must not be between high-quality schools and mediocre ones" (Barr & Parrett, 1997, p. 118).

In an extensive research study conducted by the U.S. Department of Education (2004), it was found that magnet schools attained higher student achievement levels in reading and social studies compared to regular public schools or private secular or Catholic schools. This research supports the impact specialized approaches to learning found in magnet themed schools can have on student achievement.

Additional Conclusions and Discussions

In this study, additional analyses examined differences in survey responses between principal and administrative designees. The large majority of study respondents were current principals 72.7% (N= 24), while administrative designees accounted for 27.3% (N=9) of all respondents. The job titles of the administrative designees were

either labeled an assistant principal or a STEM or magnet school coordinator. These designees had site responsibility for operation of the specialized program.

Principals and administrative designees consistently identified the highest three program elements from research question one that were believed to be of greatest importance for program sustainability: Funding Sources, Instructional Practices and Distinctive Curriculum, and Staff Development and Training. The average rating for each of the highest three program elements identified by principals and administrative designees were Instructional Practices and Distinctive Curriculum (7.50; 6.78), Staff Development and Training (7.00; 6.56) and Funding Sources (6.46; 7.00). The range of difference in rating of the highest three program elements between principals and administrative designees was between .44 and 1.04. This represents a consistency between principals and administrative designees in identifying the three program elements of greatest importance to sustainability. Differences within the highest three program elements revealed that administrative designees placed greater importance than principals on Funding Sources.

The school websites were reviewed as part of the data collection process and provided valuable insight into each school's program structure and leadership model. This information was attained by the researcher through an investigation of each school's website while attempting to obtain contact and demographic information about the sample school program. The variance of information revealed the importance of the school website in promoting and marketing a magnet school's specialty theme. Some of the sites "screamed the theme" by providing current, detailed information about the

educational program opportunities available to families, while others offered little

information that distinguished their program from any standard public school program.

According to a U.S. Department of Education Report (2004), schools need to employ

multiple strategies for promoting their programs. An informative magnet webpage is one

means commonly used to market school programs. This observation on the variance

found among the websites of schools included in the study, suggests the value of robust

school websites not only as a communication vehicle for current families, but as a

promotional tool for marketing their program to a broader population.

RECOMMENDATIONS

The following recommendations are presented based on the study findings and

conclusions. These recommendations may be considered for the field.

- In this study, it was found that a STEM themed magnet school is likely to

    be sustained if on-going funding sources are available to support the

    additional resources required to operate the program. School districts that

    host STEM themed magnet schools are generally supported by local

    communities and businesses as the need for a well trained work force for

    the future, particularly in the fields of mathematics and the sciences,

    continues to be in demand. Administrators of STEM themed magnet

    schools need to work with district staff to ensure that annual funding is

    available to cover staffing, curriculum resources and on-going

consumable materials and supplies necessary to carry out the school theme. Those funding sources could be secured through the local school district, state or federal agencies or grants, and partnerships with local businesses.

- Another finding from the study was the importance of professional development and training to program sustainability of a STEM themed magnet school. A staff that is well trained on STEM education and has access to continuous professional development will assist in securing sustainability of theme based programs. It is imperative that school district curriculum and instruction departments provide focused professional development opportunities for new and experienced staff at STEM themed magnet schools.

- One of the findings of this study was the importance of a rich curriculum and distinguishable program for long-term sustainability of specialized STEM themed magnet programs. Curriculum leaders and district administrative staff should provide opportunities for magnet school teachers to continually update and evaluate their curriculum and ensure that materials, course offerings and instructional approaches are aligned with the STEM program's mission and vision.

- An unexpected finding was the variance in information provided on the schools' websites about their STEM themed magnet program. The

website can be a valuable vehicle for marketing and promoting a school's specialty program. School leaders should work with public relations staff to make sure the information communicated on the website is effective in marketing their program not only to current and prospective families, but also to local businesses to secure on-going support and potential partnerships.

IMPLICATIONS FOR FURTHER RESEARCH

Several areas for further research have been identified from the findings of this study. The following are research topics that may be considered for additional study:

- A follow-up study should be conducted to examine in-depth the three highest rated program elements from this study, identified as having the greatest impact on program sustainability. The purpose would be to examine how specific aspects of Instructional Practices and Distinctive Curriculum, Staff Development and Training, and Funding Sources promote greater sustainability of STEM themed magnet programs.

