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The Leadership Efficacy Of Graduates Of North Carolina School Of Science And Mathematics: A Mixed-Methods Analysis

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The Leadership Efficacy of Graduates of North Carolina School of Science and Mathematics: A Mixed-Methods Analysis

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Biographical Sketch

Letita Renee Mason is the daughter of Peter E. Mason Sr., J. D., and Irma Tucker Mason. She was raised in High Point, NC and attended Guilford County schools along with her younger brother, Pete Jr. Letita went to North Carolina Central University where she received a B.A. in English with a minor in Communications & Journalism and a Master of Public Administration with a minor in education & counseling. Letita served as a Counselor at the North Carolina School of Science and Mathematics (NCSSM) for several years in both the Admissions department and Student Life. She went on to manage projects for the Research & Development division of Measurement Incorporated (MI). MI is a Durham based educational assessment firm that specializes in the development and scoring of educational testing instruments. In 1999, Letita returned to NCSSM as Director of Admissions where she works with students in various leadership capacities.

Dedication

"Did you ever know that you're my hero? You're everything I wish I could be. I can fly higher than an eagle, 'cause you are the wind beneath my wings."

(Bette Midler, "Wind Beneath My Wings")

I dedicate this work to those who inspire me every day. Mom, Dad, Peter Jr., Uncle Richard, extended family, loved ones, colleagues and my students—the wind beneath my wings!

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Abstract

This study examines the leadership efficacy amongst graduates of NCSSM from the classes of 2000–07 as the unit of analysis. How do NCSSM graduates' perceptions of their leadership efficacy align with research on non-cognitive variables as indicators of academic performance using the unit of analysis as a performance outcome? This study is based on the theoretical construct that non-cognitive psychological (also called motivational) factors are core components of leadership self-efficacy, indicative of NCSSM graduates (who had high academic performance and attained STEM degrees). It holds promise for increasing both student interest and diversity in the race to strengthen the STEM pipeline. In this study the Hannah and Avolio (2013) Mind Garden Leadership Efficacy Questionnaire (LEQ) is used. The LEQ is a battery of three instruments designed to assess individual perceptions of personal leadership efficacy across three constructs, via one survey tool. In this mixed-methods analysis, a quantitative phase was conducted to collect the data captured by the Mind Garden Leadership Efficacy Questionnaire. A Post Hoc qualitative analysis was conducted in the second phase of the data analysis, using the Trichotomous-Square Test methodology (with an associated qualitative researcher-designed Inventive Investigative Instrument). The results from the study validated the alternative hypothesis [H_1], which proposed that there no are significant differences in the perception of the Leadership Efficacy by the North Carolina School of Science and Mathematics Alumni from the classes of 2000-07 in terms of their overall "Leadership Efficacy" in regards to: Execution or "Leadership Action Efficacy"; Capacity or "Leader Means Efficacy"; and Environment or "Leader Self-Regulation Efficacy" was accepted. The results also led to the development of a new assessment tool called the Mason Leadership Efficacy Model.

CHAPTER 1

Introduction

The objective of this study is twofold. The first objective is to examine the leadership efficacy of graduates of the North Carolina School of Science and Mathematics (NCSSM) as the unit of analysis. The second objective of the study is to determine the efficacy of the Mind Garden Leadership Efficacy Questionnaire (LEQ) to determine if it is an effective method of determining leadership efficacy through an innovative, precise, and content-specific post hoc statistical analysis methodology (The Tri–Squared Test) (Osler, 2012). The unit of analysis (NCSSM) has particular focus on the completion rates of its graduates in Science, Technology, Engineering, and Mathematics (STEM) degrees, as an assessable learning outcome. The research is lensed from the theoretical construct that the NCSSM moderate leadership cultivation fosters non-cognitive skills, particularly those acquired through leadership development that instills resilience within its graduates. It is this resilience that allows NCSSM students to persist in attaining STEM degrees and follows them long after they graduate. Investigations into youth leadership development point to the significance of leadership skills learned during adolescence in the areas of critical thinking, problem solving, and reflection. These are the same skills deemed crucial in fitting youth for fruitful employment, particularly in science, technology, engineering, and mathematics (Wagner, 2008). A critical component of leader efficacy is the notion of self-efficacy. Bandura (2010), for example, noted that self-efficacy was the belief that, an individual has special aptitudes and assets to chance the demands of a precise chore. Hannah et al. (2008) also stated efficacy beliefs affected whether a person thought in self-enhancing or self-debilitating ways, including the way they motivated and preserved themselves in times when encountering hitches.

McCormick's (2002) research on self-efficacy theory additionally stated that personal efficacy influenced the objectives people selected, their aspirations, how much effort they exerted on a given task, and how long they persisted in the face of difficulties, obstacles, and disappointments. Hannah et al. (2008) also supported this notion when they surmised leadership efficacy was a detailed type of confidence associated with the knowledge and abilities associated with leading others. Furthermore, McCormick (2002) added that self-efficacy was a personal belief, a self-judgment about one's task-specific capabilities, to perform the leadership task that was the essential causal factor. NCSSM promotes self-efficacy through its leadership development. This is a critical part of Science & Mathematics enlightening its students to recognize their academic talents and full capabilities under stringent STEM academic rigor.

Against this backdrop, the unit of analysis (NCSSM) presents a topical case for the study of leadership efficacy because it has a learning environment, which supports youth leadership development by immersion in a state-supported residential program focused on accelerated preparation in science, mathematics, and humanities. Education administration researcher Sedlacek (2004) outlines the significance of considering non-cognitive skills that are strengthened through leadership, in the admissions criteria and the instructional design of an institution in the following areas:

1. Leadership = demonstrates strong leadership in any area of his/her background (e.g. church, sports, non-educational groups).
2. Long-range goals = able to respond to deferred gratification, plan ahead, and sets goals.
3. Strong support person = seeks and takes advantage of a strong support network or has someone to turn to in a crises or for encouragement.

4. Community = participates and is involved in his/her community.
5. Nontraditional learning = acquires knowledge in sustained or culturally related ways in any field outside of school.

As the research unit of analysis, within its operational framework NCSSM understands the value of including non-cognitive variables as a component of the admissions selection criteria that is assessed for student enrollment. This is clearly evident in the mission statement of the school, which appears in the following sub-section, and offers support to the rationale for this study.

1.1 NCSSM Mission Statement

The North Carolina School of Science and Mathematics was established in 1979 and the mission includes the following:

1. To educate academically talented students to become state, national, and global leaders in science, technology, engineering, and mathematics;
2. To advance public education in North Carolina; and,
3. To inspire innovation for the betterment of humankind, through challenging residential and virtual programs driven by instructional excellence and the excitement of discovery (NCSSM, 2013).

Embedded in the unit of analysis' admissions portfolio is the rating instrument for cognitive and non-cognitive responses from its applicants. The current rating criteria for all applicants covers areas on STEM interest (as s non-cognitive variable), awards (that includes - certificates, honors, and recognitions – another non-cognitive variable), leadership (the variable under analysis in this study - yet another example of a non-cognitive variable), grades, rigor of course work/program, the NCSSM math test, guidance counselor reference (a 4th non-cognitive variable), English, Math, and Science Teacher Evaluations (final non-cognitive variable) (NCSSM, 2013). In

academic year 2013, the unit of analysis stated that its applicants provided additional background information going back to their seventh grade year in an open-ended format. This is an important part of the application process because of the minor age and experience range of candidates that are applying for enrollment.

The application process to gain academic admissions into NCSSM is extraordinarily stringent. It is an accomplishment in and of itself. Admissions seeking candidates are also required to provide information on their involvement in the community, schooled-based extra-curricular activities, leadership activities, and service learning activities. As such, a much greater insight is gained by NCSSM admissions into the specifics of entering candidate leadership capabilities. Thus, the leadership cultivation process at the unit of analysis starts before the candidate enrolls and thereby aids in the future leadership development process. The pre-leadership enrollment process assesses both cognitive and non-cognitive variables of academic performance for future leadership success. NCSSM as the unit of analysis defines leadership efficacy from the perspective of a moderate leader (one who is humble, non-superior, and engaging). The moderate leadership criterion can be defined from the Mind Garden Leadership Efficacy Questionnaire (LEQ) in the areas of: “Leader Action Self-Efficacy”; “Leader Self-Regulation Efficacy”; and “Leader Means Efficacy”. Sedlacek (2004) points out “it is important to pursue cultural and gender-relevant activities of the individual applicants rather than treat them as if they all come from the similar environments “(p. 46). In addition, NCSSM also emphasizes the significance of community service as a leadership requisite in its curricula as applied to all students prior to graduation. In sum, leadership efficacy is therefore an important norm in the instructional design of NCSSM, and its effectiveness and influence in shaping its graduates attitudes in terms of demonstrated leadership (as they successfully matriculate through

NCSSM and in many cases go on to complete of a four-year STEM degree). Such a model of success both deserves and requires an in-depth auxiliary analysis of its leadership efficacy through noted and vetted leadership analysis tools (the Mind Garden LEQ) using advanced novel statistical analysis methodologies (the post hoc Tri–Squared Test).

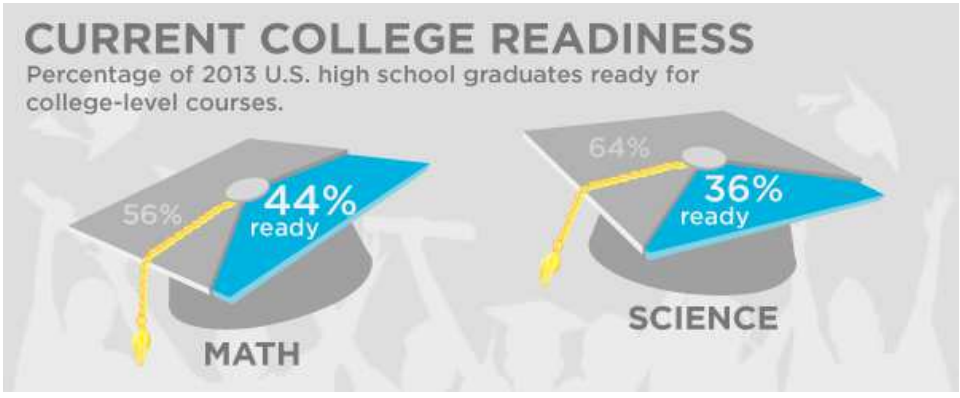
1.2 Rationale for Studying Youth Leadership Development

This section builds upon the previous sections, which briefly highlighted the rationale for studying youth leadership efficacy at NCSSM in part because it has a learning setting, which supports youth leadership development by engaging in a state-supported residential program concentrated on augmented planning in science, mathematics, and humanities. NCSSM intends to enhance skills in leadership and self-efficacy in its students, to help prepare them for the rigors of college programs in STEM degrees. The connection between leadership skills, and college achievement has been theoretically explored (Dweck, Walton, & Cohan, 2004; Ingold, 2014). Ingold (2014), for example, noted the development of leadership skills, including self-awareness, the development of self-management skills, and the ability to inspire others to achieve group goals, among others, were essential in the expenditure of energy and the perseverance required when completing a STEM degree.

Meanwhile, Dweck et al. (2004) stressed the significance of the non-cognitive factors of academic tenacity and perseverance, which helps promote long-term learning achievements. The authors added that there were characteristics and behaviors of academically tenacious students, including working academically hard, seeking out challenges, and seeing school as futuristically relevant, among others, which were significant in their successes. The academic tenacity appears to develop through leadership efficacy. NCSSM graduates practice similar academic tenacity and

perseverance through the mixture of leadership development and academic excellence in STEM curricula, which is a part of its nontraditional educational model.

According to study funded by CISCO, "nearly 28% of high school freshmen declare interest in a STEM-related field—around 1,000,000 students each year. Of these students, over 57% will lose interest in STEM by the time they graduate from high school" (Cisco, 2012, p. 1). Over the years, colleges and universities in the U.S. have experienced substantial volatility in the proportions of students initially reporting aspirations to major in an undergraduate STEM-related discipline (Pryor, Hurtado, DeAngelo, Palucki Blake, & Tran, 2010). In this report nearly 31% of all students who entered the University of California, Los Angeles, as freshmen in 1971 reported plans to major in a STEM discipline, on its Cooperative Institutional Research Program (CIRP) freshmen survey. Figure 1 indicates a 4% reduction in the percentage of students interested in STEM degrees in 2009 (about 35%). In spite of this, the percentage of college readiness of students willing to pursue degrees in STEM disciplines is increasing. Figure 1 is a graphical representation of the more current STEM degree college readiness in math and science disciplines.



Source: https://nms.org/Education/TheSTEMCrisis.aspx

Figure 1. A Graphical Representation of STEM Current College Readiness.

The development of leadership skills to correlate with academic excellence sits at the core of NCSSM educational pedagogy. Indeed, as previously indicated, NCSSM's academic and residential learning paradigm supports the concept that, critical thinking, problem-solving, and reflection skills are essential to leadership development. It appears this approach has practically helped NCSSM graduates in achieving college degrees. NCSSM (2014) also supported this view, when it noted its graduates persisted in the attainment of STEM degrees at levels that exceeded the national averages. In addition, of the 2,141 graduates of the cohort classes of 2000–2007, 82.8% (1,685) completed a Bachelor's degree in a STEM-related field.

However, in spite of the postulation that, the development of leadership efficacy helps NCSSM graduates in college degree achievements, no study on institutional leadership as an educational model that promotes leadership in STEM pipeline preparation has ever been explored in the school. Therefore, the rationale for this dissertation is to investigate the impact of NCSSM learning outcomes on non-cognitive skills, including leadership and self-efficacy, particularly in relation to college achievement of its alumni. In addition, the supplementary objective is the development of a novel model, to study and assess the effects of NCSSM program learning outcomes concerning non-cognitive factors, including leadership and self-efficacy.

1.3 Leadership Self and Means Theoretical Foundation

Leader Self and Means Efficacy Theory is unique in that it captures both leaders' self-efficacy, the confidence individuals have in their own capabilities to lead, as well as leaders' beliefs in the extent that their peers, senior leaders, resources, and other means in their environment will support their leadership: means efficacy.

Empirical research on the Mind Garden Leadership Efficacy Questionnaire shows that leader efficacy is comprised of three components—two in the domain of self-efficacy and one in the domain of means-efficacy (Hannah, 2013). The respective definitions of the three components are as follows:

1. **Leader Action Self-Efficacy**: Leaders' perceived capability to effectively execute various critical leader actions, such as motivating, coaching, and inspiring followers, and getting followers to identify with the organization goals and vision.
2. **Leader Self-Regulation Efficacy**: Leaders' perceptions capability to (a) think through complex leadership situations, (b) interpret their followers and the context, and (c) generate novel solutions using effective leadership with followers.
3. **Leader Means Efficacy**: Leaders' perceptions that they can draw upon others in their work environment (peers, senior leaders, followers) to enhance their leadership and that the organization's policies and resources can be leveraged to impact their leadership.

The conceptual framework of this study supports the theoretical construct that non-cognitive skills acquired through youth leadership development is critical to meeting the increased demand for students prepared to successfully matriculate to STEM postsecondary programs of study. In contrast to the historical preference for using cognitive variables such as standardized test scores and grade point average, to predict performance, non-cognitive variables have proven significant in the prediction of academic performance for nontraditional populations. Non-traditional students include women, first-generation college attending and under-represented minorities in STEM fields.

1.4 Purpose of the Study

An evaluation of NCSSM's educational model in post-secondary STEM pipeline preparation has never been undertaken. NCSSM's academic and residential learning paradigm supports student social cognitive development in the areas of critical thinking, problem–solving, and reflection. These same skills are considered essential to the development of leadership efficacy. The problem investigated was two-fold. The first part of the study examined the perceptions of leadership efficacy of the NCSSM graduates based on their scored responses on the Mind Garden Leadership Efficacy Questionnaire. The second part of the study involved the use of tri-squared to additionally validate study results.

The theoretical framework introduced in Bandura's 1977 research article established that the concept of self-efficacy as being central to the discussion of predictive behaviors. In a learning environment, efficacy expectations held by students are governed by beliefs that they have the ability to execute particular behaviors necessary to produce a particular outcome. According to Bandura (1997), outcome and efficacy expectations are differentiated. Although an individual believes that certain behaviors will produce a certain outcome, if they harbor major doubts about their ability to perform the requirements such information does not influence their behavior. "The strength of peoples' convictions in their own effectiveness is likely to affect whether they will even try to cope with given situations" (Bandura, 1977, p. 3). This conceptual framework supports the construct that personal mastery affect both initiation and persistence of coping behavior.

