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U.S. DECLINING GLOBAL RANKINGS IN MATH AND SCIENCE AND THE IMPACT ON OUR NATIONAL SECURITY: POLICY OPTIONS TO ELICIT ANOTHER SPUTNIK MOMENT

by

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13. ABSTRACT (maximum 200 words)

Since the end of the space race in the 1960s, America has been experiencing a decline in its global educational rankings in the science, technology, engineering, and math (STEM) curricula. Due to the interdependencies that education has with a number of our critical sectors, the declining global educational rankings can have serious effects on our national economy, technological advantage and ultimately our national security. With countries like China undertaking intensive civilian educational campaigns, completely modernizing its military, and developing extensive electronic and information warfare capabilities, our technological advantage will be critical to ensure our preparedness for these emerging threats.

The inability of society to see this decline and the inability, or lack of desire of our students, to compete and excel globally in the STEM curricula is a "collective failure." This thesis examines a number of educational policies and programs and evaluates their focus on developing students' social learning environment and social responsibility toward learning. From this review, this research has synthesized a number of recommendations for policymakers to consider in order to help America realize a national imperative toward learning and to support America in experiencing another "Sputnik moment."

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U.S. DECLINING GLOBAL RANKINGS IN MATH AND SCIENCE AND THE IMPACT ON OUR NATIONAL SECURITY: POLICY OPTIONS TO ELICIT ANOTHER SPUTNIK MOMENT

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Since the end of the space race in the 1960s, America has been experiencing a decline in its global educational rankings in the science, technology, engineering, and math (STEM) curricula. Due to the interdependencies that education has with a number of our critical sectors, the declining global educational rankings can have serious effects on our national economy, technological advantage and ultimately our national security. With countries like China undertaking intensive civilian educational campaigns, completely modernizing its military, and developing extensive electronic and information warfare capabilities, our technological advantage will be critical to ensure our preparedness for these emerging threats.

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LIST OF ACRONYMS AND ABBREVIATIONS

AP	advance placement
ARRA	American Recovery and Reinvestment Act
K-12	kindergarten through twelfth grade
CAMM	Connect a Million Minds
COMPETES	Creating Opportunities to Meaningfully Promote Excellence in Technology, Science, and Education
CSAS	Coalition for Science After School
CTE	Career and Technical Education
DHS	Department of Homeland Security
DOD	Department of Defense
DOE	Department of Energy
ESEA	Elementary and Secondary Education Act
EW	electronic warfare
FIRST	For Inspiration and Recognition of Science and Technology
FY	fiscal year
GT	gifted and talented
IW	information warfare
LEA	local education agencies
QHRS	Quadrennial Homeland Security Report
NAEP	National Assessment of Educational Progress
NCLB	No Child Left Behind
NDEA	National Defense Education Act
NGO	non-governmental organization
NLN	National Lab Network
NSB	National Science Board
NSF	National Science Foundation
OECD	Organizations for Economic Cooperation and Development
R&D	research and development
RISE	Roots in Science and Engineering
RTTT	Race To The Top

S&E	science and engineering
SAT	Scholastic Assessment Test
SJTU	Shanghai Jiao Tong University
STEM	science technology engineering and math
SY	school year
TIMSS	Trends In International Mathematics and Science Study
TWC	Time Warner Cable
U.S.	United States
WWII	World War II

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I. THE DECLINING GLOBAL U.S. EDUCATIONAL RANKINGS AND OUR HOMELAND SECURITY

A. INTRODUCTION

The inadequacies of our systems of research and education pose a greater threat to U.S. national security over the next quarter century than any potential conventional war that we might imagine.

–Hart-Rudman Commission Report.

Despite this warning, the United States has not implemented a national education imperative or developed a sense of social responsibility capable of reversing our declining interest science, technology, engineering and math (STEM) education, which had been at the forefront of national concerns following WWII, when the atomic bomb, and Sputnik fueled American society's interest and drive in the sciences, to a point in 2007 where fewer than two percent of high-school graduates receive engineering degrees from U.S. universities (Augustine, 2007, p. 47). Now, 60 years later, we are witnessing greater increase in spending by foreign governments on science and engineering (S&E) initiatives while the United States has reduced investment in these areas. Although numerous schools, government agencies, non-governmental organizations (NGO) and private corporations, and community organizations have developed policies to help bolster STEM education, U.S. schools are still declining in global rankings. The lack of interest in the sciences by our domestic students and low completions of advanced higher level science degrees by American students are compounding the problem.