- A study should be conducted to examine the sources that STEM themed magnet schools use to ensure consistent revenue to sustain specialty themed programs over time. The sources may include local and state funding, and community and business partnerships.

- Conduct a follow-up study that explicitly targets responses from other site administrative leadership staff members who are knowledgeable

about their STEM program and responsible for overall program
coordination.

- It is proposed that a subsequent study examine the impact STEM
themed magnet schools have on student achievement in reading and
mathematics based on the effectiveness of other program factors that are
in place over time.

- This study should be replicated to include other STEM themed magnet
schools that are not current members of Magnet Schools of America to
ensure broader geographic representation and to determine differences in
responses based on affiliation with MSA.

- Further study should be done to examine why school administrators did
not perceive student achievement as an important program element for
current sustainability or a high challenge for future sustainability.

STUDY SUMMARY

Magnet programs with a STEM focus are one of many types of specialty
school offerings that are reported in the literature. School programs with specific themes
and purposes attract families for many reasons including unique instructional programs
and balanced representation of student populations (U.S. Department of Education,
2004). This study examined multiple program elements identified from the literature
that school administrators report lead to sustainability of STEM themed magnet schools.
Furthermore, the study reported on the current impact and predicted future impact that

select program elements have on sustainability of specialized, STEM themed magnet programs.

The data were collected from school administrators using an online survey instrument. Schools participating in the study were selected from among those listed in the Magnet Schools of America, 2012 Directory, which cited-among others-magnet schools offering a STEM themed program.

Respondents ranked program elements in two ways to determine those deemed most important for sustainability. First, program elements were ranked by their sustainability impact on the current status of STEM themed magnet schools and compared with descriptive information about the school. Second, the program elements were ranked by future challenges related to program sustainability in the next three to five years. Finally, respondents reported the perceived impact of student achievement data results on the STEM themed magnet school and recorded their opinions of the results compared to district expectations for academic performance of all students.

The findings of the study resulted in recommendations for additional research and study of STEM programs that are supported through magnet school initiatives and other federal funding sources. Recommendations are specific to schools that operate a STEM theme through the auspices of a magnet school supported program. Additional study is recommended to further examine the program elements that have the greatest impact on sustainability of magnet schools with a STEM theme. This study could be expanded by including a larger sample of STEM themed magnet schools representing the various geographic locations in the U.S. and inviting responses from a broader

representation of school leaders who have direct knowledge of program elements that impact sustainability.

This study was designed to support the importance of sustaining STEM themed programs in schools. Whether the program is offered as a magnet school with integration goals or as a specialized school program, specifically for choice options, the concept needs to be continued to address the academic needs of students in the 21st century. Nearly a half-century ago, STEM was a response to the Sputnik era in the 1960's with a new mission to improve education through quality teacher training, sound curriculum and access to effective instructional materials (Bybee, 2013). In more recent years, magnet schools were a response to urban efforts to desegregate neighborhood schools and later were incorporated into the school choice movement (Rossell, 2005). Through these historical education movements and others to follow, quality choice-based school programs will continue to be a priority into the foreseeable future. "It is time to move beyond slogans and make STEM literacy a reality for all students" (Bybee, 2013, p. 102).

REFERENCES

REFERENCES

Ackerman, S. (2013). Magnet schools still going on school choice landscape. 1-4.
Retrieved from http://www.redefineonline.org/2013/01.

Alvarez, C.A., Edwards, D. & Harris, B. (2010). STEM specialty programs: a pathway
for under-represented students into STEM fields. *NCSSSMST Journal*, 27-29.

Archbald, D. A. (2004). School choice, magnet schools, and the liberation model: an
empirical study. *Sociology of Education, 77*, 283 – 310.
doi:10:1177/003804070407700402

Auster, P. (1965). *De-Facto Segregation*. Retrieved from
http://scholarship.law.wm.edu/wmlr/vol6/iss1/5.