Perceived self-efficacy in the paradigm of leadership efficacy influences one's choice of behavioral settings, as through avoidance mechanisms one is not likely to attempt activities which exceed their coping skills. Efficacy expectations also determine the amount of effort one

will exert as well their rate of persistence when encountering obstacles and aversive circumstances. Bandura points out that those who persist in the subjectively threatening activities that are in fact relatively safe will gain corrective experiences that reinforce their sense of efficacy, thereby eventually eliminating their defensive behavior (Bandura, 1977). This is not meant to imply that expectations be used as the sole determinant of behavior. Considerations of incentives for performing particular tasks must be taken into consideration as well. Interest in the self-processes by which human agency is exercised holds significant predictive value for academic institutions seeking to expand the population of STEM degree seekers (from a leadership perspective), thereby strengthening the pipeline of diverse workers into STEM careers (as leaders in STEM and STEM associated fields). Therefore, self-influences serve as important proximal determinants at the core of leadership causal processes. In 1993 Bandura theorized that how people feel, think, motivate themselves, and behave are all influenced by efficacy beliefs. He suggests that self-efficacy beliefs are developed through four major constructs, including cognitive, motivational, affective, and selection processes (critical areas and arenas vital to both leadership and leadership efficacy).

Bandura (1993) further expanded his initial research and demonstrated that people's primary responses to new challenges is to rely on past performance in assessing their efficacy and setting goals. Yet, as they developed a self-schema regarding their efficacy through additional experience, their performance outcomes became driven more by closely held beliefs about self-efficacy. It has been documented that perceptions of self-efficacy influences performance not only directly, but also through its powerful effects on goal setting and analytic thinking (critical leadership components).

It is important to note that within the strategy of strengthening the pipeline of students prepared to pursue STEM careers, educators are additionally advantaged when considering cognitive and social cognitive indicators of academic performance (as the unit of analysis does at the outset of its candidate selection and admission processes). This is and should be an all-inclusive and implicit process that is actively and regularly pursued. Doing so expands the diversity of populations prepared for leadership in STEM careers and directly impacts the global competitiveness and innovation of the United States and society as a whole.

1.5 Research Questions

This study sought to capture the leadership efficacy amongst NCSSM graduates from the Classes of 2000–2007. The research is guided by the following research questions:

1. What is the leadership efficacy of 2000–2007 graduates of the North Carolina School of Science and Mathematics as captured by the Mind Garden Leadership Efficacy Questionnaire?
2. How do their perceptions of leadership efficacy as captured by the Mind Garden Leadership Efficacy Questionnaire, align with research on non-cognitive indicators of academic performance?

1.6 Post Hoc Research Hypotheses

The following were the Post Hoc data analysis research hypotheses for the study:

H_0: There are significant differences in the perception of the Leadership Efficacy by the North Carolina School of Science and Mathematics Alumni for the classes 2000–07 in terms of their overall "Leadership Efficacy" in terms of Execution or "Leader Action Efficacy"; Capacity or "Leader Means Efficacy"; and Environment or "Leader Self-Regulation Efficacy."

H_1: There are no significant differences in the perception of the Leadership Efficacy by the North Carolina School of Science and Mathematics Alumni for the classes 2000–07 in terms of their overall "Leadership Efficacy" in terms of Execution or "Leader Action Efficacy"; Capacity or "Leader Means Efficacy"; and Environment or "Leader Self-Regulation Efficacy."

The aforementioned Post Hoc Research Hypotheses yield the following mathematical hypotheses using the Tri-Squared Test as the Post Hoc data analysis procedure:

Associated Post Hoc Two-Tailed Tri–Squared Test Mathematical Hypotheses

$$\mathbf{H_0: Tri^2 = 0}$$
$$\mathbf{H_1: Tri^2 \neq 0}$$

1.7 Definition of Terms

The following definition of terms applies to the specific scientific terminology used throughout the study. The research investigation terms that apply to the study are defined in detail as follows:

Academic Tenacity—Non-cognitive factors that promote long-term learning and achievement; also known as having a "growth mindset" or being a life-long learner.

Achievement Outcomes—Results of standardized measures of student performance and ability. A learning outcome is the specification of what a student should learn as the result of a period of specified and supported study (Harvey, 2004–12).

Critical Thinking—The ability of an individual to take charge, analyze, and assess his/her thinking on a consistent basis for quality improvement (Paul & Elder, 2002).

Leadership Action Efficacy/LAE—(Equal to "*Execution*": as Mind Garden Leadership Efficacy Questionnaire Items—Energize; Develop; and Coach) Leaders' perceived capability to effectively execute various critical leader actions, such as motivating, coaching and inspiring

followers, and getting followers to identify with the organization and its goals and vision (Hannah & Avolio, 2013).

Leadership Efficacy—The confidence individuals have in their own capabilities to lead as well as leaders' belief in the extent that their peers, senior leaders, resources and other means in their environment will support their leadership (Hannah & Avolio, 2013).

Leadership Efficacy Questionnaire—The LEQ is based on Leader Self and Means Efficacy Theory and is unique because it captures both leader's self-efficacy, the confidence individuals have in their own capabilities to lead, as well as leaders' beliefs in the extent that their peers, senior leaders, resources, and other means in the environment will support their leadership: means efficacy. Personal efficacy is only half of the leader efficacy story—leaders must also generate confidence that their context will support their performance as a leader. Research has shown that means efficacy operates along with self-efficacy to separately and distinctly influence performance—the LEQ captures both (Hannah & Avolio, 2013).

Leadership Means Efficacy/LME—(Equal to "*Capacity*": as Mind Garden Leadership Efficacy Questionnaire Items—Inspire; "Get My"; and Utilize) Leaders' perceptions that they can draw upon others in their work environment (peers, senior leaders, followers) to enhance their leadership and that the organization's policies and resources can be leveraged to impact their leadership (Hannah & Avolio, 2013).

Leadership Self-Regulation Efficacy/LSRE—(Equal to "*Environment*": as Mind Garden Leadership Efficacy Questionnaire Items—Determine; Motivate; and Remain) Leader's perceived capability to (a) think through complex leadership situations, interpret their followers and the context, and generate novel and effective solutions to leadership problems; coupled with

(b) the ability to motivate oneself to enact those solutions using effective leadership followers (Hannah & Avolio, 2013).

Mind Garden—An independent publisher of psychological assessments and instruments. Their organizational goal is to "preserve and grow" important psychological assessments . . . [in] the quest to grow the health of the human psyche, [Mind Garden] facilitates feedback and self-understanding. Mind Garden serves members of the academic, research, and consulting communities by offering high quality, proven instruments from prominent professionals. [Mind Garden] features two major types of instruments: Assessments Measures, such as the State Trait Anxiety Inventory (STAI), the Ways of Coping Questionnaire (WAYS), and the Adjective Check List (ACL); and Developmental Measures such as the Multifactor Leadership Questionnaire (MLQ), the Wellness Evaluation of Lifestyles (WEL), and the Social Skills Inventory (ISS; Mindgarden, 2013).

National Consortium of Specialized STEM Schools (NCSSS)—The initial thrust to establish a national consortium came from four schools: North Carolina School of Science and Mathematics; Thomas Jefferson High School for Science and Technology; Louisiana School for Mathematics, Science, and the Arts; and the Illinois Mathematics Science Academy. These schools hosted an organizational meeting in the spring of 1988 at Thomas Jefferson High in Alexandria, VA, and 11 additional schools responded to their invitation to join the efforts.

These 15 founding member institutions established the *National Consortium for Specialized Secondary Schools of Mathematics, Science, and Technology*, as a non-profit 501(c)(3) organization. In early 2014, to continue to move forward as the leader in STEM at the secondary level, Consortium board of directors voted to shorten the name to better identify the membership and constituency of the Consortium. The new name, the *National Consortium of*

Secondary STEM Schools (NCSSS) reflects the core membership, while preserving the rich heritage and history of the Consortium (www.ncsss.org).

National Student Clearinghouse—The Clearinghouse serves as a trusted agent to participating institutions, providing support for their compliance, administrative, student access, accountability, and analytical needs. Services are designed to facilitate compliance with FERPA, The Higher Education Act, and other applicable laws. Clearinghouse services comprise four service areas: Data Exchange, Financial Aid, Research Services, and Verification Services. Research Services, which was used for this study, offers services and reports that draw on the Clearinghouse's unmatched information resources on student-level educational outcomes nationwide (National Student Clearinghouse, 2015).

Non-cognitive Factors—Psychological or motivational factors and may include students' beliefs about themselves, their feelings about school, or their habits of self-control. "Educators, psychologists, and even economists recognize the importance of non-cognitive factors in achievement both in school and in the labor market" (Dweck, 2014, p. 2).

North Carolina School of Science & Mathematics (NCSSM)—The U.S.'s first public residential high school opened its doors in 1980 to 150 juniors. The program has since grown to 680 juniors and seniors representing each of North Carolina's 13 US Congressional Districts. Over the course of its institutional history, NCSSM has enrolled students from each of North Carolina's one hundred counties. NCSSM is the 17th constituent member of the University of North Carolina system and does not fall under the auspices of the NC Department of Public Instruction; a disruption of traditional state education system practices. Doing so, however, allows flexibility of instructional methodology, curriculum development, creativity and innovation in a campus community that is not bound to administering End of Grade/EOG or End

of Course/EOC tests. This also allows for an increased degree of immersion into STEM curricular, providing graduates with opportunities to cover subject matter in greater depth and detail (www.ncssm.edu).

Pedagogy—The principles, practice and profession of teaching. The methodology of teaching often referred to as the 'art' of teaching (www.thefreedictionary.com).

Post Hoc—Of Latin origin for post hoc, ergo propter hoc, or after this, therefore because of this. Relates to or being the fallacy of arguing from temporal sequence to causal relation; formulated after the fact (www.merriam-webster.com).

Self-efficacy—A person's estimate or personal judgment of his or her own ability to succeed in reaching a specific goal (e.g., quitting smoking or losing weight), or a more general goal (e.g., continuing to remain at a prescribed weight level; Hughes & Demo, 1989).

STEM—Science, technology, engineering and mathematics (HERI, 2010).

Tri-Squared Test—Trichotomy-Squared Test is a comprehensive statistical test of specifically developed for the field of Education Science, or Educscience. Eduscience is a broad field and its professionals are directly involved in the field. The primary positions in the learning environment that the Eduscientist assume are in the following areas: Administration (which includes Leaders, Organizational Heads, and Organizational Management Professionals), Instruction (which includes Teachers, Professors, and Facilitators), Practice (which includes Practitioners in a variety of Specified Areas and Arenas), and Technology (which includes Educational Technologists, Instructional Technologists, and Information Technologists; Osler, 2012).

Underrepresented Minority—For the purposes of this study this demographic includes African American, American Indian and Hispanic populations which are so severely

underrepresented in number in science, technology, engineering and mathematics fields (U.S. Census Bureau, 2011). Underrepresented minorities are sometimes referred to as racial ethnic minority students.

U.S. Congressional District—An electoral constituency that elects a single member of a congress (www.merriam-webster.com).

1.8 Delimitations and Limitations

This study is delimited to the sample size of the number of identified NCSSM graduates from the classes of 2000–2007. Contact information for graduates is gained through, NCSSM Alumni Affairs periodic contact update requests. NCSSM obtained data on graduation demographics through the National Student Clearinghouse, a trusted source for education outcomes and student educational outcomes research (National Student Clearinghouse, 2015). The sample size represents only one third of the total alumni population.

1.9 Significance of Study

This study holds significance for the assessment of leadership efficacy of students seeking enrollment in secondary accelerated STEM educational programs. Use of non-cognitive factors offer promising considerations for "raising the achievement of underprivileged children and, ultimately, closing the achievement gaps based on race and income" (Dweck, 2014, p. 2).

Of additional importance are the implications for assessing measurable leadership development outcomes of the NCSSM educational model, which have never been studied. An assessment methodology designed to measure the impact of STEM leadership development on the rate of attainment of degrees and work in STEM careers currently does not exist. Such a model could help address the crises in students prepared to successfully meet both the social and academic demands that serve as deterrents to the pursuit of STEM studies.

1.10 Summary

Chapter 1 set the tone for the present study. This research project examines the perceptions of leadership self-efficacy of NCSSM graduates and provides background information on the decrease in national competitiveness in preparing students to pursue STEM degrees. Also addressed is the importance of student leadership development in equipping high school graduates with tool sets that advantage competitive candidates for STEM career fields. In its 35th year of service to the communities of North Carolina, NCSSM holds promise as an educational model in preparing graduates that go on to pursue STEM degrees and careers that exceed national trends.

Additional insight into the broader issue of the STEM educational crises in the U.S. is included to provide a framework in which this study is undertaken. A definition of terms associated with this particular research model is provided and study research questions are outlined. The mission and admissions criteria of NCSSM's educational model explore the disruptive pedagogy on which the institution was founded and similar residential programs across the country have been established.

Chapter 2 contains a review of literature that covers research on the STEM achievement gap; historical insight on the state-supported residential educational model. This chapter also examines Bandura's social cognitive theory of self-efficacy and the role non-cognitive factors like leadership efficacy play in predicting academic performance.

In Chapter 3 the research methodology is provided. This chapter contains the purpose and context of the study along with the rationale for the study's design. Information about the study participants and the LEQ survey instrument is also provided in chapter three. An analysis of the

procedures used in the qualitative and post-hoc quantitative mixed methods phases is provided and the method of data analysis outlined.

Chapter 4 offers an analysis of the research data gathered in each phase of the mixed methods process. Responses collected from the Mind Garden LEQ are disaggregated using a descriptive inferential statistical method for the qualitative phase. The quantitative post-hoc tri-squared test hypothesis is provided and results presented.

Chapter 5 contains a discussion of the research findings and implications for stakeholders. Recommendations for further research in the area of non-cognitive factors as predictors of academic performance and attainment of STEM degrees offered. A summary of considerations for increasing student interest and expanding inclusivity of non-traditional populations in STEM programs are provided.

CHAPTER 2

Literature Review

2.1 Introduction

Review of the associated literature is divided into three strands. Strand one of this chapter examines research addressing the issues relating to the importance of the unit of analysis (NCSSM) as model STEM institution and the history of the STEM Achievement Gap in the United States. According to the Committee on Science Engineering and Public Policy (2007) the strength of the STEM pipeline has become largely dependent on the ability of students to persist and graduate in STEM degree fields. From an historical perspective, predictors of academic performance in STEM programs have been heavily weighted on cognitive indicators of academic performance such as standardized test scores. Yet a growing body of research points to the importance of social cognitive factors as critical indicators of performance in STEM degree programs when considering first generation and underrepresented minority populations. Research of the literature profiling the social cognitive, also known as non-cognitive, variables is explored.

Strand two of this chapter takes an in-depth look at Bandura's Social Cognitive Theory on Self–Efficacy historically as it is a foundational concept that applies to Leadership Efficacy, which is the research paradigm of this study. A review of the theoretical framework for the present study is addressed using Bandura's social cognitive theory, which outlines four sources of information on self-efficacy. These include enactive attainments, vicarious experience, verbal persuasion, and physiological state (Bandura, 2010). Pajares and Miller (1994) facilitated a study that discovered a strong correlation between self–concept and math performance. Self–concept and self–efficacy prevail as two of the most important factors that contribute to the

development of student interest in STEM. Further, Bandura (2010) hypothesized that belief in oneself influences individual abilities, perhaps more than actual aptitude. The self–concept acts as a mechanism that influences the individual's perceived confidence when performing a task (Hackler, 2011). A review of literature on youth leadership development and the influence of leader self-efficacy on STEM degree outcomes will also be examined.

Strand three of the literary review offers insight into North Carolina's historical leadership on the frontlines of STEM education with the establishment of NCSSM (the research unit of analysis). In the section entitled "disrupting class" insight is provided into the vision and mission of the first state-supported residential high school in the country. Founded through the leadership of Governor James B. Hunt Jr., former Governor, Senator and Duke University President Terry Sanford, and academician and author John Ehle, NCSSM opened in 1980 as a high school specializing in a curriculum focused on science and mathematics. It is an approach grounded in the economic construct that key to North Carolina's future growth is fostering competitiveness in a global economy by investing in the development of human and intellectual capital (Experience NCSSM, 2012). This strand will exam NCSSM's educational outcomes and its institutional impact on the development of human and intellectual capital as an educational model.

2.2 The STEM Achievement Gap

Current literature points to a national crisis in the U.S. of students prepared for STEM careers. It supports the need for more studies on this topic and addresses the gap in meeting the need for innovative and effective tools designed to assess teaching, learning and leadership development initiatives to boost STEM preparation amongst today's students. This is an important step in preparing undergraduates for the workforce of the future, a workforce that is

projected to be heavily focused on science, technology, engineering, and mathematics (STEM) fields. It also holds promise for the stimulation of national economic growth while decreasing the demand for outsourcing of jobs in the United States (Office of the Press Secretary, 2009).