B. FRAMING: THE ABILITY TO ELICIT A SPUTNIK MOMENT RESIDES WITHIN THE COMMUNITY

Previous educational policies aimed at addressing our global STEM rankings and capabilities have focused on improving schools, curricula, and teacher skills. Federal educational policies such as the No Child Left Behind (NCLB) and Race to the Top, as well as the state level programs, have relied on the development of standardized testing and educational system performance based measurements as a method to fix the declining U.S. STEM capabilities. For decades, the federal government, Department of Education,

and the state education systems have committed time and resources to these programs with unimpressive results. At a time when the declining economy has resulted in massive educational budget cuts, state educational systems have found themselves increasingly struggling to fund federal mandates with slow and lackluster results.

During the tense periods of the postwar 1940s and 1950s and the space race of the 1960s, the United States was able to reach a level of scientific superiority in a relatively short amount of time in large part due to a sense of nationalism and social responsibility. The "Sputnik Moment," awoke the American public and academia to the urgent need to compete and outdo their Soviet competition. In 1957, the Soviets had successfully launched a satellite into space ahead of the U.S. Fearing to be technologically outdone and left vulnerable to its arch enemy, the U.S. began earnestly pursuing space flight, both for satellites and man. Students were instilled with a sense of urgency and responsibility that the future of the country and the free world relied on their success in the sciences. Today's American students lack the sense of urgency, nationalism, and sense of global competitiveness. Students are not committed to the pursuit of the hard sciences, instead preferring less stringent courses of study with little or no understanding of what the impact of their decision will have on the security and prosperity of their country.

Conversely, other countries are using nationalism and the sense of individual duty and responsibility to develop increasingly effective and competitive STEM educational programs that are developed with and thrive on lower budget requirements. For example, Taiwan, Russia and Finland have successful educational systems that develop students' sense of social responsibility and nationalism. Early childhood development programs focus on the individual's capabilities as a means to support the whole of the nation. This sense of the importance of one's individual success as it relates to the success of the community is often developed at an early age and reinforced continually throughout their education.

C. PROBLEM STATEMENT

Over the past several decades, the U.S. has seen a continual decline in the global ranking of our educational capabilities. The 1998 *Trends in International Mathematics and Sciences Study* (TIMSS) rated United States' secondary students in science and mathematics well below the international average (National Science Board, 1998, p. 1). According to the study, American schools are usually plagued with low expectations and low performance in science and math. Nearly 10 years later, the 2007 TIMSS also produced results showing that the United States fourth and eighth graders continued to perform at levels below that of countries such as Taiwan, Korea, Singapore, Hong Kong Special Administrative Region (Hong Kong), Japan, Hungary, and the Russian Federation (National Science Board, 2009, p. 2). The National Science Board (1999) also noted that there is a declining interest and participation of domestic students in science and engineering and that this is a disturbing trend that ranges from kindergarten through twelfth grade (K-12). Furthermore, it is indicative of the failure of the U.S. education system (National Science Board, 1999, p. 2). According to another author, fewer than 15 percent of U.S. high-school graduates have sufficient mathematics and science credentials to pursue engineering degrees (Augustine, 2007, p. 44). The poor performing K-12 educational system is thus having a cascading effect on institutions of higher learning. Three out of four two-year and four-year institutions find it necessary to offer remedial courses to incoming students because they are ill prepared for the curriculum (Augustine, 2007, p. 35).

The declining global competitiveness of America's K-12 education and upper-level education, specifically in the math and sciences, has serious implications on our economy, technological advantage, and even national security. A 2002 study by Jorgenson, Ho, and Stiroh indicated that a more highly educated workforce contributes to overall increased in the annual economic growth of a nation and that families led by college graduates have a higher per year income (Kodrzycki, 2002). In addition, the global increase in the S&E capacity also creates a number of issues for the United States, including the exportation of high tech jobs, a growing technology deficit, loss of transformative research capacity, and impact on domestic technology corporations. To

illustrate the point, between 1985 and 2008 the U.S. share of worldwide high technology exports declined seven percent from 21 percent to 14 percent (National Science Board, 2010, p. 6). In addition, the loss of domestic S&E capacity can impact the development and manufacture of national security related technology that cannot be manufactured overseas, as well as having intellectual property ramifications (National Science Board [NSB], 2010, p. 6). As economies become more technology based, it will be essential for the U.S. to develop an educated populace to support these economies. According to Allen Greenspan, former Federal Reserve chairman, "if you don't solve the K-12 educational problem, nothing else is going to matter all that much" (Augustine, 2007, p. 32).