Barribeau, P., Butler, B., Corney, J., Doney, M., Gault, J., Gordon, J.,…Palmquist, M.
(2012). Survey Research. Writing@CSU. Colorado State University. Retrieved
from http://writing.colostate.edu/guides/guide.cfm?guideid=68.

Barr, R.D. & Parrett, W.H. (1997). *How to create alternative, magnet, and charter
schools that work.* Bloomington, IN: National Educational Service.

Betts, J.R., Rice, L.A., Zau, A.C., Tang, Y.E., & Koedel (2006). San Francisco, CA.
Public Policy Institute of California.

Black, S. (1996). The pull of magnets. *The American School Board Journal, 183*(9), 34-
36.

Blank, R. K. (1989, September). Educational effects of magnet high schools. Paper
prepared for the Conference on Choice and Control in American Education, 4 –
44. University of Wisconsin-Madison, *Office of Educational Research and
Improvement.*

Blank, R.K. & Archbald, D.A. (1992). Magnet schools and issues of education quality.
The Clearing House, 66(2), 81-87. Retrieved from http://web/ebscohost.

Brown, R., Brown, J., Reardon, K. & Merrill, C. (2011, March). Understanding STEM: current perceptions. *Technology and Engineering Teacher,* 70(6), 5 – 9.

Burke, L. M. & McNeill, J. B. (2011). "Educate to innovate": how the Obama plan for STEM education falls short. *The Heritage Foundation, 2504,* 1-8.

Butin, D.W. (2010). *The Education Dissertation*. Thousand Oaks, CA: Corwin Press.

Bybee, R. W. (2010, September). Advancing STEM education: a 2020 vision. *Technology & Engineering Teacher*,*70*(1), 30-35. Retrieved from http://web/ebscohost.

Bybee, R.W. (2013). *The Case for STEM Education, Challenges and Opportunities.* National Science Teachers' Association.

Carey, R.D. (2006). Planning for equity. *American School Board Journal, 53 – 57.*

Carr, S. (2012). *Interview: Magnet school proponent Richard Kahlenberg on magnet v. charter school debate.* The Hechinger Report: Wired Academic.

Cavanagh, S. (2008). States heeding calls to strengthen STEM; equipping students to succeed in science, technology, engineering, and math holds economic appeal. *Education Week, 27*(30), 1-8. 10,12-13,16,22-23.

Chen, G. (2007, December). What is a magnet school? *Public School Review.* Retrieved from http://www.publicschool reviews.com/articles2.

Christie, K. Premature arrival of the future. (2007, November). *Phi Delta Kappa International. 165 – 166.*

Coffee, A. & Frankenberg, E. (2009). *Two years after the PICS decision: Districts' integration: Efforts in a changing climate.* The Civil Rights Project.

Cookson, P.W. (1994). *School choice*. New Haven, MA; Yale University Press.

Cookson, P. & Shroff, S. (2012). *Recent experience with urban school choice plans.* Retrieved from http://www.soundvision.com/info/education/pubschool/pub.choicexp.asp.

Dancy, M. & Johnson, C. (2008). *Barriers and promises in STEM reform.* Retrieved from http://www.nsf.gov/about/budget/fy2007/tables/NSFSUMMARYTABLESCHARTS/ST-14.xls.

Darling – Hammond, L. (2010). *The flat world and education*. New York, NY: Teachers College Press.

DeCoster, J. (2004). Data Analysis in SPSS. Retrieved from http://www. stat-help.com/notes/html.

Drew, D.E. (2011). *STEM the tide*. Baltimore, MD: The Johns Hopkins University Press.

Ferrara, P.J. (1975). The failure of busing. The Harvard Crimson. Retrieved from: *http://www.thecrimson.com/article/1975/4/28/the-failure-of-busing-pblbast-week/*.

Flaxman, E., Guerrero, A., & Gretchen, D. (1999). The educational benefits of magnet schools. Retrieved from http://ncrve/berkely.edu/abstracts/MDS-803/MDS-803-the.html.

Fleming, N. (2012, May). Magnets reimagined as a school choice option. *Education Week.*

Frahm, R.A. (2010, January). $2 billion later, do magnet schools help kids learn? Retrieved from http://ww2.ctmirror.org/print/3850.