In 2006, NASA initiated an aggressive campaign in collaboration with numerous colleges and universities to address the future needs and goals of the space agency, and to ensure the national security of the knowledge economy (Coppola & Malyn-Smith, 2006). Consisting of more than 80 organizations, the International Technology Education Association (ITEA) was founded to foster stability and growth in the STEM pipeline and to develop a prosperous knowledge economy in the U.S. The ITEA also works to stimulate interest in STEM fields and provides information about the workforce (Hackler, 2011). Some of the organizations of this 80-member consortium include: Cambridge University, the Center for the Advancement of Scholarship on Engineering Education, Carnegie Mellon University, the Federal Aviation Administration, the International Society for Technology in Education, Massachusetts Institute of Technology, the Society of Women Engineers, Texas Southern University, and Harvard University (Hackler, 2011).

In today's economy, job competitiveness requires skill sets that allow access to STEM careers. Mastery of mathematics concepts and skills plays an integral role in the ability of students to successfully pass through the gateway of STEM educational attainment. There are numerous studies that have been conducted to gain greater insight into factors that contribute to the mathematics achievement gap between the United States and other countries (King, 2010). The reliance of immigrant populations to meet the demands for STEM workers in the U.S. has created a complex national problem (United States Department of Labor, 2007). In his book *The Global Achievement Gap*, Tony Wagner outlines in Chapter Two, "The Old World of School"

seven survival skills of educational programs that help advance the competitiveness of the U.S. as a nation. They are critical thinking and problem solving, collaboration across networks and leading by influence, agility and adaptability, initiative and entrepreneurialism, effective oral and written communication, accessing and analyzing information, and curiosity and imagination (Wagner, 2010).

American students are increasingly in direct competition with youth from developing countries. In his research, Wagner (2010) embraces the increasing gap in achievement between advantaged white students and their low-income racial ethnic minority peers as a call to action. The educational system must be reformed if it is to deliver educational access to all students that are relevant, engaging and transcendent of American's separatist historical approach (Wagner, 2010). Traditionally, Whites have largely dominated the STEM fields. Demographic projections, however, forecast a decline in White workers by the year 2030. Asian American, Indian, African American, and Hispanic populations will continue to increase. Therefore, to support a rapidly expanding diverse population, the U.S. will need to improve the inclusiveness of the STEM workforce (Babco, 2004).

The Presidential Executive Report titled Prepare and Inspire: K–12 Education in Science, Technology, Engineering, and Math (STEM) For America's Future America's Future advises: "We must prepare all students, including girls and minorities who are underrepresented in these fields, to be proficient in STEM subjects…[and] we must inspire all students to learn STEM and in the process, motivate many of them to pursue STEM careers" (President's Council of Advisors on Science and Technology [PCAST], 2010, p.15). In an effort to identify methods to recruit and retain increased numbers of African American students in gifted education, Ford and her colleagues analyzed various factors contributing to chronic underrepresentation of African

American students in gifted programs. Gould traversed two centuries to outline how *priori* assumptions and fears associated with different ethnic groups, particularly African Americans, led to conscious fraud—dishonest and prejudicial research methods, deliberate miscalculations, convenient omissions, and data misrepresentation among scientists studying intelligence (Gould, 1981). Employing traditional measures for identifying STEM talent that demonstrate historical cultural bias, has produced diminishing returns for secondary and postsecondary education.

Figure 2 is an illustration of Table 1 of "National Trends in Minority Representation for Gifted Programs" (Adger, 2004, p.3) and disaggregates minority student representation in gifted programs from 1978 to 1992. The North Carolina Commission on Raising Student Achievement and Closing Gaps (First Report to the State Board of Education, 2001) also cited the need for greater minority inclusion in advance courses/programs (Adger, 2004). Building a STEM-literate society has become more important than once realized (Riccards, 2009).

Table 1

National Trends in Minority Representation for Gifted Programs

Student Population	1978	1980	1982	1984	1992
Hispanic	6.8 5.15 (u = 25%)	9.0 5.4 (u = 40%)	8.6 4.0 (u = 53%)	13.2 7.2 (u = 45%)	13.7 7.9 (u = 42%)
American Indian	0.8 0.3 (u = 62%)	0.7 0.3 (u = 57%)	0.5 0.3 (u = 40%)	0.8 0.3 (u = 62%)	1.0 0.5 (u = 50%)
Asian	1.4 3.4 (o = 59%)	2.2 4.4 (o = 50%)	2.6 4.7 (o = 45%)	3.7 6.8 (o = 46%)	4.0 7.0 (o = 43%)
African American	15.7 10.3 (u = 33%)	20.1 11.1 (u = 45%)	25.8 11.0 (u = 57%)	24.5 12.9 (u = 47%)	21.1 12.0 (u = 41%)

Top number indicates percentage of student population; Middle number represents percentage of gifted population; "o" indicates overrepresentation; "u" indicates underrepresentation

Figure 2. National Trends in Minority Representation for Gifted Students (Adger, 2004, p. 3).

Wigfield and Eccles (2002) support this assessment with their research on *The Development of Competence Beliefs, Expectancies for Success, and Achievement Values from Childhood through Adolescence.* Their research on expectancy-value theory posits that individuals' expectancies for success and the value they have for succeeding are important determinants of their motivation to perform different achievement tasks, and their choices of which tasks to pursue. Research shows that psychological factors often referred to as motivational or non-cognitive factors, can matter even more than cognitive factors for students' academic performance (Dweck et al., 2014). "The term *noncognitive* is used to refer to variables relating to adjustment, motivation, and perceptions, rather than the traditional verbal and quantitative (often called cognitive) areas typically measured by standardized tests" (Sedlacek, 2004, p. 36). Thirty years of research supports the usefulness of non-cognitive variables for assessing all students. Current research indicates that non-cognitive factors are critical for assessing underrepresented populations, as cognitive variables such as grades and standardized test scores provide a limited snapshot of student potential.

2.3 Bandura's Social Cognitive Theory of Self-efficacy

In 1960 Albert Bandura proposed his social learning theory (SLT). By 1986, the theory had been redefined as social cognitive theory (SCT) positing that learning in social context with a dynamic and reciprocal interaction of the person, environment, and behavior. Social Cognitive Theory places an emphasis on social influence and considers the unique way in which individuals acquire and maintain behavior, while also considering the social environment in which individuals behave (Boston University School of Public Health, 2013). Originally developed to provide health professionals with insight focused on maintenance of behavior as opposed to initiating behavior. Maintenance of behavior is the goal of public health. The theory

takes into consideration a person's past experiences, which factor into whether behavioral action will occur. Bandura was able to determine that past experiences influence reinforcements, expectations, and expectancies, all of which shape whether a person will engage in a specific behavior (Boston University School of Public Health, 2013).

Bandura's social cognitive theory has been researched in relation to the study of self–regulation and motivation in academic environments (Bandura, 2010). The author (2010) stated that individuals possess a self–system that enables them to exercise a measure of control over their thoughts, feelings, and actions. As a self–regulatory system, this function enables individuals to modify their setting and control their actions. According to Bandura, this self-system contains the individual's cognitive and affective structures which encompass the capability to symbolize, learn from others, plan alternative strategies, regulate one's behavior and engage in self-reflection (Pajares & Miller, 1994). Five constructs were created based on the original social learning theory (SLC). By 1986 the theory had evolved to include a sixth construct termed self-efficacy, and became known as the social cognitive theory (SCT).

The first five constructs were developed as part of the SLT; the construct of self-efficacy was added when the theory evolved into social cognitive theory (SCT). *Behavioral Change Models,* a Boston University School of Public Health (2013) publication, defines the six social cognitive theoretical constructs as follows:

1. Reciprocal Determinism—This is the central concept of SCT. This refers to the dynamic and reciprocal interaction of person (individual with a set of learned experiences), environment (external social context), and behavior (responses to stimuli to achieve goals).

2. Behavioral Capability—This refers to a person's actual ability to perform a behavior through essential knowledge and skills. In order to successfully perform a behavior, a person must know what to do and how to do it. People learn from the consequences of their behavior, which also affects the environment in which they live.
3. Observational Learning—This asserts that people can witness and observe a behavior conducted by others, and then reproduce those actions. This is often exhibited through "modeling" of behaviors. If individuals see successful demonstration of a behavior, they can also complete the behavior successfully.
4. Reinforcements—This refers to the internal or external responses to a person's behavior that affect the likelihood of continuing or discontinuing the behavior. Reinforcements can be self-initiated or in the environment, and reinforcements can be positive or negative. This is the construct of SCT that most closely ties to the reciprocal relationship between behavior and environment.
5. Expectations—This refers to the anticipated consequences of a person's behavior. Outcome expectations can be health-related or not health-related. People anticipate the consequences of their actions before engaging in the behavior, and these anticipated consequences could influence successful completion of the behavior. Expectations derive largely from previous experience. While expectancies also derive from previous experience, expectancies focus on the value that is placed on the outcome and are subjective to the individual.
6. Self-efficacy—This refers to the level of a person's confidence in his or her ability to successfully perform a behavior. Self-efficacy is unique to SCT although other theories have added this construct at later dates, such as the Theory of Planned

Behavior. Self-efficacy is influenced by a person's specific capabilities and other individual factors, as well as by environmental factors (barriers and facilitators).

In a study on resiliency, Rutter (1979) points out that it is worthwhile to understand why some at-risk students are able to be successful in spite of adversity. Werner and Smith (1982) researched children who thrived despite adversity and became successful. They determined several factors and relationships that protected particular children from the negative impacts of their surroundings. These protective factors that shielded certain children included maturity, optimism, high motivation and energy level, along with self-efficacy (Rutter, 1979). This research outlines three primary systems in a child's life, which are the family, school and community. Each serves a role in promoting resiliency within individual young persons.

Studies or resiliency have not only been the topic or research in the areas of psychology and psychopathology, but also in the field of education. Winfield (1991) and Alva and Padilla (1995) completed studies of educational resilience on African American and Hispanic students. Henderson and Milstein (1996) provided a synthesis of factors that are common protectors of resilience and developed an outline to guide educators in facilitating resilient behavior in children. In 1995, Wang, Haertel, and Walberg "proposed that the study of resilience should focus on the relationships that characterize the development and functioning of resilient individuals and interventions that foster resilience" (p. 5). This model fosters the premise that student's behavior is caused by their engagement with their environment, their disposition, and circumstantial influences, as opposed to a single event or factor.

Self-efficacy and other expectancy beliefs share the common perception that they are individual beliefs about one's perceived capability. The commonalities depart at the intersection of self-efficacy and the individuals' perceived capabilities to attain designated types of

performances and achieve specific results. According to social cognitive theory, the events over which personal influence is exercised vary. Depending on what is being managed, it may entail regulations of one's own motivation, thought processes, affective states and actions, or changing environmental conditions" (Pajares, 2013, p. 546).

The significance of using a qualitative approach to this study is particularly purposeful. Historic research has demonstrated consistent racial gaps in educational attainment. In spite of the myriad reasons for these gaps, "we still do not understand the many factors that shape student success at multiple levels of the education pipeline" (Allen, Suh, Gonzalez, & Yang, 2008). In their 2008 publication titled *Explaining—or Defending—Winners and Losers in the Competition for Educational Attainment*, Allen et al. argue that research involving analysis of large statistical data sets, risks dehumanizing disadvantaged students by ignoring complex experiences that influence educational attainment. Zuberi (2001) is critical of research that does not emphasize theory and methodology, positing that since failing to place statistical patterns in broader socio-historical context, such quantitative methods-driven research often reproduces unchallenged racist theories and methodologies.

In a research study entitled The Decision of African American Students to Complete High School: An Application of the Theory of Planned Behavior, Davis et al. (2002) examined the questionnaire responses of male and female African American high school students. This theory was deemed most appropriate for the study of factors that contribute to high school students' decision to stay in school because of its focus on personal beliefs and attitudes, perceived social expectations, and self-efficacy concerns (Davis et al., 2002). Educators, psychologists, and economists recognize the importance of non-cognitive factors in school and in the labor force. Governor James B. Hunt and his team of advisors transformed the educational

landscape by establishing the nation's first public residential high school, the North Carolina School of Science and Mathematics, focused on STEM preparation and the development of non-cognitive skills in leadership competencies

2.4 "Disrupting Class": State-supported Residential Model a Pre-Cursor to NCSSM

Governor Terry Sanford was a visionary in helping to make North Carolina a state where education is valued. Sanford established the NC Community College system and garnered a $100 million strategy for improving North Carolina's K–12 education program in the early 1960's (Hunt, 2013). Sanford's gubernatorial advisory team included Joel Fleishman, John Ehle and many others whose innovative ideas and creative energies characterized the leadership and accomplishments of the Sanford Administration. Strongly influenced by Sanford's leadership, Governor James B. Hunt considered Terry Sanford the mentor (Building North Carolina, 2013) and driving inspiration behind initiatives to reform and modernize public schools in NC.

Transforming education became Hunt's signature mission. Hunt began his second term in 1981 when he championed the establishment of the North Carolina Biotechnology Center. The action led to the state becoming a leader in both the biotechnology and pharmaceutical industries. A few years earlier the Hunt administration had successfully founded the North Carolina Microelectronics Center in the Research Triangle. North Carolina began to earn a reputation around the country as a center for the fastest growing high technology industry (Pearce, 2010). Early in his second term Hunt called on Terry Sanford, John Ehle, and Eli Evans, the innovative thinkers behind the development of the North Carolina School of the Arts. Ehle and Evans had the idea of establishing a residential high school for students with potential for high achievement in science and mathematics. Gaining support and funding for the concept from the legislature was a hard sell (Pearce, 2010).

In his research on state supported residential programs, Dr. Brent Jones (2009) reports that in 1980, the North Carolina School of Science and Mathematics pioneered a successful program for high-achieving youth. It was the first state-supported residential STEM high school in the United States and abroad. NCSSM quickly become the template for state-sponsored residential math and science schools (SRMs) across the nation. Queen Noir of Jordan visited in the early 1980's along with a delegation of foreign educators. Shortly thereafter, the first program modeled after NCSSM was established internationally. Today there are programs in several states and countries that replicate NCSSM's model in many ways. Although many of its progressive approaches have been replicated, there are several factors which make NCSSM one of a kind. Contextual and structural researcher summative descriptions of these areas are outlined in order on the pages that follow to provide greater insight into and appreciation of NCSSM's innovative and unique educational model.

Governance Summary:

1. NCSSM falls under the auspices of the University of North Carolina system as the 17th constituent member. As the seventeenth constituent member of the UNC system, NCSSM is assured flexibility in curriculum, teaching approach and class day scheduling.
2. Because it does not fall under the auspices of the North Carolina Department of Public Instruction, students enrolled in NCSSM's residential program do not take state curriculum assessments or end of course and end of grade tests as do their traditional public school peers.
3. NCSSM faculty members are required to have master's degrees. Many have Ph.D.'s as well as national teaching certification.

Enrollment Summary:

1. Key to the uniqueness of NCSSM's educational model is mandated purpose and formula for student enrollment. Established with the passing of *North Carolina General Statute 116-132, 1985*, the founding legislation provides: the purpose of the School shall be to foster the educational development of North Carolina high school students who are academically talented in the areas of science and mathematics and show promise of exceptional development through participation in a residential educational setting emphasizing instruction in the areas of science & mathematics . . .
2. The legislation is carefully worded to support the identification of academic talent and promise in STEM fields as considerations for enrollment. This suggests a critical awareness by leadership that enrollment criteria should be based on both traditional and non-traditional measures of academic performance. Disparities in standardized test scores and representation in academically gifted and talented programs is historically biased to exclude underrepresented minority students. This has been an important consideration in protecting NCSSM as having the highest enrollment diversity within its peer group of consortium schools.
3. To ensure statewide representation in the enrolled student body, *NC General Statute 116-235* mandates: an equal number of qualified rising high school juniors is admitted to the program and to the residential summer institutes in science and mathematics from each of North Carolinas congressional districts.
4. Figure 4 is provided to show the geographic context of the legislatively mandated enrollment formula for applicants applying to NCSSM.

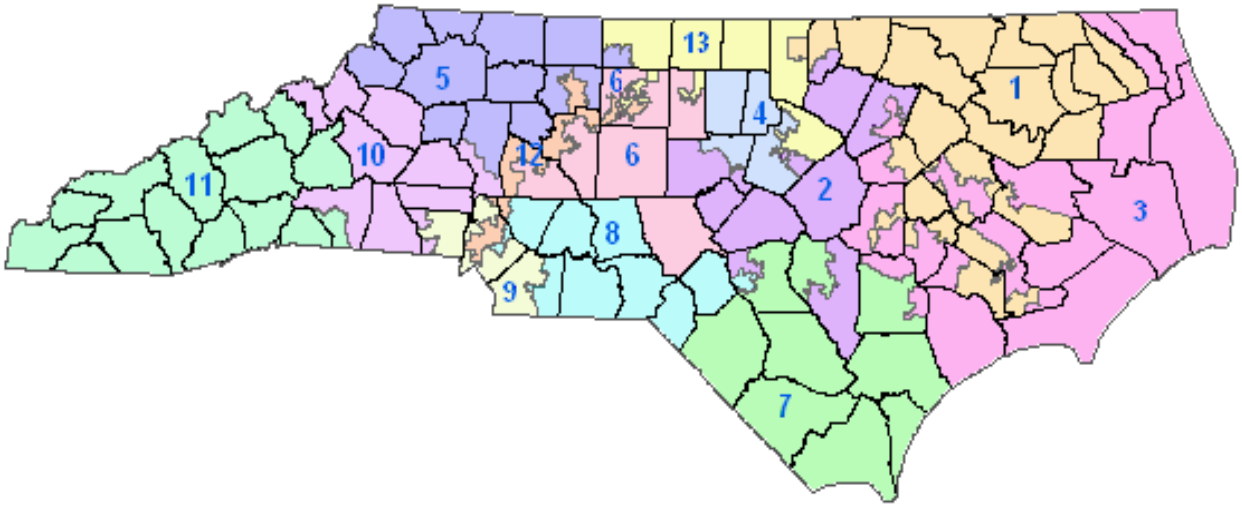


Figure 3. The North Carolina U.S. 13th Congressional District Map.