Although the problem is readily evident to those who are regularly impacted by the issue, the National Academies of Sciences report commented on the declining American educational outlook, stating, "There is of course, little political gain in taking the lead in addressing challenging problems—even serious problems—that most of the public has yet recognized to be problems" (Augustine, 2007, p. 76). With a lack of public realization of the impact caused by the declining educational capabilities, there is little sense of urgency or understanding of the individual student's role in addressing the problem. Unlike in the 1940s when there was a media blitz and the concern for global annihilation if the United States were to lose the nuclear race, today's communities and students have little understanding or sense of urgency with respect to their role in the national security of their country.

D.   PURPOSE OF THE STUDY

This thesis evaluated a number of current initiatives from a variety stakeholders and makes strategic policy recommendation to develop a national imperative within communities to pursue science and math education in order to support our economic prosperity and national security. This evaluation included a number of state, federal, non-governmental organizations (NGO) and private corporations, and international educational policies and programs.

E.   RESEARCH QUESTIONS

Primary Question

What strategic policy recommendations can be made to promote the interest of our domestic population in pursuing higher level STEM education in order to support our technological advantage, national security, and economic wellbeing?

Secondary Question

To identify gaps in current policies and to make future recommendations, this thesis will answer the following set of secondary questions.

- In what ways can the education system contribute to the strategic priority of STEM education in support of our national security?

- In what ways can NGOs and private corporations, contribute to the strategic priority of STEM education in support of our national security?

- In what ways can government and military organizations contribute to the strategic priority of STEM education in support of our national security?

- In what ways can the community contribute to the strategic priority of STEM education in support of our national security?

- In what ways can the media contribute to the strategic priority of STEM education in support of our national security?

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II. LITERATURE REVIEW

A. INTRODUCTION

The United States has seen declining global educational ranking and interest of its domestic population in pursuing the hard sciences. For decades, state, and federal educational programs and policies have focused on addressing many of the same issues for decades, yet our global educational rankings have not improved. Current and past education polices manly focus on the same core areas, such as standardized testing, teacher and school performance, and curriculum development. With the declining economy resulting in significant educational budget cuts and at the same time global technological capacity is increasing, U.S. educational policymakers need to consider alternative programs and policies to increase American students' interest and success in the STEM education.

While there is significant research literature and data available regarding the various federal and state educational policies, there is a lack of current information regarding the development students' sense of social responsibility towards learning. The evaluation of existing policies and programs, combined with the novel analysis of domestic and global programs that are aimed at developing more effective social learning environments, will increase the collective knowledge available regarding educational policies and programs.

The following review focuses on scholarly literature regarding the integral relationship between our educational system and our national security. The initial two parts of the literature review provide information regarding the serious issues created by our declining domestic STEM educational rankings. The first section focuses on our declining global educational ranking and the impacts this has on our technological advantage and the economy. The goal of this section is to examine the correlation between our declining STEM capabilities and the rising exportation of higher education, the reliance of foreign technology development and production, and the impact this has on our economy and transformative research capabilities. This section provides the reader

with a better understanding of the interdependency that education plays in many of our critical systems. The next section focuses on the cascading effect that a declining educational system can have and it ultimate impacts on our national security.

Policies of the late 1900s resulted in an increased reliance on foreign oil, which has impacted our national security. The following analysis of the impact, created by the declining STEM capabilities, provides scholarly literature on how our current educational STEM rankings is having a similar impact on our national security through the increased reliance on foreign technology and skilled workers due to our decreasing domestic educational capacity and interest. The final section identifies gaps in current literature and research that may yield possible solutions regarding ways in which the U.S. educational system, government and military organizations, NGOs and private corporations, and the community contribute to the strategic priority of STEM education in support of our national security.