Frankenberg, E. & Lee, C. (2002). *Race in American public schools: rapidly resegregating school districts.* The Civil Rights Project.

Frankenberg, E., Siegel–Hawley, G. & Orfield, G. (2008). *The forgotten choice? Rethinking magnet schools in a changing landscape.* The Civil Rights Project.

Frankenberg, E. & Siegel-Hawley, G. (2008). *An overlooked model; magnet schools can successfully promote diversity as well as choice for parents and students.* American School Board Journal, 34-35.

Friedman, T.L. (2005). *The world is flat; a brief history of the twenty-first century.* New York, NY: Farrar, Straus and Giroux.

Fruchter, N. (2007). Urban schools public will; making education work for all our children. New York, NY: Teachers College Press.

Gamoran, A. (1996). Do magnet schools boost achievement? *Educational Leadership, 42 – 46.*

Goldring, E. & Smrekar, C. (2002). Magnet schools, reform and race in urban education. *The Clearing House, 76*(1), 13-15.

Gunn, N. (2011). The Presidents Math & Science Teachers' Initiative. Retrieved from: *www.**whitehouse**.gov/administration/eop/ostp/**initiatives***

Handelsman, J., Ebert-May, D. Betchner, R., Bruns, P., Chang, A., DeHaan, R., …Wood,W.B., (2004). Science, 304(5670), 521-522.

Hargreaves, A. & Fink, D. (2006, May). The ripple. *Educational Leadership,* 16–20.

Hausman, C. & Goldring, E. (2000). Parent involvement, influence, and satisfaction in magnet schools: do reasons for choice matter? *The Urban Revie*w, *32*(2), 105-121.

Hausman, C. & Brown, P. M. (2002). Curricular and instructional differentiation in magnet schools: market driven or institutionally entrenched? *Journal of Curriculum and Supervision, 17*(3), 256-276.

Hausman, C. & Goldring, E. (2000). School community in different magnet program structures. *School Effectiveness and School Improvement*, *11*(1), 80-102.

Hausman, C. & Goldring, E. (2000). Parent involvement, influence, and satisfaction in magnet schools: do reasons for choice matter? *The Urban Revie*w, *32*(2), 105-121.

Hendrie, C. (1998). New magnet school policies sidestep an old issue. Race. *Education Week*, 17/(39), 10.

Howell, W.G. & Peterson, P.E. (2002). *The education gap – voucher & urban schools. Washington, DC: Brookings Institution Press.*

Hughes, B. (2009). How to start a STEM team. *Technology Teacher, 69*(2), 27-29. Retrieved from http://web/esbcohost.

Hutton, P. & VandenBurg, T. (2011). STEM for all. *Educational Facility Planner*, 45(4), 19-23.

Kafer, K. (2005, April). *Choices in education*: 2005 progress report, 1848, 1-10.

Keaton, P. (2012). Public Elementary and Secondary School Student Enrollment and Staff Counts From the Common Core of Data: School Year 2010–11 (NCES 2012-327). U.S. Department of Education. Washington, DC: National Center for Education Statistics. *Retrieved from http://nces.ed.gov/pubsearch.*

Kim, J. & Sunderman, G.L. (2004). *Does NCLB provide good choices for students in low performing schools*? The Civil Rights Project.

Klauke, Amy (1988). Magnet schools. *ERIC Digest Series Number EA 26*. (2011). Retrieved at http://www.ericdigest.org/pre-928/magnet.html.

Levasseur, R.E. (2011). *Dissertation Research, An Integrative Approach.* St. Augustine, FL. MindFire Press.

Magnet School of America, Annual Report (2013). Retrieved from: http://www.magnet.edu/files/documents/msa-2013-annual-report-final.pdf.

Magnet Schools of America, Planning Committee Report (2011); Document 3.0 Strategic plan 2010-2013.

McPherson, E. (2009). Moving from separate, to equal, to equitable schooling: Revisiting school desegregation policies. *Urban Education,* 46, 465 – 480.

Means, B., Confrey, J., House, A., Bhanot, R. (2008, October). *SRI International.* SRI Project P17858.

Meeder, H., (2013). *The STEM leader guide; Practical advice for creating a STEM school.* Columbia MD: All View Creek Media.