Curriculum Summary:

1. NCSSM course catalogue states: the first consideration in building each student's course of study is to ensure a thorough grounding in mathematical, scientific, and communications skills and concepts (NCSSM, 2012).
2. NCSSM course catalogue states: it is important for students to learn enough about a variety of academic disciplines in mathematics and the sciences and in other fields to become informed decision makers and competent leaders in the technological world of the 21st century (NCSSM, 2012).
3. Approximately 82% of each graduating class has taken one or more AP exams. Of students sitting for AP exams, 72% scored 4 or 5, which compares with approximately 34% of all AP test-takers (NCSSM, 2012).

Class Rank Summary:

1. NCSSM has a highly motivated and competitively selected school population. The majority of students are clustered near the top of the grading scale and therefore NCSSM

finds it is not beneficial to students nor does it add clarity to the character of the academic program to rank students.

Grade Point Average (GPA) Summary:

1. All NCSSM courses are at the honors level or higher. Physical Activity/Wellness courses, Student Life courses, Work Service, Service Learning and Mini-Term are graduation requirements. Along with Special Study Options, these requirements carry no quality points and are not computed in the GPA.
2. Course #300-349 = introductory courses that meet a core NCSSM graduation requirement. Comparable to honors level courses at many high schools (A+AA- 5.0; B+BB- 4.0; C+CC- 3.0; D 0.0) (NCSSM, 2012).
3. Course #350-399 = meet one or more of the following criteria: accelerated versions of classes of the 300-349 level; courses that require prerequisites taken at NCSSM; courses at a level higher than a typical high school honors course; courses that are for seniors only (A+AA- 5.5; B+BB- 4.5; C+CC- 3.5: D 0.0) (NCSSM, 2012).
4. Course #400-449 = at the level of introductory college courses and/or that help prepare students to take an Advanced Placement examination (A+AA- 6.0: B+BB- 5.0; C+CC- 4.0; D 0.0) (NCSSM, 2012).
5. Course #450-499 = deal with topics beyond those of the introductory college courses (A+AA- 6.0; B+BB- 5.0; C+CC- 4.0; D 0.0) (NCSSM, 2012).

Graduation Requirements Summary:

1. Physical Activity/Wellness courses, Student Life courses, Work Service, Service Learning and Mini-Term are graduation requirements (NCSSM, 2012).
2. English = minimum of 4 trimester credits required.

3. Mathematics = minimum of 5 trimester credits required and students must complete pre-calculus or higher math. Students who enroll in algebra need to complete six trimester credits.
4. Science = minimum of 6 trimester credits required and students need to complete two trimester credits each in biology, chemistry, and physics. At least three must be completed in the junior year (NCSSM, 2012).
5. History/Social Science = minimum of 2 trimester credits required.
6. World Languages = minimum 6 credits required, except for juniors enrolling in intermediate or higher level in which case only 3 trimester credits are required (NCSSM, 2012).
7. Physical Activity/Wellness = minimum of 1 credit hour required.
8. Student Life Courses = requires a grade of satisfactory in each course in SL101 and SL102.
9. All students must successfully complete a minimum of 60 hours of SSL105 Summer Service Learning.
10. All students must successfully complete two years of WS105 Work Service of three hours per week.
11. All students are responsible for cleaning residence hallways, bathrooms, dorm rooms, and lounges. Housekeeping and maintenance staff clean and paint halls each summer in preparation for the upcoming academic year. Students pay a deposit of $285 upon enrollment, which covers the cost for PSAT registration. The remainder is refunded if they incur no costs associated with room/property damages, lost books or electronic pass–keys or printing overages.

Governor Jim Hunt wanted to create a place where teaching methods are varied and the learning environment more energetic. “Yes, the teachers lecture, but students frequently raise their hands to participate in discussions” (Christensen, Horn, & Johnson, 2008). Students work in groups while teachers meander around the room providing insight, guidance and assistance. Students also work on fun projects, participate in interactive course assignments, and even attend class outside under a large canopy of oak trees dating back to the 1700s.

NCSSM’s 35-year history includes the modeling of twenty public residential high schools across the nation based upon its educational approach to STEM preparation. NCSSM is also a founding member of the National Consortium of Stem Secondary Schools of which there are 100 secondary school members and 300 affiliate university members. Despite the anecdotal evidence supporting its successes, research on the impact of NCSSM’s educational model on achievement outcomes has not been done and may hold significant findings for strengthening the STEM pipeline. Policy makers continue to wrestle with the difficulty of defining a strategy for addressing predicted shortages in STEM fields. This research will explore NCSSM’s disruptive educational approach in order to inform policy, transform leadership, and foster greater diversity in STEM careers.

2.5 Summary

In this dissertation, the perceptions of leadership self-efficacy of NCSSM graduates from classes 2000–2007 are examined. NCSSM has produced very strong results in the performance of its graduates in STEM programs across the nation. This is particularly impactful considering the average age of STEM Ph.D. recipients is 33 years of age, and the majority of the sample population researched is younger than the national average (National Science Foundation, 2012).

As the U.S. looks to strengthen the pipeline of students prepared to pursue degrees and careers in STEM fields, there is an ever-widening achievement gap in STEM workforce needs and student matriculation rates and obtainment of STEM degrees. NCSSM is considered a pioneer as the first state supported residential high school for high achieving 11th- and 12th-grade students. The institutional pedagogical design framed by youth leadership development along with STEM preparation. NCSSM fosters self-awareness, ability, self-management, personal and professional values, ability to inspire others, drive, and persistence to complete STEM degrees. This project examines the leadership self-efficacy of NCSSM graduates from classes 2000–2007.

CHAPTER 3

Methodology

3.1 Introduction

The research investigation methodology used in this study consisted of a threefold in-depth data analysis. In the first part of the data gathering methodology the researcher conducted an initial primary investigation that used the Mind Garden LEQ to determine initial leadership efficacy research outcomes with the identified sample (2000-07 NCSSM graduates who were willing to participate and complete the LEQ research investigative instrument). Once this data was collected and tabulated, Mind Garden completed the initial data analysis using inferential and descriptive statistics (see appendix). In the second phase of the research methodology the researcher began conducting the first part of the mixed methods qualitative analysis, which was a core part of the Tri–Squared Test. This core component consisted of the creation of the qualitative Tri – Squared Test Inventive Investigative Instrument – The Mason Mind Garden LEQ Advanced Post Hoc Assessment and Inventory ™ © (created in tandem with the Tri-Squared Test founded: Dr. James E. Osler II, a member of the researchers dissertation committee). The research qualitative post hoc instrument was constructed using the mathematical conventions and axioms inherent to the Tri–Squared Test. The Construction of Letita Mason's Inventive Investigative Instrument consisted of the following Tri–Squared Trichotomous Categorical Variables (Osler, 2012) (listed for clarity). Trichotomous Categorical Variables [TCV]: a_1 = Leader Action Efficacy: (Execution) [Mind Garden LEQ Items 1–7]; a_2 = Leader Means Efficacy: (Capacity) [Mind Garden LEQ Items 8–14]; and a_3 = Leader Self-Regulation Efficacy: (Environment) [Mind Garden LEQ Items 15–22]. The research qualitative post hoc instrument appears as follows on the next page (see Figure 4).

The Mason–Osler Mind Garden LEQ Advanced Post Hoc Assessment and Inventory ™ ©					
a_1	Section 1. **Leader Action Efficacy: (Execution)** [Mind Garden LEQ Items 1–7] perceived capability to effectively execute various critical leader actions, such as motivating, coaching and inspiring followers, and getting followers to identify with the organization and its goals and vision.				
	Responses: [Select only one from the list.] ▶		High b_1	Moderate b_2	Low b_3
	a.	The Rating of Overall Mind Garden Leadership Efficacy Questionnaire for Items 1–3:	☐	☐	☐
	b.	The Rating of Overall Mind Garden Leadership Efficacy Questionnaire for Items 4–6:	☐	☐	☐
	c.	The Rating of Overall Mind Garden Leadership Efficacy Questionnaire for Item 7:	☐	☐	☐
a_2	Section 2. **Leader Means Efficacy: (Capacity)** [Mind Garden LEQ Items 8–14] Leaders' perceived capability to (a) think through complex leadership situations, interpret their followers and the context, generate novel and effective solutions to leadership problems; coupled with (b) the ability to motivate oneself to enact those solutions using effective leadership with followers.				
	Responses: [Select only one from the list.] ▶		High b_1	Moderate b_2	Low b_3
	d.	The Rating of Overall Mind Garden Leadership Efficacy Questionnaire for Items 8–10:	☐	☐	☐
	e.	The Rating of Overall Mind Garden Leadership Efficacy Questionnaire for Items 11–13:	☐	☐	☐
	f.	The Rating of Overall Mind Garden Leadership Efficacy Questionnaire for Item 14:	☐	☐	☐
a_3	Section 3. **Leader Self-Regulation Efficacy: (Environment)** [Mind Garden LEQ Items 15–22] Leaders; perceptions that they can draw upon others in their work environment (peers, senior leaders, followers) to enhance their leadership and that the organization's policies and resources can be leveraged to impact their leadership.				
	Responses: [Select only one from the list.] ▶		High b_1	Moderate b_2	Low b_3
	g.	The Rating of Overall Mind Garden Leadership Efficacy Questionnaire for Items 15–17:	☐	☐	☐
	h.	The Rating of Overall Mind Garden Leadership Efficacy Questionnaire for Items 18–20:	☐	☐	☐
	i.	The Rating of Overall Mind Garden Leadership Efficacy Questionnaire for Items 21–22:	☐	☐	☐

Figure 4. The Researcher Designed Qualitative Inventive Investigative Instrument for the Advanced Post Hoc Tri–Squared Analysis of the Mind Garden Leadership Efficacy Questionnaire.

The final phase of the researcher's data analysis methodology was grounded in the post hoc mixed methods Tri–Squared analysis. Once the researcher as an observational analyst studied and extracted the LEQ data into the series of Mason Mind Garden LEQ Advanced Post Hoc Assessment and Inventory ™ © qualitative instruments, the data was then transformed quantitatively using the Tri–Squared Test statistical procedure. The final results of the advanced post hoc Tri–Squared Test appear in Chapter 4.

The remainder of Chapter 3 covers the research design and methods used in this study which are detailed in this chapter along with an examination of the perceptions of leadership efficacy of NCSSM graduates from the class of 2000–2007. This chapter is divided into the following sections: Purpose and context; Rational for Study Design; Participants; Instrumentation; Data Collection Procedures; and the Method of Data Analysis.

A description of the research purpose and context section provides insight into the methodology used in the study. It also details the setting in which the study was conducted. The 'subjects' section describes the population and sample used in the study and provides demographic information on the subjects. The instrumentation section provides insight information on the survey instruments used; including their validity and reliability. The procedures section focuses on the process employed for gathering the data used in the survey. It also describes how the data was used in the study. A brief discussion of the methods used for analyzing the data makes up the final section of the chapter.

The multipart Mind Garden Leadership Efficacy Questionnaire was used to collect basic information about study participants (sex, age, education level) and obtain data regarding their leadership experiences, leadership self-efficacy perceptions and perceptions of others.

3.2 Purpose and Context of Study

The purpose of this research study is to collect and analyze data on perceptions of leader self and means efficacy of graduates of NCSSM from the classes of 2000–2007. A mixed methods analytical model that utilized both quantitative and qualitative measures was employed. The population consists of NCSSM graduates from the classes of 2000–2007. The research seeks to determine if graduates of NCSSM report high levels of self-confidence, efficacy, and leadership development.

3.3 Rationale for Study Design

The design used for the study is a sequential mixed methods approach that combines both a qualitative and quantitative phase. According to Creswell (2009), the particular post-hoc study design begins with a qualitative method in which the LEQ theory is tested. This phase is followed by a quantitative phase using the Post-Hoc Trichotomous-Squared test.

A pragmatic worldview opens the door to diverse methods, worldviews, and assumptions, as well as different forms of data collection and analysis (Creswell, 2009, pg.11). Rather than focusing on methods, this research emphasizes the importance of youth leadership development in increasing the pipeline of K-12 students in STEM degree programs. Creswell points out: "pragmatist researchers look to the *what* and *how* to research, based on the intended consequences—where they want to go with it" (Creswell, 2009, p. 11).

This particular design was conceived from the researcher's interest in the NCSSM state supported residential model and its impact on the rate of graduates completing STEM degrees. "What" characteristics relating to leader self-efficacy do graduates demonstrate and "how" are they demonstrated. Outcomes gained from the present research project contribute to the scholarship and body of knowledge regarding the impact of educational processes and

methodologies that inspire student interest in and pursuit of STEM degrees. This holds significance in creating policy, programming, and learning approaches that align with national objectives to drive innovative outcomes and foster emergent potentialities in human innovation and a global society.

3.4 Participants

The participants of this study are comprised of graduates of NCSSM from 2000 to 2007. The qualitative and quantitative approach was used to analyze leadership development as perceived by NCSSM graduates, from the classes of 2000–2007. Leadership efficacy is a specific form of efficacy associated with the level of confidence in the knowledge, skills, and abilities associated with leading others (Hannah et al., 2008).

According to theories on self-efficacy, one's personal degree of efficacy greatly influences the goals people choose, their aspirations, how much effort they will exert on a given task, and how long they will persist in the face of difficulties, obstacles, and disappointments. Degree of self-efficacy is also related to one's willingness or drive to meet the challenges that are required to complete degrees in STEM fields. Self-efficacy has also been correlated with whether a person experiences self-hindering or self-aiding thought patterns, how well a person responds to taxing and threatening circumstances, and how resilient a person is when faced with adversity and setbacks (Bandura, 2010).

The research questions guides the focus of this study:

1. What are the perceptions of Leadership Efficacy of 2000–2007 graduates of the North Carolina School of Science and Mathematics as captured by the LEQ?

2. How do these perceptions of Leadership Efficacy of 2000–2007 graduates of the North Carolina School of Science and Mathematics align with research on non-cognitive indicators of academic performance?

The study consists of graduates of a state supported residential high school located in Durham, North Carolina. The campus is situated on 27 acres of the 1906 Old Watts Hospital and Nursing School. There are six residence halls to accommodate the 680 enrolled juniors and seniors. The 2010–2011 NCSSM School Profile lists the following statistics:

1. Mean SAT 1361 (combined math and reading);
2. Class took 575 AP exams (57% were 5's, 96% scored 3 or better);
3. 3 of 4 AP Scholars for North Carolina over the past 2 years;
4. 12 students earned the top merit based scholarships at UNC-CH, NC State and Duke;
5. 2 of 4 winners in NASA's Conrad Spirit of Innovation Competition;
6. Semi-finalist in Siemens Competition in Math, Science and Technology;
7. Students performed 22,000 hours of community service in 2009–2010 (Profile NCSSM, 2010–2011).

Outreach at NCSSM consists of the following data:

1. Largest provider of K–12 distance education programming in the state;
2. Interactive Video Conference Courses-for-credit to more than 500 part-time students in 29 schools across North Carolina (2010–2011);
3. NCSSM Online offers 18 honors courses to more than 180 North Carolina students;
4. Academic enrichment programming to nearly 2,500 students at 45 schools across North Carolina (2010–2011); and
5. Professional development to more than 4,000 North Carolina educators since 1992.

3.5 Instrumentation

This study consists of both a qualitative and quantitative research approach. The initial phase employs the Mind Garden Leadership Efficacy Questionnaire (LEQ), with copyright permission granted to the researcher, to survey the perceptions of participants. Mind Garden provides researchers with survey instruments, as well as Web based collection of multi-rater data. The second phase of this research project consists of a post-hoc analysis of the survey data, using the Trichotomy-Squared Statistical model created and developed by James E. Osler of North Carolina Central University.