B.   PROBLEM IDENTIFICATION

1.   The Declining Global Educational Ranking of the United States and the Impact on Our Technological Advantage and the Economy

For decades American schools have been plagued with low expectations and declining performance in science and math. The National Center for Education Statistics *Fourth International Mathematics and Sciences Study*, conducted in 2007, showed that only one percent of the fourth graders and six percent of the eighth graders scored at or above international benchmarks in advanced mathematics (National Science Board, 2009, p. 15). The percentages were even lower for those American fourth and eighth graders who exceeded international benchmarks in 8th grade math (National Science Board, 2009, p. 15). Countries that were exceeding the capabilities of the United States included: Chinese Taipei, Korea, Singapore, Hong Kong, Japan, Hungary, and the Russian Federation. The National Science Board (2009) also noted that there is a declining interest and participation of domestic students in science and engineering, especially within the K-12 lower education environment. According to the National Science Board, lower education is failing to develop the student's interest in the science and engineering

(1999, p. 2). From 2000 until 2006, the number of U.S. high school students who expressed an interest in becoming scientists or engineers dropped from 36 percent to six percent, and in 2007 fewer than two percent of high-school graduates receive engineering degrees from U.S. universities (Augustine, 2007, p. 47). The corresponding percentages are event lower for women and minorities. Furthermore, fewer than 15 percent of U.S. high-school graduates have sufficient mathematics and science credentials to pursue engineering degrees (Augustine, 2007, p. 44).

The declining global rankings of the United States education system are not limited only to lower education. While it is noted that the United States currently has 54 of the top 100 universities, as rated by the Shanghai Jiao Tong University (SJTU) ratings, it appears that the U.S. is under represented in the top 500 universities, whereas China has 19 universities in the top 500 globally ranked universities (Marginson & Wende, 2007, p. 314). This under representation in the top 500 indicates that the U.S. is investing in these top 54 universities at the expense of broader regional knowledge bases (Marginson & Wende, 2007, p. 314). The SJTU has been conducting ratings for research universities since 2003, and it is the accepted ranking for the annual Academic Ranking of World Universities report. Although focused primarily on the ranking of scientific research universities, the SJTU uses publically available data, such as scientific publications published by the university, number of times these publications are cited in research and the number of Nobel Laureates are teaching at the university in their ranking.

In 2001, the United States accounted for almost a third of the world's production of scientific articles (Marginson & Wende, 2007, p. 319). The concerning fact is that this was an almost eight percent decline of their contribution to the overall world output from 1988 (Marginson & Wende, 2007, p. 319). During this same time period, countries like Korea and China saw a drastic increase in the number of scientific publications. Korea increased publications from 771 to 11,037, and China increased publications from 4,619 to 20, 978 in the same 13-year time span (Marginson & Wende, 2007, p. 319). The poor performing U.S. lower education systems, the lack of interest in the sciences by domestic students, and the increasing global competition in the science and engineering field is

indicating serious future implications for the United States. The United States' share of global output of doctorates in science and engineering declined from 52 percent in 1986 to 22 percent in 2003, and the percentage of those issued to U.S. citizens dropped to 53 percent in 2005 (Augustine, 2007, p. 43).

In response to the emerging global education competition, several countries have implemented programs and policies in the 21st century aimed directly at the United States' dominance of the science and research universities. For example, the European Union is focusing governmental policy on developing centers of excellence and is posturing to make the European Institute of Technology a challenger to the top ranking U.S. universities (Marginson & Wende, 2007 p. 322). In addition, Germany is implementing a plan to develop a group of universities that will be capable of being part of the top 10 research universities in the world. Furthermore, China, India, Singapore, and Korea are all taking major steps to ensure that they are at the forefront of science and technology research. China is also taking steps to develop world class universities and is undergoing a state driven educational achievement initiative to increase the quantity and quality of education in China.

Between 1998 and 2004, China increased it admission in undergraduate studies four-fold to 20 million, making it the largest higher education system in the world (Li, Whalley, Zhang, and Zhao, 2008, p. 6). China has developed two state wide programs to provide influx of funding in order to implement massive overhauls to their university system to increase global competitiveness. China has also implemented the 211 Project to increase the research capacity of its leading 100 universities and the 985 Project to support 38 universities throughout the country (Li et al., 2008, p. 11). As a result, China has seen its number of doctoral awards issued raise from just 19 in 1983 to 18,625 in 2003, and a doctoral admission of 54,000 in 2005 (Li et al., 2008, p. 6).