Meeks, L.F., Meeks, W.A., & Warren, C.A. (2000). Racial Desegregation: Magnet schools, vouchers, privatization, and home schooling. *Education and Urban Society*, *33*(88), 88 – 101.

Merrill, C. & Daugherty, J. (2010). STEM education and leadership: A mathematics and science partnership approach. *Journal of Technology Education. 21(2).21 – 34.*

Merritt, E.T., Beaudin, J.A., Cassidy, C.R. & Myler, P.A. (2005). *Magnet and specialized schools of the future: a focus on change.* Lanham, MA: Scarecrow Education.

Michelson, R., Bottia, M. & Southworth, S. (2008, March). *School choice and segregation by race, class and achievement.* EPIC. Retrieved from http://eps1.asu.edu/epru/documents/EPSL-0803-260-EPRU.pdf

Minnesota Department of Education Report (2008). *Magnet schools; A guide to Minnesota magnet school choices.*

Musumeci, M. & Szczypkowski, R. (1991). *New York State magnet school evaluation study : final report:* Larchmont, NY. MAGI Educational Services, Inc.

National Center for Educational Statistics. (2001). Retrieved from http://www.nces.ed.gov/pubs2001/overview.

National Geographic. United States Regions. Retrieved from: http://education.nationalgeographic.com/education/maps/united-states-*regions/?ar_a=1.*

National Research Council. (2011). *Successful Stem Education: A Workshop Summary.* A Beatty, Rapporteur. Committee on Highly Successful Schools or Programs for K-12 STEM Education, Board on Science Education and Board on Testing and Assessment,. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

National Research Council. (2011). *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics.* Committee on Highly Successful Science Programs for K-12 Science Education, Board on Science Education and Board on Testing and Assessment, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

Patton, M. (1990). *Qualitative evaluation and research methods, 169-186.* Beverly Hills, CA: Sage.

Rapley, D. (2011). This is not your father's tech plan. *T H E Journal*, *38*(6), 12-14.

Raywid, M.A. (1990). Is there a case for choice? *Educational Leadership,48(4), 4-12.*

Roberts, C.M. (2010). *The dissertation journey*. Thousand Oake, CA: Corwin – A SAGE Company.

Ross, K.N. (2005). Quantitative Methods in Educational Planning. International Institute for educational Planning. UNESCO.

Rossell, C.H.(1990). *The carrot or the stick for school desegregation policy; magnet schools or forced busing.* Philadelphia, PA: Temple University Press.

Rossell, C.H. (2005). *No longer famous, but still intact*. Education Next, 44-49.

Sanders, M. (2009). STEM, STEM education, STEMmania. *The Technology Teacher*, 20–26.

Siegel–Hawley & Frankenberg (2012). *Reviving magnet schools: Strengthening a successful choice option.* The Civil Right Project.

Slavin, R.E. (2007). *Educational research in an age of accountability*. United States of America: Pearson Educators, Inc.

Smrekar, C. (2009). Beyond the tipping point: Issues of racial diversity in magnet school following unitary status. *Peabody Journal of Education, 84*, 209-226.

Smrekar, C. & Goldring, E. (1999). *School choice in urban America; magnet schools and the pursuit of equity*. New York, NY: Teachers College Press.

Steel, J. & Levine, R. (1994). *Educational innovation in multiracial contexts: the growth of magnet schools in American education.* American Institutes for Research: Palo Alto, CA.

Talbert-Johnson, C. (2000). The political context of school desegregation: equity, school improvement, and accountability. *Education and Urban Society,* (33)1, 8-16.

Tapping America's Potential (2008, July). *Progress report: Gaining momentum, losing ground.* Retrieved from http://www.tap2015.org.

Tefera, A., Frankenberg, E., Siegel–Hawley, G., & Chirichigno, G. (2011). *Integrating suburban schools: how to benefit from growing diversity and avoid segregation.* The Civil Rights Project.

Thomas, J. & Williams, C. (2010). The history of specialized STEM schools and the formation and role of the NCSSSMST. *Roeper Review,* (32), 17-24. doi:10.1080/02783190903386561

Toch, T. & Linnon, N. (1991). Schools that work. *U.S. News & World Report*, *110*(20), 58 – 64.