3.6 Reliability and Validity

Validation of the LEQ has been conferred across seven diverse samples. It has demonstrated predictive qualities in important outcomes such as ratings of leader performance, enhanced motivation to lead others, and highly effective leadership styles; including transformational leadership style. The LEQ model has demonstrated that leader self and means efficacy can be developed through mentoring programs and targeted leader development programs. No other leader efficacy measure has been validated across the full range of convergent, discriminant, and predictive validity tests required for proper validation (Hannah & Avolio, 2013).

"Research, development and practical applications in the 25 years since Burn's (1978) significant publication on transforming leaders, has shown that transformational leadership generally generates greater follower effectiveness and satisfaction than does transactional leadership" (Avolio & Bass, 2004, p. 36). The Multifactor Leadership Questionnaire, from which the LEQ is derived, has been used in approximately 300 research programs, doctoral dissertations and masters' theses globally between 1995 and 2004. Copyright has been granted

for the present research study, which will become a part of Mind Garden meta-analysis process providing additional validation of the instrument.

To further validate the Mind Garden Leadership Efficacy Questionnaire, a Post Hoc was conducted using the Tri-Squared test. "The basis for Tri-Squared is similar to the Meta-Cognitive Analysis of Shell and Marsh that was designed to replace Meta-Analysis as a more effective means of analyzing data in the social and behavioral sciences" (Osler, 2012, p. 25). Tri-Squared is a universally applicable in-depth investigative procedure. It is considered innovative because it allows researchers to validate qualitative methods by transforming data into measureable quantitative outcomes. It brings both the quantitative and qualitative together seamlessly and unifies the data analysis methodology. The reporting procedures align specifically with initial research questions, hypothesis, and variables. According to Osler (2012), Tri-Squared is designed to empower 21st Century researchers who are seeking statistical tools that validate their research.

3.7 Procedures

In Phase I of the study, email data is mined from the NCSSM alumni database. A letter of introduction from institutional alumni affairs was forwarded to the cohort on the researcher's behalf. Participants have four weeks to submit their responses. Response rates and completion rates are monitored on a daily basis. This is the qualitative stage of the mixed-methods methodology.

The survey is switched to "inactive" to prevent additional participant responses. Acquired data were analyzed via in inferential statistical method conducted by Mind Garden. Data downloads are grouped based on the three LEQ conceptual categories. These are Leadership Action, Leadership Means and Leadership Self-Regulation Efficacy. Phase II, is a post-hoc

analysis of the LEQ survey outcomes using the Tri-Squared Test (Osler, 2013). This is the quantitative stage of the mixed-methods approach to this research project.

3.7.1 Qualitative phase. The qualitative phase of this research project includes the distribution of the LEQ to graduates of NCSSM via the Web. The LEQ takes approximately 10 minutes to complete. Empirical research on the LEQ shows that leadership efficacy is comprised of three components (two self-efficacy and one means-efficacy; Hannah & Avolio, 2004).

1. **Leadership Action Self-Efficacy—**examines leaders' perceived capability to effectively execute various critical leader actions. These actions include motivating, coaching and inspiring others. It also addresses leaders' ability to get followers to identify with the organizations goals and vision.
2. **Leader Self-Regulation Efficacy—**analyzes leaders' perceived capability to link though complex leadership situations, interpret their followers and the context, and generate novel and effective solutions to leadership problems, coupled with the ability to motivate oneself to enact those solutions using effective leadership with followers.
3. **Leader Means Efficacy—**looks at leaders' perceptions that they can draw upon others in their work environment (peers, senior leaders, followers) to enhance their leadership and that the organization's policies and resources can be leveraged to impact their leadership.

Leader Self and Means Efficacy, as captured in the LEQ, can be defined as "Leaders' belief in their perceived capabilities to organize the psychological capabilities, motivation, mean, collective resources, and courses of action required to attain effective, sustainable performance across their leadership roles, demands, and contexts" (Hannah & Avolio, 2004, p. 1).

3.7.2 Post-hoc quantitative mixed methods phase. Trichotomy-Squared Test is a comprehensive statistical test specifically developed for the field of Education Science, or Eduscience. Eduscience is a broad field and its professionals are directly involved in the field. The primary positions in the learning environment that the Eduscientist assume are in the following areas: Administration (which includes Leaders, Organizational Heads, and Organizational Management Professionals), Instruction (which includes Teachers, Professors, and Facilitators), Practice (which includes Practitioners in a variety of Specified Areas and Arenas), and Technology (which includes Educational Technologists, Instructional Technologists, and Information Technologists; Osler, 2012). Several NCSSM institutional documents were reviewed to support the use of Tri-Squared approach. These include:

1. Mission statement,
2. Strategic plan,
3. Enrollment trends, and
4. NCSSM Graduation Data Classes of 2000–2007.

Tri-Squared is defined as the "Total Transformative Trichotomous-Squared Test." It involves the development of trichotomous categorical variables, which have their basis in associated trichotomous outcome variables. The research model is paired with an instrument that is psychometrically delivered as a test, qualitatively delivered in the form or a research questionnaire metric via an assessment rubric. As long as the trichotomous categorical variables are measured according to the established associated trichotomous outcome variables then the research has merit within the strict confines and rigorous requirements of the Tri-squared Test (Osler, 2012).

"Tri-Squared statistic transforms qualitative data into quantitative data and then measures the difference between the two to determine the validity of the initial research hypothesis" (Osler, 2012, p. 25). According to Osler (2012), the inventive investigate instrument offers the researcher diverse options for application. The instrument can take the psychometric format of a test and the qualitative format of research questionnaire, the anonymous format of a survey. The format also includes being "given as in-depth questions during an interview or evaluated as a comprehensive metric via an assessment rubric" (Osler, 2012).

3.8 Method of Data Analysis

The quantitative phase of this research project includes the distribution of the LEQ to graduates of NCSSM via the Web. The LEQ takes approximately 10 minutes to complete. Copyright protections and limited disclosure restrictions, only permit LEQ survey responses and data analysis to be conducted by the Mind Garden Company. Data results were made available for download, from the Mind Garden Company's secured data warehousing network, to the researcher.

Extraction of the data was accomplished using a descriptive inferential statistical method. The data remains securely housed with Mind Garden and provides additional research validating the LEQ instrument. The researcher summarized the findings from the data analysis provided by Mind Garden. A Tri-Squared post-hoc analysis was also conducted, additionally validating the LEQ outcomes, and the survey instrument.

The quantitative phase of this research project involves the use of the Tri-Squared test, which is also defined as the "Total Transformative Trichotomous-Squared Test." It involves the development of trichotomous categorical variables, which have their basis in associated trichotomous outcome variables. The research model is paired with an instrument that is

psychometrically delivered as a test, qualitatively delivered in the form or a research questionnaire metric via an assessment rubric. As long as the trichotomous categorical variables are measured according to the established associated trichotomous outcome variables then the research has merit within the strict confines and rigorous requirements of the Tri-squared Test (Osler, 2012).

The Tri-Squared test is regarded for precision of fit and what is known in the field of statistics as parsimony, or simplicity. The value of the Tri-Squared test is its ability to transform qualitative data into quantitative outcomes.

3.9 Summary

Chapter 3 established the research methodology for capturing the perceptions of leadership self and means efficacy of NCSSM graduates from the classes of 2000–2007. Perceptions of participants were captured through the Leadership Efficacy Questionnaire. It also provides insight into employing Tri-Squared test to quantify qualitative inferential data outcomes. Results and findings yield benefits to leaders in education and public policy, as well as public, private and non-for-profit organization focused on STEM preparation and strengthening the STEM pipeline.

CHAPTER 4

Analysis

4.1 Introduction

This chapter provides insight into research findings from both the Mind Garden quantitative data collection and the post hoc Trichotomous–Squared Test. The sample population consists of NCSSM graduates from the classes of 2000–2007. Of the 189 respondents, 68 completed LEQs. Due to copyright restrictions, the LEQ will not be disclosed in its entirety for this research project. As per copyright regulations concerning the use of the instrument, only one item per construct will be presented along with a discussion of item outcomes. A copy of the analyzed data set is provided in the appendix. To honor copyright agreements, the LEQ survey instrument is not presented in this publication,

4.2 Quantitative Research Questions

The research questions for the study were as follows:

1. What is the leadership efficacy of 2000–2007 graduates of the North Carolina School of Science and Mathematics as captured by the Mind Garden Leadership Efficacy Questionnaire?
2. How do their perceptions of leadership efficacy as captured by the Mind Garden Leadership Efficacy Questionnaire, align with research on non-cognitive indicators of academic performance?

4.3 Research Hypothesis Test Results

The mathematical formula for the Tri-Squared is reported illustrating the final outcome of the research hypothesis test: the null hypothesis (H_0) is rejected at $p > 0.05$ is 9.488. Thus, the Post Hoc research Null Hypothesis is overwhelmingly rejected:

H_0: [rejected after The post hoc Tri–Squared Test data analysis] (mathematically represented previously as **H_0: $Tri^2 = 0$**) There are significant differences in the perception of the Leadership Efficacy by the North Carolina School of Science and Mathematics Alumni for the classes 2000–07 in terms of their overall "Leadership Efficacy" in terms of Execution or "Leader Action Efficacy"; Capacity or "Leader Means Efficacy"; and Environment or "Leader Self-Regulation Efficacy." Thereby accepting the following alternative or initial research hypothesis:

H_1: [accepted after The post hoc Tri–Squared Test data analysis] (mathematically represented previously as **H_1: $Tri^2 \neq 0$**) There are no significant differences in the perception of the Leadership Efficacy by the North Carolina School of Science and Mathematics Alumni for the classes 2000–07 in terms of their overall "Leadership Efficacy" in terms of Execution or "Leader Action Efficacy"; Capacity or "Leader Means Efficacy"; and Environment or "Leader Self-Regulation Efficacy."

The aforementioned Post Hoc Research Hypotheses yield the following mathematical hypotheses using the Tri-Squared Test as the Post Hoc data analysis procedure:

4.4 Qualitative Mind Garden LEQ

The initial research question asked the following: What are the perceptions of leadership efficacy of NCSSM graduates from 2000–2007? Response from the data analysis yielded the following outcome: The Mind Garden Leadership Efficacy Questionnaire data positively supported the unit of analysis: NCSSM (in terms of leadership efficacy). In this particular instance, NCSSM STEM educational outcomes from graduates aligned with research on non-cognitive indicators of academic performance in terms of moderate leadership efficacy. A sample of the complete Mind Garden data set analyzed using descriptive and inferential statistics

is included in the appendix. (Important note: The complete LEQ instrument in its entirety will not be shared in this document due to Mind Garden intellectual property rights).

4.4.1 Qualitative research questions 1 and 2. Results of the Mind Garden LEQ indicate perceptions of leadership efficacy of NCSSM graduates 2000-07 fall strongly into the moderate range (see Table 9, Tri–Squared Standard 3 by 3 Table, Trichotomous Outcome Variable: $\boldsymbol{b_2}$, across complete row). Outcomes from the post hoc analysis completely align with research on the non-cognitive variables as predictors of leadership efficacy, in terms of the unit of analysis leadership development ("Moderate" as indicated by Trichotomous Outcome Variable: $\boldsymbol{b_2}$).

4.4.2 Qualitative outcomes as tabular data. Demographic Data Outcomes.

Table 1 displays the demographic data of respondents by gender. Table 1 offers an analysis of sample respondents by gender of which 29 or 43% were male and 39 or 57% were female. NCSSM's student enrollment is 51% male and 49% female, NCSSM Course Catalogue, 2012). Table 2 follows and illustrates demographic data in terms of frequency and percentage of participant's age.

Table 1

LEQ Sample Respondents by Gender

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Male	29	42.6	29	42.6
Female	39	57.4	68	100.0

Table 2 is an analysis of the age frequency of LEQ respondents with the youngest being 24 years of age and the oldest 32 years of age. Comparing the age of the respondents to level of education provides further insight into the motivation, drive and sense of leader self-efficacy of

NCSSM alumni from the classes of 2000-2007. The evidence suggests that NCSSM graduates exhibit academic tenacity or grit. Their outcomes suggest NCSSM have a growth mindset, which allows them to become lifelong learners. Table 3 follows and presents descriptive statistical data in terms of frequencies and percentages on research respondent's level of degree attainment.

Table 2

LEQ Sample Respondents Age Frequency

Leader Efficacy Questionnaire				
Your age in years	Frequency	Percent	Cumulative Frequency	Cumulative Percent
24	1	1.5	1	1.5
25	6	8.8	7	10.3
26	8	11.8	15	22.1
27	6	8.8	21	30.9
28	6	8.8	27	39.7
29	10	14.7	37	54.4
30	10	14.7	47	69.1
31	11	16.2	58	85.3
32	10	14.7	68	100.0

Table 3 disaggregates the data of participant's level of educational attainment. Further analysis of sample population demographics can be found later in this chapter. The section that follows scores the LEQ instrument in the following fashion: The responses to survey items are scored and the domain of leadership efficacy assessed by each question. The LEQ is scaled for scores points of 0–33 for "*Not at all Confident*," 34–67 for "*Moderately Confident*," and 68–100 for "*Totally Confident*." Respondents are prompted with "As a Leader I can . . ." (Hannah & Avolio, 2013). They then assign a score from 0–100 to items 1–22 based on their level of

confidence in the area assessed. Table 4 follows and begins the descriptive data analysis of the LEQ Leadership efficacy criterion areas (Items 1-7).

Table 3

Sample Respondents Level of Degree Attainment

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
.	1	1.5	1	1.5
Some college	1	1.5	2	2.9
A Bachelor's degree	24	35.3	26	38.2
A Master's degree	24	35.3	50	73.5
A professional degree (e.g., DDS, JD, MD etc.)	10	14.7	60	88.2
A Doctorate (e.g., Ph.D.)	8	11.8	68	100.0

Table 4

Leader Action Efficacy/LAE/Execution

Item #	% Totally Confident	% Moderately Confident	% Not at all Confident
#1	5	56	
#2	4	56	
#3	12	48	
#4	5	58	
#5	3	52	
#6	15	48	
#7	5	54	

Table 4 shows Leader Action Efficacy/LAE/Execution (Items #1–7) is defined as leaders' perceived capability to effectively execute various critical leader actions, such as motivating, coaching, and inspiring followers, and getting followers to identify with the

organization and its goals and vision (Hannah & Avolio, 2013). See Table 4. Item #5: Get my followers to meet the requirements we have set for their work? Of respondents, 9.1% rated themselves *Totally Confident*, 76.5% rated themselves *Moderately Confident*, while 44% saw themselves as *Not at all Confident*. Table 5 follows and highlights Leader Means Efficacy/LME/Capability.

Table 5 displays Leader Means Efficacy/LME/Capability (Items #8–14) is defined as leaders' perceived capability to (a) think through complex leadership situations, interpret their followers and the context, and generate novel and effective solutions to leadership problems, coupled with (b) the ability to motivate oneself to enact those solutions using effective leadership with followers (Hannah & Avolio, 2013).

Table 5

Leader Means Efficacy/LME/Capability

Item #	% Totally Confident	% Moderately Confident	% Not at all Confident
#8	17	43	8
#9	9	44	15
#10	5	51	12
#11	17	49	2
#12	9	50	9
#13	4	42	22
#14	22	45	1

Item #14: Rely on my leaders to come up with ways to stimulate my creativity? Received the lowest number of *Totally Confident* responses at 1.5 percent. The sample rated themselves 66.2% *Moderately Confident* and 32.4% *Not at all Confident*, for the same question.

Table 6 illustrates Leader Self-Regulation Efficacy/LSRE/Environment (Items #15–22), is defined as leaders' perceptions that they can draw upon others in their work environments (peers, senior leaders, followers) to enhance their leadership and that the organization's policies and resources can be leveraged to impact their leadership (Hannah & Avolio, 2013). See Table 6, Item #20: Strive to accomplish the targeted goals of my superiors? The sample communicates that at 45.6% of the sample are *Totally Confident* in their demonstration of this trait. Additionally 52.9% are *Moderately Confident*, while 1.5% responded *Not at all Confident.*

Table 6

Leader Self-Regulation Efficacy/LSRE/Environment

Item #	% Totally Confident	% Moderately Confident	% Not at all Confident
#15	10.3	72.1	17.6
#16	30.9	64.7	4.4
#17	38.2	57.4	4.4
#18	29.4	66.2	4.4
#19	39.7	52.9	7.4
#20	45.6	52.9	1.5
#21	27.9	61.8	10.3
#22	27.9	70.6	1.5

Across the three constructs, LSRE demonstrated the highest scores for *Totally Confident.* Percentage points for Items #15–22 are disaggregated in Table 3. With the exception of Item #15 which posted 10.3% of respondents, the sample responded with cumulative ratings for *Totally Confident* at 27.9% and higher. The domain for the LSRE/Environment construct proves to be the area of greatest confidence for NCSSM graduates.

The construct that received the highest score as a result of the Tri-Squared Test, was window $\boldsymbol{a_3b_1}$, with 253 total points. This is the maximum level of confidence expressed by alumni and it relates to self-perceived notions of leadership efficacy expressed by drawing upon others in their work environments (peers, senior leaders, followers) to enhance their leadership and that the organization's policies and resources can be leveraged to impact their leadership (Hannah & Avolio, 2013). Table 7 follows and breaks down respondent's responses to items regarding Education by Gender.

Table 7

Education by Gender

Degree	Female	Male	Total
No Degree	0	1	1
Some College	0	1	1
Bachelor Degree	9	15	24
Master Degree	7	17	24
Professional Degree (e.g., DDS, JD, MC)	8	2	10
Doctorate Degree (e.g., Ph.D., Ed.D.)	5	3	8
Total	39	29	68

Table 7 shows the sample (n = 68) that is broken down by gender, race, and level of educational attainment. Along with the LEQ 22 survey questions, the sample also responded to the following demographic questions:

1. Gender;
2. Age in years;
3. Highest level of education that you have completed;

4. Number of years employed following completion of High School;
5. Number of years of experience at current job;
6. What country or region were you born in;
7. What is the primary cultural background with which you most closely identify;
8. Total years of experience in leadership positions (years, months);
9. Number of employees you currently supervise
10. Largest number of employees that you have ever supervised at any one point in time;
11. Besides the courses in your high school and college education, how many total days have you spent in leadership training courses?

Sample responses to these questions provide additional insight into factors that may impact the perceptions of leadership self-efficacy by NCSSM alumni. It is important to note that alumni graduating in the class of 2007 may have currently completed or still be in the process of completing graduate degrees. National Center for Education Statistics (2013) reports 59% of first-time, full-time students who began seeking a bachelor's degree at a four-year institution in fall of 2006 completed the degree at that institution in six years and matriculating into graduate programs as opposed to work. Limited employment due to the downturn of global and national economic conditions during in the last decade may also play a factor.

Amongst the sample's 68 respondent findings, one indicated they did not attend college, while there was only one respondent who only had "some college." The number of NCSSM alumni completing advanced degrees is significant. Twenty-four of alumni completed Bachelor's degrees. An equal number of 24 respondents also completed a Master's degree, while 18 completed professional or doctorate degrees (see Table 7).

The data show that NCSSM female, alumni (alumnae) correlates strongly with the attainment of advanced degrees. NCSSM enrolls 49% female and 51% male students. The application pool consistently sees a higher number of female applicants for enrollment, despite there being slightly less bed space to accommodate them residentially. NCSSM touts that it is "undefeated in football since 1980" (www.ncssm.edu). The school does not offer the sports of football, field hockey, or lacrosse, which may impact the number of males that apply to the residential program. Table 8 follows and presents Educational Level by Race (as defined by the LEQ).

Table 8

Educational Level by Race

	Race			
Education Level	Asian or Pacific Islander	African American	Caucasian	Other
No Degree	0	0	1	0
Some College	0	0	1	0
Bachelors	0	1	21	1
Masters	2	2	20	0
Professional	0	1	8	1
Doctorate	1	2	5	0

Table 8 highlights Research outcomes in the areas of race and degree level also present interesting outcomes (see Table 8). The sample indicates one white student with *No Degree*, and one Asia/Pacific Islander as having *Some College*. Of those indicating receipt of a *Bachelor* degree, there were 23; one African American, 21 Caucasian, and one other. The number of sample alumni that persisted toward the completion of a *Master* degree, was 22; two Asian/Pacific Islander, two African American, and 20 Caucasian.

Alumni obtained 10 *Professional* degrees; eight of which were Caucasian, one African American, and one "other." Of the eight *Doctorate* degrees conferred to NCSSM alumni, one was Asian/Pacific Islander, two were African American and five were white. Based on a recent institutional study of NCSSM graduates from the classes of 2000–2007, the number of alumni completing STEM degrees is 53% compared to the national average of 48% of bachelor's degree students and 69% of associate's degree students who entered STEM fields between 2003 and 2009 had left these fields by spring of 2009. Roughly one-half of these leavers switched their majors to a non-STEM field, and the rest of them left STEM fields by exciting college before earning a degree or certificate (National Center for Education Statistics, 2013).

High ratings of a_1b_2 align with alumni self-perceptions of Leader Action Efficacy (Execution) at a moderate level. Hannah et al. (2012) adds the self-regulatory dimension of Leader Self and Means Efficacy (LSME) reflects leaders' belief regarding their ability to self-motivate, the action dimension reflects their beliefs in their capability to behave in ways that in turn motivate others to act. The conceptualizing of action LSME includes beliefs leaders hold about their capacity to direct and inspire, coach, administer rewards, and otherwise gain follower commitment and enhance follower performance (Hannah et al., 2012).

LEQ data for "number of years of experience at current job" demonstrates that 82% of respondents have 0–5 years of experience. Participants provided a context through which to view their experience of leadership action efficacy in the work environment. A strong majority of 78% responded to the "number of employees you currently supervise" in the 0-5 people range. Alumni perceptions of characteristics outlined by Hannah et al. (2012)—which include leaders beliefs they can direct and inspire, coach, administer rewards, and otherwise gain follower commitment and enhance follower performance—are moderate.

4.5 Qualitative Post Hoc Tri-Squared Test Research Hypotheses

The following were the Post Hoc data analysis research hypotheses for the study resulted in the rejection of the Null Hypothesis: ($\mathbf{H_0}$) (thereby accepting the researcher's initial [Alternative] hypothesis: ($\mathbf{H_1}$). The advanced in-depth post hoc tri–squared two-tailed mathematical hypotheses as they were used to determine the validity, reliability, and objectivity of the LEQ were: Rejected = $\mathbf{H_0: Tri^2 = 0}$; and Accepted = $\mathbf{H_1: Tri^2 \neq 0}$.

4.6 LEQ Data Analysis Conducted by Mind Garden

Critical to the discussion of leadership efficacy, is creating an understanding of the importance of its duality. Leadership Efficacy frames personal self-efficacy as merely one-half of the equation. It also focuses on the importance of leaders generating confidence "that their context will support their performance as a leaders" (Hannah & Avolio, 2013). The LEQ captures both means efficacy and self-efficacy, as research demonstrates they operate jointly. Research also supports the premise that efficacy is not only important in driving leader effectiveness, it also influences which experiences and challenges one pursues (Bandura, 2010).

Fredrickson (2001) theorizes that psychological resources such as self-efficacy have been shown to promote flourishing, positive affectively, and a broadened perspective on possible thought and behavior choices during times of change and stress. Empirical research on the LEQ shows that leader efficacy is comprised of three components (two self-efficacy and one means efficacy) and there is a scale in the LEQ for each (Fredrickson, 2001). The three components are defined as follows:

1. Leader Action Efficacy: (Execution) Leaders' perceived capability to effectively execute various critical leader actions, such as motivating, coaching and inspiring

followers, and getting followers to identify with the organization and its goals and vision.

2. Leader Means Efficacy: (Capacity) Leaders' perceived capability to (a) think through complex leadership situations, interpret their followers and the context, generate novel and effective solutions to leadership problems; coupled with (b) the ability to motivate oneself to enact those solutions using effective leadership with followers.
3. Leader Self-Regulation Efficacy: (Environment) Leaders; perceptions that they can draw upon others in their work environment (peers, senior leaders, followers) to enhance their leadership and that the organization's policies and resources can be leveraged to impact their leadership. (Hannah & Avolio, 2013)

4.7 LEQ Post Hoc Tri-Squared Test Results

The 3 × 3 Tri-Squared table reports the qualitative outcomes based on the Mind Garden Leadership Efficacy Questionnaire Trichotomous Categorical Variables according to participant responses as the Trichotomous Outcome Variables. Table 6 shows that participants primarily and overwhelmingly selected the "Moderate" Outcome Variable ($\boldsymbol{a_1b_2}$ = 372, $\boldsymbol{a_2b_2}$ = 324, and $\boldsymbol{a_3b_3}$ = 339) rather than the alternative Trichotomous Outcome Variables of either "Maximum" or "Minimum." This overwhelmingly indicates that the vast majority of the respondents (n_{Tri} = 68) as a whole viewed their overall "Leadership Efficacy" in terms of [Execution or Leader Action Efficacy]; [Capacity or Leader Means Efficacy]; and [Environment or Leader Self-Regulation Efficacy] from a "middle of the road" or average perspective.

The mathematical formula for the Tri-Squared is reported illustrating the final outcome of the research hypothesis test: the null hypothesis (H_0) is rejected at $p > 0.05$ is 9.488. Thus, the Post Hoc research Null Hypothesis is overwhelmingly rejected:

H_0: There are significant differences in the perception of the Leadership Efficacy by the North Carolina School of Science and Mathematics Alumni for the classes 2000–2007 based upon the experiences of NCSSM's integrated leadership curriculum in terms of their overall "Leadership Efficacy" in terms of: Execution or "Leader Action Efficacy"; Capacity or "Leader Means Efficacy"; and Environment or "Leader Self-Regulation Efficacy."

Table 9 follows and describes the outcomes of the post hoc Tri–Squared Test.

Table 9

Post Hoc Qualitative Outcomes of the Tri-Squared Test for the Mind Garden Leadership Efficacy Questionnaire

Post Hoc Data Analyzed Using the Trichotomous-Squared Test Three by Three Table designed to analyze the research questions from the Mind Garden Leadership Efficacy Questionnaire with the following Trichotomous Categorical Variables: $\boldsymbol{a_1}$ = Execution: Leader Action Efficacy; $\boldsymbol{a_2}$ = Capacity: Leader Means Efficacy; and $\boldsymbol{a_3}$ = Environment: Leader Self-Regulation Efficacy. The 3 × 3 Table has the following Trichotomous Outcome Variables: $\boldsymbol{b_1}$ = Maximum (Scores: 68–100 = A High Level of Confidence); $\boldsymbol{b_2}$ = Moderate (Scores = 34–67 = A Medium Level of Confidence); and $\boldsymbol{b_3}$ = Minimum (Scores = 0–33 = A Low Level of Confidence). The Inputted Qualitative Outcomes are reported as follows:

$n_{Tri} = 68$

$\alpha = 0.05$

TRICHOTOMOUS OUTCOME VARIABLES	TRICHOTOMOUS CATEGORICAL VARIABLES		
	$\boldsymbol{a_1}$	$\boldsymbol{a_2}$	$\boldsymbol{a_3}$
$\boldsymbol{b_1}$	55	69	253
$\boldsymbol{b_2}$	372	324	339
$\boldsymbol{b_3}$	49	33	35

$$\boldsymbol{Tri}^2 \; d.f. = [C - 1][R - 1] = [3 - 1][3 - 1] = 4 = \boldsymbol{Tri}^2_{[\bar{x}]}$$

The Alternative Hypothesis is accepted:

H_1: There are no significant differences in the perception of the Leadership Efficacy by the North Carolina School of Science and Mathematics Alumni for the classes 2000–2007 based upon the experience of NCSSM's integrated leadership curriculum in terms of their overall "Leadership Efficacy" in terms of: Execution or "Leader Action Efficacy"; Capacity or "Leader Means Efficacy"; and Environment or "Leader Self-Regulation Efficacy."

Many researchers point to the development of leadership skill sets such as self-awareness, the ability to work and use self-management strategies, awareness of the importance of working from personal and professional values, and the ability to deal with and inspire others to achieve group goals as also being necessary to the development of drive and persistence to complete STEM degrees (Ingold, 2014).

4.8 Summary

This chapter identified the findings for each of the two research questions. The survey population included a total of 68 participants comprised of NCSSM graduates 2000-2007. Of the 68 Mind Garden LEG responders, 57% were female and 43% were male. All participants fell between the ages of 24-23 years of age. At 16%, the largest group of responders indicated that they were 31 years of age, while 2% indicated they were 24 years of age placing 28 years as the mean age of the sample. Racial composition of participants was 82.4% Caucasian, 8.8% African American, 4.4% Asian or Pacific Islander, and 1.5% other.

The results of the data for Research Questions 1 reveal that NCSSM graduates 2000-2007 demonstrate a moderate level of leadership efficacy at a rate of 76.1% in the domain of leader action efficacy, 73.6% in the domain of leader action efficacy, and 83.4% in leader self-regulation efficacy. Research Question 2 revealed that levels of leadership efficacy of the

sample and their attainment of STEM degrees align with research on non-cognitive variables as indicators of future academic performance.

The LEQ post hoc Tri-Squared test determined that the alternative hypothesis: the null hypothesis (H_0) is rejected at $p > 0.05$ is 9.488. **H_1:** There are no significant differences in the perception of the Leadership Efficacy by the North Carolina School of Science and Mathematics Alumni for the classes 2000–2007 based upon the experience of NCSSM's integrated leadership curriculum in terms of their overall "Leadership Efficacy" in terms of: Execution or "Leader Action Efficacy"; Capacity or "Leader Means Efficacy"; and Environment or "Leader Self-Regulation Efficacy," was accepted. Trichotomous Outcome Variables overwhelmingly selected "Moderate" in the domains of execution (means)/a_1b_2 = 372, capacity (action)/a_2b_2 = 324, and environment (self-regulation)/a_3b_3 = 339.

CHAPTER 5

Discussion and Further Research

5.1 Discussion

This study was designed to address a gap in literature regarding the relationship between the non-cognitive variables acquired through youth leadership development and attainment of STEM degrees. The results of this study are intended to advise, inform, and strengthen the K–12 pipeline of students prepared for STEM careers. Fredrickson (2001) theorizes that psychological resources such as self-efficacy have been shown to promote a flourishing and broadened perspective on possible thought and behavior choices during times of change and stress. Having the opportunity to navigate many of those challenges through enrollment in an academically demanding residential program two years prior to college facilitates student leadership self-efficacy.

Life skills associated with the three constructs of leader self-efficacy include critical thinking, problem solving, intrinsic motivation, risk-taking and self-awareness. According to Bloom's Taxonomy, there are six different levels of cognitive domain of factual and conceptual knowledge progressing from elementary to complex (Apple & Krumsieg, 2001). According to Apple and Krumsieg (2001), Anderson and Krathwohl (2001) expanded the single dimension of the original taxonomy into a two-dimensional framework consisting of both factual/conceptual knowledge and cognitive process. High quality educational objectives employ both.

NCSSM educational methodology fosters the development of capacities that encourage thinking skills at levels three through levels five. Graduates are able to apply, construct, analyze, dissect, model relationships, connect functions, theorize, hypothesize and create an original work

(Apple & Krumsieg, 2001). The report *Postsecondary Outcomes for NCSSM Graduates 2000–2007* (NCSSM, 2013) places the rate of completion of STEM bachelor's degrees at 54% overall.

NCSSM underrepresented minority graduates demonstrate a 45% completion rate of undergraduate STEM degrees. The *Bayer Facts of Science Education XIV: Female and Minority Chemists and Chemical Engineers Speak about Diversity and Underrepresentation in STEM* (2010) is a public opinion research project commissioned by Bayer Corporation which examine the dual issues of diversity and underrepresentation in STEM. In this study, more than three-quarters (77%) of those polled say significant numbers of women and underrepresented minorities are missing from the U.S. STEM workforce today because they were not identified, encouraged or nurtured to pursue STEM studies early on (Bayer, 2010).

5.2 Implications

From a policy perspective, the NCSSM residential program is meeting its mission helping to strengthen the pipeline of students prepared for study in STEM programs in universities across the world. On a global basis, students in China earned about 23%, those in the European Union earned about 19%, and those in the U.S. earned about 10% of science and engineering degrees (www.nsf.gov/statistics/seind12/pdf/c02.pdf). Research into the high rate of graduates obtaining STEM degrees across all state funded residential programs in the US holds implications for expansion of this successful educational model.

From a practical perspective, the future of state funded residential programs requires broadening and expanding funding resources for growth and sustainability. Thirty-five years ago when NCSSM opened its doors, it was the only program focused on STEM preparation of high school students. As a disruptive model, NCSSM predates the comprehensive school reform movement of the early 1990s and has inspired development of STEM magnet, charter,

independent, private, and early-college programs. As a practice, NCSSM admits students that demonstrate leadership skills and are engaged in service to the community. Such criteria is purposeful in assessing students for enrollment as if provides insight into the applicant's sense of entitlement or service. Response outcomes show that NCSSM alumni perceptions of leadership self and means efficacy demonstrate a high level of humility based on survey data.

From the perspective of youth leadership development, this research holds implications for informing best practices for nurturing leadership efficacy amongst students in public secondary education in preparation for STEM degrees. Investigations into youth leadership development demonstrate the importance of leadership skills learned during adolescence in the areas of critical thinking, problem solving, and reflection, as critical to fitting youth for successful employment; particularly in Science, Technology, Engineering and Mathematics (STEM; Cano, 1993; Celuch & Slama, 1999; Densten & Gray, 2001; Gréhaigne, Godbout, & Bouthier, 2001; Myers & Dyer, 2006). Initiatives for future STEM education in public schools should be focused on environments that foster decreased external competitiveness between students by fostering a growth mindset that embraces a sense of internal competitiveness or drive to become one's best self. NCSSM's approach eliminates class rank as a measure that creates academic isolation, arrogance and avidity. Humility, generosity and philanthropy characterize NCSSM graduates.