Toppo, G. (2004, May). Busing's altered route. *USA Today.* Retrieved from http://web.ebsco.com.

Trilling, B. & Fadel, C. (2009). *21ˢᵗ century skills*. San Francisco, CA: John Wiley & Sons, Inc.

United States Department of Education, Office of Innovation and Improvement. (2004). *Creating successful magnet schools programs.* Retrieved from http://www.ed.gov/admins/comm/choice/magnet/.

United States Department of Education, Office of Innovation and Improvement. (2008). *Creating and Sustaining Successful K-8 Magnet Schools.* Retrieved from http://www.ed.gov/admins/comm/choice/magnet/.

Waldrip, D., Marks, W., & Estes, N. (1993). *International research institute on educational change.* University of Houston: College of Education.

Waldrip, D. (2000). Brief history of magnet schools. *Magnet schools conference*. Retrieved from http://www.magnet.edu/resources/msa-history.

Wilson, C. & Harsha, P. (2009). IT policy; the long road to computer science education reform. *Communications of the ACM*, 52(9), 33 – 35.

UCdavis.edu (2014). Evaluating Samples. Retrieved from:
    http://psychology.ucdavis.edu/faculty_sites/rainbow/html/fact_sample.html.

APPENDICES

APPENDIX A

STUDY SURVEY

Principal perceptions on sustainability of STEM themed magnet schools

Penny Howard, Doctoral Student at St. Cloud State University, St. Cloud, MN is gathering data related to sustainability of STEM themed magnet schools that are current members of Magnet Schools of America (MSA). The data will be analyzed to determine the most critical factors that principals perceive lead to program sustainability in STEM schools included in the study. The results of the study will be reported in the researcher's dissertation and upon request, shared with those who respond to the survey.

Please take a few minutes to provide your perceptions and feedback on the following questions.

Thank you in advance for your participation in this important study.

Informed Consent for Participation in the Study

The information on this page is required to inform you of the background, potential risks, and the voluntary nature of this survey.

Background Information and Purpose

The purpose of this study is to gather information on the perceptions of current principals at STEM themed magnet schools on factors that lead to program sustainability. The information will be used by the researcher to understand the various aspects related to sustainability of STEM themed magnet schools. Schools selected to participate in the study are current members of Magnet Schools of America (MSA). The results of the study will be reported in the researcher's final dissertation.

Procedures

If you decide to participate, you will be asked to complete an anonymous survey using the survey tool, Survey Monkey. Your survey information will be analyzed as an aggregate group. Some of the data will be analyzed based on the various demographics (U.S. region, school size, years of experience, etc.), but data for small and easy to identify subgroups will not be reported.

Risks

There are no foreseeable risks associated with participation in this study.

Benefits

The information obtained by this survey will be shared with other principals and district administrators upon request.

Confidentiality

This is an anonymous survey. No personally identifiable information will be gathered or stored. As stated earlier, only group responses will be reported. No information that could identify an individual respondent will be reported.

Research Results

If you are interested in learning the results of the study, contact the researcher, Penny Howard at penny.howard@moundsviewschools.org or 651-621-6603.

Contact Information

If you have additional questions, please contact the researcher, Penny Howard at 651-621-6603 or penny.howard@moundsviewschools.org. You may also contact the researcher's advisor at St. Cloud State University, Dr. John Eller at 320-308-4272 or jfeller@stcloudstate.edu.

Voluntary Participation/Withdrawal

Participation in the study is voluntary. Your decision whether or not to participate will not affect your current or future relations with St. Cloud State University or the researcher. If you decide to complete the survey and there are any questions that you are not comfortable in answering, you do not need to answer them.

Acceptance to Participate

Your completion of the survey indicates that you consent to participate in the study. Thank you.

1. Are you currently serving as the principal at your STEM magnet school?

◯ Yes

◯ No

If no, please describe your position.

[   ]

2. How many years have you served in this position at your current school?

◯ 1 – 2 years

◯ 3 – 5 years

◯ 6 – 9 years

◯ 10 or more years

Other (please specify)

[   ]

3. Were you involved in the development of the STEM magnet program at your school?

◯ Yes

◯ No

Other (please specify)

[   ]

4. How many years has your school been operating as a STEM magnet school?

◯ First year of implementation

◯ 2nd year

◯ 3rd year

◯ 4th year

◯ 5 – 9 years

◯ 10 or more years

Comments:

[   ]

5. In addition to the principal, indicate other administrative or teacher leadership positions available at your site to support the STEM magnet program (check all that apply).