Academic tenacity is defined as the non-cognitive factors that promote long-term learning and achievement (Dweck et al., 2014). A Stanford University research study was conducted which included ethnically and economically diverse students. The research outcomes demonstrate that individual student perceptions of intelligence as being a fixed quality, is central to the development of resilience. "Students may view intelligence as a fixed quantity that they

either possess or do not possess (a fixed mindset) or as a malleable quality that can be increased with effort and learning (a growth mindset)" (Dweck et al., 2014, p. 5).

5.3 Mason Leadership Efficacy Model (MLEM)

How do these perceptions of leadership efficacy as captured by the Mind Garden LEQ, align with research on non-cognitive indicators of academic performance? Results from the current research have yielded rich insights into the perceptions of leadership efficacy of NCSSM graduates. Figure 5 offers a graphic representation of the research methodology developed by the researcher. NCSSM alumni from 2000-2007 demonstrate moderate levels of leadership efficacy with a mean score of 76% in the domain of leader means efficacy; 74% in the domain of leader action efficacy; and 83% self-regulation efficacy. Based on the MLEM, these outcomes suggests that NCSSM graduates 2000–2007 possess a refreshing degree of humility in light of their academic and career attainments. Anecdotally, alums speak of the sense of responsibility to honor the investment by their local and statewide community to fund a state supported residential high school education. The cultivation of a spirit of servant leadership through work service and community service requirements or meeting the demands of learning to live independently like having to manage time, cleaning, and maintaining their residence halls.

Figure 4 presents the Mason Leadership Efficacy Model (MLEM) as an innovative outcome of this scholarly undertaking. The model provides a useful approach to assessing leadership efficacy of students in STEM educational programs. MLEM can be employed by various organizational entities to assess the self-efficacy of leaders, administrators, workers as well as students. For the purpose of this study, the target population is identified as "graduate" in the model.

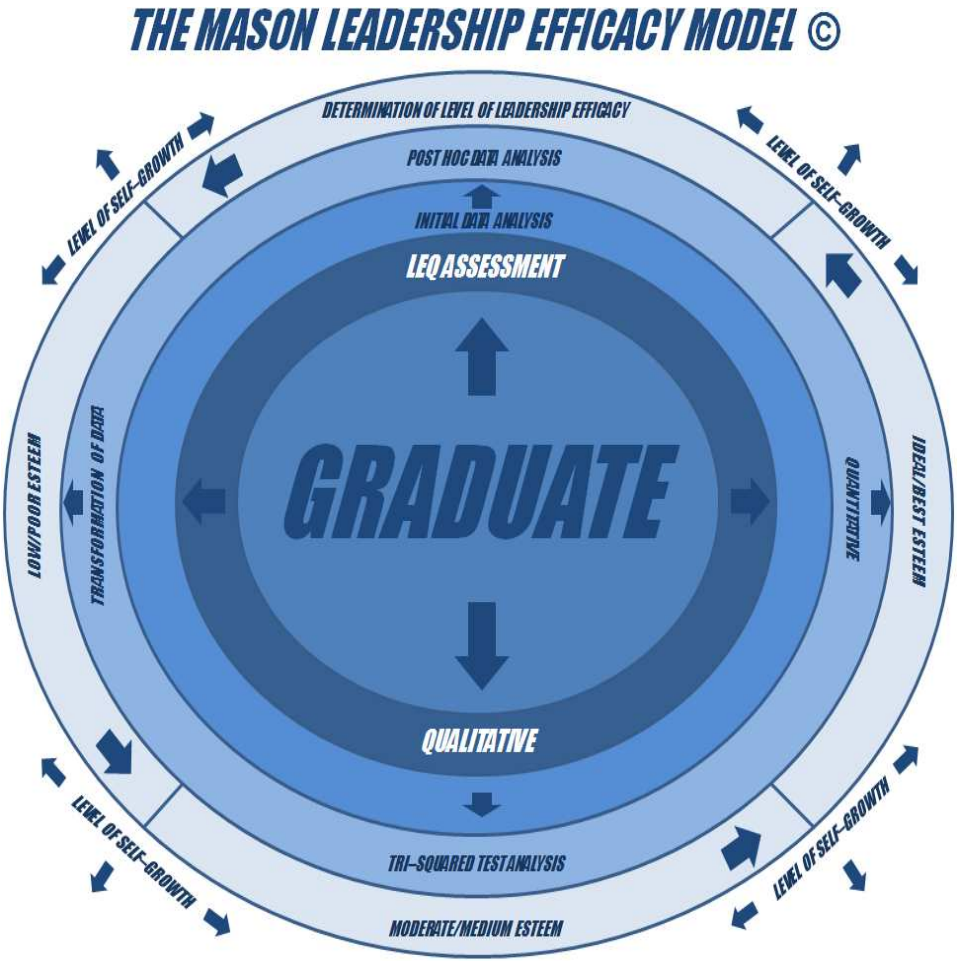


Figure 5. The Mason Leadership Efficacy Model.

The first perimeter or the center of the model defines the research population targeted for analysis. For the present study, *graduate* represents 2000–2007 graduates of NCSSM. The second perimeter represents the qualitative stage of the model where participants completed the Mind Garden Leadership Efficacy Questionnaire. In the third perimeter, the initial analysis of data is conducted providing descriptive outcomes using an inferential statistical method. Perimeter four is the post hoc stage of the process where qualitative data is transformed into quantitative data using the Tri-Squared test. The fifth or final perimeter captures level of leadership efficacy of participants. Chapter 5 contains a detailed discussion of the MLEM in relation to the findings of the current research and framing an outline for future direction.

5.4 Recommendations for Further Research

This study presented several statistically significant findings. Additional benefit would be gained from exploring many of these findings in greater detail using both qualitative and quantitative research methods. Doing so would allow the researcher to investigate unique findings. For example LEQ administered to alumni from earlier graduating classes, with additional years of work experience. “As leaders develop Leadership Means and Self Efficacy over time through such activities as role modeling, mastery experiences and vicarious learning, we expect more efficacious leaders will build increased motivation to take on leadership roles and challenges” (Hannah et al., 2012).

Subsequent studies should address some limitations of the study. Surveying incoming juniors, rising and graduating seniors would provide valuable data. Follow-up surveys should be conducted every year in order to inform youth leadership development initiatives that foster leadership self-efficacy. It is critical that qualitative data be collected as well. Allowing student voices to be heard and to inform learning modalities both academically and residentially focused on Leadership Self and Means Efficacy development.

Although residential programs can optimize access to students for more hours of the day, youth leadership development initiatives can be successfully implemented within traditional day programs. Community, religious, social, fraternal, and civic organizations alike have a responsibility to sponsor programs designed to foster academic preparation that nurture leadership self and means efficacy. Parents should also consider the importance of children participating in summer residential and leadership programs, which provide children with the opportunity to build the resilience and confidence that characterize STEM degree obtainers.

Mentoring techniques can be a means of building agency with students as a function of youth leadership development. In order to remain globally competitive the U.S. must broaden the pipeline of students pursuing STEM degrees. Youth leadership development programs should be designed to inspire elementary and middle school aged students to embrace STEM studies. Programs targeting underserved and underrepresented students in STEM degree and career fields should ensure they have role models with which the students identify. Gainen (1995) noted that students majoring in STEM had the greatest rate of attrition.

Professional development should also ensure faculty and staff are equipped with tool kits designed to create dynamic and engaging youth leadership development opportunities with their students. According to Bandura, cognitively generated motivation is a product of the exercise of forethought that allows envisioned successful future outcomes to become a source of motivation to regulate current behaviors (Hannah et al., 2008).

As an actionable outcome, students with fixed mindsets believe their intellectual ability is limited. Dweck et al. (2014) concluded that these students are often full of concerns about their ability, and this can lead, in the face of challenges and setbacks, to destructive thoughts (e.g., "I failed because I am dumb"), feelings (humiliation), and behavior (giving up). In contrast, students with a growth mindset will embrace the exact same challenge as an opportunity to learn and grow. It is a mindset that fosters transcendence of setbacks while remaining focused on long-term learning.

Critical to the understanding of how to motivate and inspire youth toward STEM education is the recognition of learning processes that hinder growth mindset development. It holds promising implications for greater diversity and inclusion of nontraditional populations such as under-represented minority, first generation college attending and women, in STEM

careers. A recent research study determined that students with more of a fixed mindset and students with more of a growth mindset entered junior high school with identical past achievement test scores. Their math grades differed by the end of the first term and diverged increasingly over the next two years. Student with a growth mindset showed continuous improvement; those with the fixed mindset did not (Dweck et al., 2014).

5.5 Conclusion

As a researcher, I am inspired to broaden the discussion and scholarship on the impact of accelerated state funded residential programs such as NCSSM, on advancing the pipeline of students prepared to pursue STEM studies at the postsecondary level. Having served in the capacity of chair for the Diversity committee and as diversity columnist for the bi-annual journal, it is hoped that these research findings will inform the future enrollment and retention efforts of Consortium schools. Understanding how non-cognitive variables gained through youth leadership development can offer predictive performance insights used to enroll a diverse student population.

From a professional standpoint, the ability to assess leader action, leader means, and leader self-regulation efficacy offers a disruptive approach to assessing future student motivation and success. This research holds lots of promise for assessing characteristics for enrollment that open the gates to greater numbers of underserved and underrepresented minority students gaining access to STEM careers. There is something about the sense of ability and self-worth that shines on the face of an NCSSM third trimester junior or graduating senior. They are critical thinkers, problem solvers and community leaders. Research has shown that when people believe that they have the attributes required to meet challenges that they will, as reinforced over time, develop a standardized response pattern. With high levels of practice and familiarity, even complex events

can become less demanding or even automatic processes for experienced individuals (Hannah et al., 2008).

My work over the past 30 years has been at the forefront of STEM youth talent identification, assessment, and development. As an effective leader, my research will serve as a platform for research, youth leadership development, educational scholarship and empowerment through global training and programming that disrupts the traditional educational model. The MLEM helps to inform my work and can be useful to various organizational entities to assess the level of leadership efficacy of students, faculty, administrators, leadership, management and even parents.

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Appendix

LEQ Data Set

Data Set Name	WORK.SURVEY_CLEAN	Observations	68
Member Type	DATA	Variables	66
Engine	V9	Indexes	0
Created	Monday, October 27, 2014 01:18:14 PM	Observation Length	432
Last Modified	Monday, October 27, 2014 01:18:14 PM	Deleted Observations	0
Protection		Compressed	NO
Data Set Type		Sorted	NO
Label			
Data Representation	WINDOWS_64		
Encoding	wlatin1 Western (Windows)		

Engine/Host Dependent Information	
Data Set Page Size	16384
Number of Data Set Pages	3
First Data Page	1
Max Obs per Page	37
Obs in First Data Page	15
Number of Data Set Repairs	0
Filename	C:\Users\welper\AppData\Local\Temp\SAS Temporary Files_TD9468_PORTCLARENCE_\survey_clean.sas7bdat
Release Created	9.0301M2
Host Created	X64_8PRO

Alphabetic List of Variables and Attributes						
#	Variable	Type	Len	Format	Informat	Label
39	Action	Num	8	BEST12.	BEST32.	Leader Action Efficacy
12	Advice	Num	8	BEST12.	BEST32.	
53	advice1	Char	1			Go to my superiors for advice to develop my leadership
27	Age	Num	8	BEST12.	BEST32.	Your age in years
6	Coach	Num	8	BEST12.	BEST32.	
47	coach1	Char	1			Coach followers to assume greater responsibilities for leadership
32	Culture	Num	8	BEST12.	BEST32.	What is the primary cultural background with which you most closely identify?
44	culture1	Char	1			
5	Develop	Num	8	BEST12.	BEST32.	
46	develop1	Char	1			Develop agreements with followers to enhance their participation
28	Education	Num	8	BEST12.	BEST32.	What is the highest level of education that you have completed?

Alphabetic List of Variables and Attributes						
#	Variable	Type	Len	Format	Informat	Label
43	education1	Char	1			
3	Email	Char	21	$21.	$21.	Email address
4	Energize	Num	8	BEST12.	BEST32.	
45	energize1	Char	1			Energize my followers to achieve his/her best
25	Ethical	Num	8	BEST12.	BEST32.	
66	ethical1	Char	1			Distinguish the ethical components of problems/dilemmas
2	First	Char	11	$11.	$11.	First Name
26	Gender	Num	8	BEST12.	BEST32.	Your gender
42	gender1	Char	1			
8	Get	Num	8	BEST12.	BEST32.	
49	get1	Char	1			Get my followers to meet the requirements we have set for their work
16	Guidance	Num	8	BEST12.	BEST32.	
57	guidance1	Char	1			Count on others to give me the guidance I need to complete work assignments
29	Hsplus	Num	8	BEST12.	BEST32.	Number of years employed following completion of High School
10	Identify	Num	8	BEST12.	BEST32.	
51	identify1	Char	1			Get followers to identify with the central focus of our mission
24	Innovate	Num	8	BEST12.	BEST32.	
65	innovate1	Char	1			Think up innovative solutions to challenging leadership problems
7	Inspire	Num	8	BEST12.	BEST32.	
48	inspire1	Char	1			Inspire followers to go beyond their self-interests for the greater good
30	Jobyrs	Num	8	BEST12.	BEST32.	Number of years experience at your current job
37	Largest	Num	8	BEST12.	BEST32.	Largest number of employees that you have ever supervised at any one point in time
13	Lead	Num	8	BEST12.	BEST32.	
54	lead1	Char	1			Effectively lead working within the boundaries of my organizations policies
38	Leaddays	Num	8	BEST12.	BEST32.	Besides courses in your high school and college education, how many total days have you spent in leadership training courses
18	Leadstyle	Num	8	BEST12.	BEST32.	
59	leadstyle1	Char	1			Determine what leadership style is needed in each situation
40	Means	Num	8	BEST12.	BEST32.	Leader Means Efficacy
22	Mission	Num	8	BEST12.	BEST32.	
63	mission1	Char	1			Develop detailed plans to accomplish complex missions
35	Months	Num	8	BEST12.	BEST32.	Months
19	Motivate	Num	8	BEST12.	BEST32.	
60	motivate1	Char	1			Motivate myself to take charge of groups

Alphabetic List of Variables and Attributes						
#	Variable	Type	Len	Format	Informat	Label
33	Other	Char	53	$53.	$53.	If other cultural background
1	Participant	Char	6	$6.	$6.	Participant Last Name
21	Perform	Num	8	BEST12.	BEST32.	
62	perform1	Char	1			Motivate myself to perform at levels that inspire others to excellence
17	Problemsolve	Num	8	BEST12.	BEST32.	
58	problemsolve1	Char	1			Rely on my peers to help solve problems
31	Region	Char	28	$28.	$28.	What country or region were you born in?
11	Relyon	Num	8	BEST12.	BEST32.	
52	relyon1	Char	1			Rely on my organization to provide the resources needed to be effective
41	Selfreg	Num	8	BEST12.	BEST32.	Leader Self Regulation Efficacy
20	Steadfast	Num	8	BEST12.	BEST32.	
61	steadfast1	Char	1			Remain steadfast to my core beliefs when Im challenged
15	Stimulate	Num	8	BEST12.	BEST32.	
56	stimulate1	Char	1			Rely on my leaders to come up with ways to stimulate my creativity
23	Strive	Num	8	BEST12.	BEST32.	
64	strive1	Char	1			Strive to accomplish the targeted goals set by my superiors
36	Supervise	Num	8	BEST12.	BEST32.	Number of employees you currently supervise
14	Support	Num	8	BEST12.	BEST32.	
55	support1	Char	1			Count on my leaders to support high standards of ethical conduct
9	Utilize	Num	8	BEST12.	BEST32.	
50	utilize1	Char	1			Utilize the forms of rewards and punishments that work best with each follower
34	Years	Num	8	BEST12.	BEST32.	Years

Leader Efficacy Questionnaire				
Energize my followers to achieve his/her best	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	5	7.4	5	7.4
Moderately Confident	56	82.4	61	89.7
Totally Confident	7	10.3	68	100.0

Leader Efficacy Questionnaire				
Develop agreements with followers to enhance their participation	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	4	5.9	4	5.9
Moderately Confident	56	82.4	60	88.2
Totally Confident	8	11.8	68	100.0

Leader Efficacy Questionnaire				
Coach followers to assume greater responsibilities for leadership	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	12	17.6	12	17.6
Moderately Confident	48	70.6	60	88.2
Totally Confident	8	11.8	68	100.0

Leader Efficacy Questionnaire				
Inspire followers to go beyond their self-interests for the greater good	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	5	7.4	5	7.4
Moderately Confident	58	85.3	63	92.6
Totally Confident	5	7.4	68	100.0

Leader Efficacy Questionnaire				
Get my followers to meet the requirements we have set for their work	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	3	4.4	3	4.4
Moderately Confident	52	76.5	55	80.9
Totally Confident	13	19.1	68	100.0

Leader Efficacy Questionnaire				
Utilize the forms of rewards and punishments that work best with each follower	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	15	22.1	15	22.1
Moderately Confident	48	70.6	63	92.6
Totally Confident	5	7.4	68	100.0

Leader Efficacy Questionnaire				
Get followers to identify with the central focus of our mission	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	5	7.4	5	7.4
Moderately Confident	54	79.4	59	86.8
Totally Confident	9	13.2	68	100.0

Leader Efficacy Questionnaire				
Rely on my organization to provide the resources needed to be effective	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	17	25.0	17	25.0
Moderately Confident	43	63.2	60	88.2
Totally Confident	8	11.8	68	100.0

Leader Efficacy Questionnaire				
Go to my superiors for advice to develop my leadership	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	9	13.2	9	13.2
Moderately Confident	44	64.7	53	77.9
Totally Confident	15	22.1	68	100.0

Leader Efficacy Questionnaire				
Effectively lead working within the boundaries of my organizations policies	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	5	7.4	5	7.4
Moderately Confident	51	75.0	56	82.4
Totally Confident	12	17.6	68	100.0

Leader Efficacy Questionnaire				
Count on my leaders to support high standards of ethical conduct	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	4	5.9	4	5.9
Moderately Confident	42	61.8	46	67.6
Totally Confident	22	32.4	68	100.0

Leader Efficacy Questionnaire				
Rely on my leaders to come up with ways to stimulate my creativity	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	22	32.4	22	32.4
Moderately Confident	45	66.2	67	98.5
Totally Confident	1	1.5	68	100.0

Leader Efficacy Questionnaire				
Count on others to give me the guidance I need to complete work assignments	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	17	25.0	17	25.0
Moderately Confident	49	72.1	66	97.1
Totally Confident	2	2.9	68	100.0

Leader Efficacy Questionnaire				
Rely on my peers to help solve problems	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	9	13.2	9	13.2
Moderately Confident	50	73.5	59	86.8
Totally Confident	9	13.2	68	100.0

Leader Efficacy Questionnaire				
Determine what leadership style is needed in each situation	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	12	17.6	12	17.6
Moderately Confident	49	72.1	61	89.7
Totally Confident	7	10.3	68	100.0

Leader Efficacy Questionnaire				
Motivate myself to take charge of groups	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	3	4.4	3	4.4
Moderately Confident	44	64.7	47	69.1
Totally Confident	21	30.9	68	100.0

Leader Efficacy Questionnaire				
Remain steadfast to my core beliefs when Im challenged	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	3	4.4	3	4.4
Moderately Confident	39	57.4	42	61.8
Totally Confident	26	38.2	68	100.0

Leader Efficacy Questionnaire				
Motivate myself to perform at levels that inspire others to excellence	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	3	4.4	3	4.4
Moderately Confident	45	66.2	48	70.6
Totally Confident	20	29.4	68	100.0

Leader Efficacy Questionnaire				
Develop detailed plans to accomplish complex missions	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	5	7.4	5	7.4
Moderately Confident	36	52.9	41	60.3
Totally Confident	27	39.7	68	100.0

Leader Efficacy Questionnaire				
Strive to accomplish the targeted goals set by my superiors	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	1	1.5	1	1.5
Moderately Confident	36	52.9	37	54.4
Totally Confident	31	45.6	68	100.0

Leader Efficacy Questionnaire				
Think up innovative solutions to challenging leadership problems	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	7	10.3	7	10.3
Moderately Confident	42	61.8	49	72.1
Totally Confident	19	27.9	68	100.0

Leader Efficacy Questionnaire				
Distinguish the ethical components of problems/dilemmas	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not at all Confident	1	1.5	1	1.5
Moderately Confident	48	70.6	49	72.1
Totally Confident	19	27.9	68	100.0

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Male	29	42.6	29	42.6
Female	39	57.4	68	100.0

Leader Efficacy Questionnaire				
Your age in years	Frequency	Percent	Cumulative Frequency	Cumulative Percent
24	1	1.5	1	1.5
25	6	8.8	7	10.3
26	8	11.8	15	22.1
27	6	8.8	21	30.9
28	6	8.8	27	39.7
29	10	14.7	37	54.4
30	10	14.7	47	69.1
31	11	16.2	58	85.3
32	10	14.7	68	100.0

Analysis Variable : age Your age in years				
N	Mean	Std Dev	Minimum	Maximum
68	28.8676471	2.3366286	24.0000000	32.0000000

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
.	1	1.5	1	1.5
Some college	1	1.5	2	2.9
A Bachelors degree	24	35.3	26	38.2
A Masters degree	24	35.3	50	73.5
A professional degree (e.g., DDS, JD, MD etc.)	10	14.7	60	88.2
A Doctorate (e.g., Ph.D.	8	11.8	68	100.0

Leader Efficacy Questionnaire				
Number of years employed following completion of High School	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	1	1.5	1	1.5
1	1	1.5	2	3.0
2	3	4.5	5	7.5
3	6	9.0	11	16.4
4	8	11.9	19	28.4
5	6	9.0	25	37.3
6	2	3.0	27	40.3
7	9	13.4	36	53.7
8	5	7.5	41	61.2
9	5	7.5	46	68.7
10	7	10.4	53	79.1
11	2	3.0	55	82.1
12	6	9.0	61	91.0
13	3	4.5	64	95.5
14	3	4.5	67	100.0
Frequency Missing = 1				

Analysis Variable : hsplus Number of years employed following completion of High School				
N	Mean	Std Dev	Minimum	Maximum
67	7.3432836	3.6329812	0	14.0000000

Leader Efficacy Questionnaire				
Number of years experience at your current job	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	6	9.0	6	9.0
1	25	37.3	31	46.3
2	11	16.4	42	62.7
3	5	7.5	47	70.1
4	3	4.5	50	74.6
5	6	9.0	56	83.6
6	3	4.5	59	88.1
7	2	3.0	61	91.0
8	2	3.0	63	94.0
9	2	3.0	65	97.0
10	1	1.5	66	98.5
12	1	1.5	67	100.0
Frequency Missing = 1				

Analysis Variable : jobyrs Number of years experience at your current job				
N	Mean	Std Dev	Minimum	Maximum
67	2.8656716	2.7573347	0	12.0000000

Leader Efficacy Questionnaire				
What country or region were you born in?	Frequency	Percent	Cumulative Frequency	Cumulative Percent
California	1	1.5	1	1.5
Cape Town, South Africa	1	1.5	2	2.9
Germany (US Citizen born abr	1	1.5	3	4.4
Hong Kong	1	1.5	4	5.9
NC	1	1.5	5	7.4
NC--Piedmont	1	1.5	6	8.8
North Carolina	1	1.5	7	10.3
North Carolina (Southeast)	1	1.5	8	11.8
North Carolina, USA	1	1.5	9	13.2
Ohio, USA	1	1.5	10	14.7
PA, USA	1	1.5	11	16.2
South	1	1.5	12	17.6
Sweden	1	1.5	13	19.1
U.S.	1	1.5	14	20.6
US	7	10.3	21	30.9
US South	2	2.9	23	33.8
US, Southeast (NC)	1	1.5	24	35.3
USA	22	32.4	46	67.6
USA - Southeast	1	1.5	47	69.1
USA/NC	1	1.5	48	70.6
United States	13	19.1	61	89.7
United States - Southeastern	1	1.5	62	91.2
United States of America	2	2.9	64	94.1
United States, North Carolin	2	2.9	66	97.1
United States/Southeast	1	1.5	67	98.5
Usa	1	1.5	68	100.0

	Frequency	Percent	Cumulative Frequency	Cumulative Percent
.	2	2.9	2	2.9
Asian or Pacific Islander	3	4.4	5	7.4
African American	6	8.8	11	16.2
Caucasian	56	82.4	67	98.5
Other	1	1.5	68	100.0

Leader Efficacy Questionnaire				
If other cultural background	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Father was ex-con and atheist. Try that in the south.	1	25.0	1	25.0
Indian subcontinent	1	25.0	2	50.0
Mixed - Pacific Islander / White	1	25.0	3	75.0
N/A	1	25.0	4	100.0
Frequency Missing = 64				

Leader Efficacy Questionnaire				
Years	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	4	6.3	4	6.3
1	7	10.9	11	17.2
2	11	17.2	22	34.4
3	13	20.3	35	54.7
4	2	3.1	37	57.8
5	9	14.1	46	71.9
6	3	4.7	49	76.6
7	1	1.6	50	78.1
8	4	6.3	54	84.4
9	3	4.7	57	89.1
10	3	4.7	60	93.8
12	1	1.6	61	95.3
14	1	1.6	62	96.9
16	2	3.1	64	100.0
Frequency Missing = 4				

Analysis Variable : years Years				
N	Mean	Std Dev	Minimum	Maximum
64	4.5781250	3.7619848	0	16.0000000

Leader Efficacy Questionnaire				
Months	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	17	45.9	17	45.9
1	2	5.4	19	51.4
2	3	8.1	22	59.5
3	2	5.4	24	64.9
4	1	2.7	25	67.6
5	1	2.7	26	70.3
6	8	21.6	34	91.9
9	1	2.7	35	94.6
10	1	2.7	36	97.3
11	1	2.7	37	100.0
Frequency Missing = 31				

Analysis Variable : months Months				
N	Mean	Std Dev	Minimum	Maximum
37	2.7297297	3.2799784	0	11.0000000

Leader Efficacy Questionnaire				
Number of employees you currently supervise	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	26	41.3	26	41.3
1	8	12.7	34	54.0
2	4	6.3	38	60.3
3	5	7.9	43	68.3
4	4	6.3	47	74.6
5	2	3.2	49	77.8
6	1	1.6	50	79.4
8	2	3.2	52	82.5
9	1	1.6	53	84.1
10	1	1.6	54	85.7
13	1	1.6	55	87.3
15	2	3.2	57	90.5
18	1	1.6	58	92.1
20	1	1.6	59	93.7
25	2	3.2	61	96.8
60	1	1.6	62	98.4
70	1	1.6	63	100.0
Frequency Missing = 5				

Analysis Variable : supervise Number of employees you currently supervise				
N	Mean	Std Dev	Minimum	Maximum
63	5.6984127	12.4273825	0	70.0000000

Leader Efficacy Questionnaire				
Largest number of employees that you have ever supervised at any one point in time	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	9	13.8	9	13.8
1	1	1.5	10	15.4
2	7	10.8	17	26.2
3	6	9.2	23	35.4
4	6	9.2	29	44.6
5	3	4.6	32	49.2
6	3	4.6	35	53.8
8	6	9.2	41	63.1
10	4	6.2	45	69.2
12	1	1.5	46	70.8
14	1	1.5	47	72.3
15	6	9.2	53	81.5
16	1	1.5	54	83.1
18	2	3.1	56	86.2
19	1	1.5	57	87.7
20	2	3.1	59	90.8
25	2	3.1	61	93.8
30	1	1.5	62	95.4
45	1	1.5	63	96.9
50	1	1.5	64	98.5
60	1	1.5	65	100.0
Frequency Missing = 3				

Analysis Variable : largest Largest number of employees that you have ever supervised at any one point in time				
N	Mean	Std Dev	Minimum	Maximum
65	9.8461538	11.7755451	0	60.0000000

Leader Efficacy Questionnaire				
Besides courses in your high school and college education, how many total days have you spent in leadership training courses	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	19	29.2	19	29.2
1	2	3.1	21	32.3
2	4	6.2	25	38.5
3	5	7.7	30	46.2
4	3	4.6	33	50.8
5	5	7.7	38	58.5
6	1	1.5	39	60.0
7	3	4.6	42	64.6
10	4	6.2	46	70.8
13	1	1.5	47	72.3
14	3	4.6	50	76.9
15	2	3.1	52	80.0
16	1	1.5	53	81.5
20	2	3.1	55	84.6
25	1	1.5	56	86.2
30	3	4.6	59	90.8
31	1	1.5	60	92.3
50	1	1.5	61	93.8
60	1	1.5	62	95.4
90	1	1.5	63	96.9
180	1	1.5	64	98.5
3650	1	1.5	65	100.0
Frequency Missing = 3				

Analysis Variable : leaddays Besides courses in your high school and college education, how many total days have you spent in leadership training courses				
N	Mean	Std Dev	Minimum	Maximum
65	68.4000000	451.9465123	0	3650.00

Leader Efficacy Questionnaire				
Leader Action Efficacy	Frequency	Percent	Cumulative Frequency	Cumulative Percent
40	1	1.5	1	1.5
41.4	1	1.5	2	2.9
45.7	1	1.5	3	4.4
48.6	1	1.5	4	5.9
57.1	1	1.5	5	7.4
58.6	2	2.9	7	10.3
60	2	2.9	9	13.2
61.4	2	2.9	11	16.2
62.9	2	2.9	13	19.1
64.3	2	2.9	15	22.1
67.1	1	1.5	16	23.5
68.6	3	4.4	19	27.9
71.4	3	4.4	22	32.4
72.9	1	1.5	23	33.8
74.3	2	2.9	25	36.8
75.7	3	4.4	28	41.2
77.1	4	5.9	32	47.1
78.6	5	7.4	37	54.4
80	2	2.9	39	57.4
81.4	5	7.4	44	64.7
82.9	1	1.5	45	66.2
84.3	5	7.4	50	73.5
85.7	3	4.4	53	77.9
87.1	3	4.4	56	82.4
88.6	3	4.4	59	86.8
90	4	5.9	63	92.6
91.4	1	1.5	64	94.1
94.3	2	2.9	66	97.1
95.7	1	1.5	67	98.5
100	1	1.5	68	100.0

Analysis Variable : action Leader Action Efficacy				
N	Mean	Std Dev	Minimum	Maximum
68	76.1117647	13.0404369	40.0000000	100.0000000

Leader Efficacy Questionnaire				
Leader Means Efficacy	Frequency	Percent	Cumulative Frequency	Cumulative Percent
34.3	1	1.5	1	1.5
38.6	2	2.9	3	4.4
41.4	1	1.5	4	5.9
47.1	1	1.5	5	7.4
52.9	3	4.4	8	11.8
58.6	1	1.5	9	13.2
60	3	4.4	12	17.6
61.4	1	1.5	13	19.1
65.7	4	5.9	17	25.0
68.6	3	4.4	20	29.4
70	2	2.9	22	32.4
71.4	4	5.9	26	38.2
72.9	3	4.4	29	42.6
74.3	2	2.9	31	45.6
75.7	6	8.8	37	54.4
77.1	3	4.4	40	58.8
78.6	2	2.9	42	61.8
80	4	5.9	46	67.6
81.4	1	1.5	47	69.1
82.9	3	4.4	50	73.5
84.3	4	5.9	54	79.4
85.7	1	1.5	55	80.9
87.1	3	4.4	58	85.3
88.6	4	5.9	62	91.2
90	3	4.4	65	95.6
92.9	1	1.5	66	97.1
95.7	1	1.5	67	98.5
97.1	1	1.5	68	100.0

Analysis Variable : means Leader Means Efficacy				
N	Mean	Std Dev	Minimum	Maximum
68	73.6367647	14.0301158	34.3000000	97.1000000

Leader Efficacy Questionnaire				
Leader Self Regulation Efficacy	Frequency	Percent	Cumulative Frequency	Cumulative Percent
46.3	1	1.5	1	1.5
53.8	1	1.5	2	2.9
58.8	1	1.5	3	4.4
61.3	1	1.5	4	5.9
68.8	2	2.9	6	8.8
70	1	1.5	7	10.3
71.3	1	1.5	8	11.8
72.5	1	1.5	9	13.2
73.8	1	1.5	10	14.7
75	6	8.8	16	23.5
76.3	1	1.5	17	25.0
77.5	2	2.9	19	27.9
78.8	3	4.4	22	32.4
80	2	2.9	24	35.3
81.3	1	1.5	25	36.8
82.5	4	5.9	29	42.6
83.8	2	2.9	31	45.6
85	4	5.9	35	51.5
86.3	4	5.9	39	57.4
87.5	5	7.4	44	64.7
88.8	3	4.4	47	69.1
90	2	2.9	49	72.1
91.3	3	4.4	52	76.5
92.5	3	4.4	55	80.9
93.8	3	4.4	58	85.3
95	2	2.9	60	88.2
96.3	2	2.9	62	91.2
97.5	4	5.9	66	97.1
98.8	2	2.9	68	100.0

Analysis Variable : selfreg Leader Self Regulation Efficacy				
N	Mean	Std Dev	Minimum	Maximum
68	83.4426471	10.8458716	46.3000000	98.8000000