☐ Magnet School Facilitator (oversees management of program)

☐ Curriculum Support (assists teachers with instructional materials/strategies)

☐ Content Area Coach (works directly with teachers to impact their practices)

☐ Dean of Students (administrative & student support)

☐ Assistant Principal (administrative support)

☐ Technology Integration Support (assists teachers with use of technology in their curriculum)

☐ Other (please specify)

[   ]

*6. Rank order the importance of the following program development & operational elements that you believe have contributed to sustainability of your STEM magnet school program (1 = highest ranking).

[▼]	Community Partnerships (business/ agency relationships with the STEM magnet school)
[▼]	Funding sources (revenue for staffing, facility adjustments, instructional materials & supplies)
[▼]	Instructional Practices & Distinctive Curriculum (specialized program offerings and delivery system that are unique to STEM education)
[▼]	National/State Leadership (support & guidance from organizations that promote STEM magnet programs)
[▼]	Outreach & Marketing (resources for promotional & recruitment efforts)
[▼]	Program Recognition (awards/publications to promote STEM programs)
[▼]	School Board/District leadership/support (policies and district operational structure supports the program)
[▼]	Staff Development & Training (opportunities & resources for on-going staff learning)
[▼]	Student Achievement (availability of standardized achievement data in reading & math)

7. Describe the impact the top three program elements you selected have had on program sustainability.

#1 program element that impacted sustainability	[ ]
#2 program element that impacted sustainability	[ ]
#3 program element that impacted sustainability	[ ]

✱8. Rank order the program elements that you predict to be future challenges to sustaining your STEM magnet school program in the next 3 –5 years. (1 = highest ranking).

| [▼] | Community Partnerships (business/agency relationships with STEM school) |

| [▼] | Funding S urces (revenue f r staffing, f cility adjustments, instructional materials & s upplies) |

| [▼] | Instructional Practices & Distinctive Curriculum (specialized program offerings and delivery system that are unique to STEM education) |

| [▼] | National/State Leadership (support & guidance from organizations that promote STEM magnet programs) |

| [▼] | Outreach & Marketing (resources for promotional and recruitment efforts) |

| [▼] | Program Recognition (awards/publications to distinguish STEM programs) |

| [▼] | School Board/District leadership & Support (policies and district operational structure supports the program) |

| [▼] | Staff development & training (opportunities & resources for on-going staff learning) |

| [▼] | Student Achievement (availability of standardized achievement data in reading & math) |

9. Describe why the top three program elements you selected in question # 8 will be challenges that impact program sustainability in the next 3 –5 years.

#1 Challenge [   ]

#2 Challenge [   ]

#3 Challenge [   ]

10. Select a choice that best describes the grade configuration of your STEM magnet school.

◯ elementary (any grades K –6)

◯ primary (any grades 1 –3)

◯ intermediate (any grades 4 –6)

◯ K-8

◯ middle school/junior high (any grades 5 –8)

◯ high school 9-12

◯ other (explain)

11. Identify the U.S.region in which your STEM magnet school is located.

◯ Northeast States (ME, NH, MA, VT, RI, NJ, PA, CT, NY, DE)

◯ Southeast States (WV, DC, VA, NC, SC, KY, AR, LA, TN, MD, MS, AL, GA, FL)

◯ Midwest States (ND, SD, NE, KS, MN, IA, MO, WI, IL, IN, OH, MI)

◯ Southwest States (AZ, NM, OK, TX)

◯ Western States (WA, OR, CA, NV, UT, CO, WY, MT, ID, HI, AK)

12. Based on annual 2012-13 standardized achievement test data, describe your overall student achievement in reading.

◯ Below 20%ile

◯ Between 20%ile - 39%ile

◯ Between 40% ile - 59%ile

◯ Between 60%ile - 79%ile

◯ 80%ile or over

What standardized achievement measure(s) did you use?

☐

13. In your opinion, what does your standardized achievement test data from the last three years suggest about the school-wide performance of students' achievement in reading?

☐ Significantly below School District expectations.

☐ Below School District expectations.

☐ At S hool District expectations.

☐ Above School District expectations.

☐ Significantly above School District expectations.

Other (please specify)

☐

14. In your opinion, what impact has your STEM magnet program had on the school-wide reading achievement based on your response from question # 13?

◯ The STEM program had a significant impact on students' reading achievement.

◯ The STEM program had a moderate impact on students' reading achievement.

◯ The STEM program had some impact on students' reading achievement.

◯ The STEM program had little impact on students' reading achievement.

◯ The STEM program had no impact on students' reading achievement.

Other (please specify)

☐

15. Based on annual 2012–13 standardized achievement test data, describe your overall student achievement in math.

○ Below 20%ile

○ Between 20%ile – 39%ile

○ Between 40%ile – 59%ile

○ Between 60%ile – 79%ile

○ 80%ile or over

What standardized achievement measure(s) did you use?

[   ]

16. In your opinion, what does your standardized achievement test data from the last three years suggest about the school-wide performance of students' achievement in math?

☐ Significantly below School District expectations.

☐ Below School District expectations.

☐ At S hool District expectations.

☐ Above School District expectations.

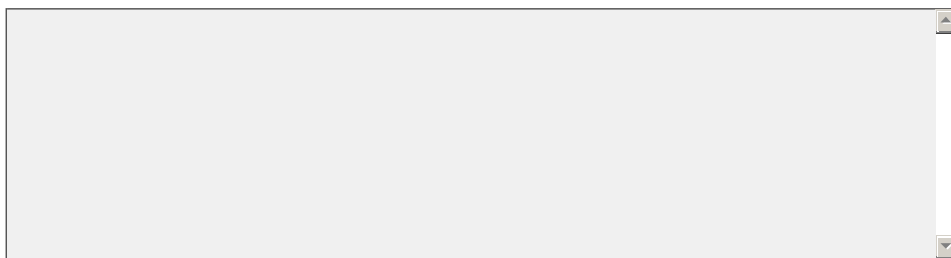☐ Significantly above School District expectattions.

Other (please specify)

[   ]

17. In your opinion, what impact did your STEM magnet program have on the school-wide math achievement based on your response to question # 16?

○ The STEM program had a significant impact on students' math achievement.

○ The STEM program had a moderate impact on students' math achievement.

○ The STEM program had some impact on students' math achievement.

○ The STEM program had little impact on students' math achievement.

○ The STEM program had no impact on students' math achievement.

Other (please specify)

[   ]

18. Include any additional comments related to sustainability of your STEM magnet school that will help the researcher fully understand your program.

19. If you would like to be included in the drawing for a $100 gift card to Target, please provide your name & mailing address. (By providing your contact information, the anonymity of your survey responses will not be impacted. No information that could identify an individual respondent will be reported in the findings.)

APPENDIX B

PARTICIPANT SOLICITATION EMAIL

December 2013

Dear (insert principal's name),

I am conducting a study about *Sustainability of STEM Schools* and would greatly appreciate your help.   As a doctoral student in the School Administration and Leadership Program at St. Cloud State University in Minnesota, I am looking at STEM schools that operate as a magnet program to determine the critical program elements that principals perceive lead to sustainability.   *The population for the study is very limited; therefore, a high response rate is important.*

As a principal at a STE(A)M themed magnet school, I understand the demands on your time.   The *survey is briefand should take about 12-15 minutes to complete.*   If you are able to complete the survey by *(date),* you will be entered into a drawing for a *$100 gift card to Target.* I hope to hear from you within the given timeframe.

In advance, THANKS for your willingness to complete the on-line survey. Here is the on-line Survey Monkey link.   *Remember…15 minutes – "max" to complete the survey.*

https://www.surveymonkey.com/s/BSYBPKN

Please give me a call regarding questions you have about the survey. If you would like to conduct the survey over the phone or prefer a copy of the survey mailed to you, let me know. I can be reached at 651-621-6603.

Penny Howard
Doctoral Student in School Administration & Leadership
St. Cloud State University, St. Cloud, MN.