Russia is also in a technological race with the United States with its universities and research development centers. Former President Medvedev is developing a technological think tank development community, a "Stanford in Russia," located in a town outside of Moscow called Skolkovo. Skolkovo will include the world's largest nanotechnology program and is designed to lure Russian émigrés back to their homeland

(Mathew & Nemstova, 2010, p. 2). With Russia's push to develop its domestic research and university system, many of the talented youth who may have studied and worked in the U.S. may now elect to stay in Russia. In the past, the United States has benefited from the STEM talent leaving Russia and former Soviet bloc, many of which often became citizens and contributed to our transformative research capacity. This was the case with Russian Born Sergei Brin, a computer science engineer who studied at the University of Maryland and Stanford before starting Google

The economy plays a critical role in sustaining educational programs and investment in science and engineering initiatives. During periods of economic decline, there are often significant cuts in U.S. school funding. The combined state budget shortfalls for the 2010 and 2011 fiscal year are projected to be more than $350 billion and are expected by state fiscal agencies to continue into the future (Lav & McNichol 2009, p. 1). As a result of state balanced budget requirements, the state support for education will be impacted to a greater extent due to the fact that states cannot carry a deficit and must balance their budgets annually. Therefore, states are left cutting expenditures, raising taxes and fees, or using reserves to meet their budgets. As a result, states are left making vast staffing and budget cuts to K-12 and university education programs. Many of these cuts are a continuation of cuts that have been ongoing since the beginning of the twenty-first century. In 2002 and 2004, 34 states cut K-12 funding, which resulted in fewer teachers, shorter days, and increased class sizes (Lav & McNichol, 2009, p. 7). In September of 2009, the District of Columbia Public School system eliminated 226 teaching positions to meet its budget. In a press release from April 2010, which was issued following the laying off of 26,000 teachers, California State School Superintendent Jack O'Connell made the following statement:

> California is at a critical tipping point where deep state budget cuts is having an effect on whether we can produce the next generation of students who can thrive in our hypercompetitive global economy because we may not have enough teachers. (California Department of Education. News Release, 2010, p. 1)

State support for higher education represents 62 percent of the educational operating budget nationwide (Johnson, Koulish, & Oliff, 2008, p. 3). States enacted

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funding cuts for education that ranged from the single digits, to cuts as deep as a reduction of 17 percent in state funding for colleges in Rhode Island. In addition, numerous universities had to eliminate staffing positions, reduce academic offerings, and reduce the number of registered students. In 2008, the University of Florida reduced the size of the undergraduate classes by 4,000 students (Johnson et al., 2008, p. 3). Between 2008 and 2013, the continued economic decline caused states to spend an average of 28 percent less on education than they did in 2008 (Oliff, Palacios, Johnson, Leachman, & Oliff, 2013, p. 1). Tuition rates and fees for students have also been steadily climbing over the last decade, creating an even greater financial barrier for perspective students. In a five year period following the 2007–2008 school year, tuition rates raised an average of 27 percent over the 2007–08 tuition rates (Oliff et al., 2013, p. 2).

Increased science and engineering S&E capability and research and development (R&D) plays an important role in economic growth and employment. A 2002 study by Jorgenson et al. estimated that a more highly educated workforce contributed to overall increased in economic growth of 3.4 percent per year from 1958 until 1999 (Kodrzycki 2002, p. 43). According to Federal Reserve statistics, during a 15-year period, which ended in 2004, the net worth of families led by college graduates increased by 61 percent, while those led by high school dropouts rose by only 12 percent (Augustine, 2007, p. 32).

Increased global competition in S&E capacity creates a number of issues for the United States, including the exportation of high tech jobs, a growing technology deficit, loss of transformative research capacity, and impact on domestic technology corporations. Between 1985 and 2008, the U.S. share of worldwide high technology exports declined seven percent from 21 percent to 14 percent. In addition, the loss of domestic S&E capacity can impact the development and manufacture of national security related technology that cannot be manufactured overseas (National Science Board, 2010, p. 6). Asian countries have realized that maintaining an effective and competitive education system is essential to sustaining economic growth in a post-industrial; knowledge based global economy (Levine, 2010, p. 1). Microsoft Chairman Bill Gates provided a concerning view of our economic sustainment and the state of our educational system when he warned, "We simply cannot sustain an economy based on innovation

unless our citizens are educated in mathematics, science and engineering" (Augustine, 2007, p. 48). However, there is a serious loss of our innovative potential in the fact that almost half of our high school physics students are female, but only 18 percent of the recipients of doctoral degrees in physics are women. Advanced degrees to women and minorities are disproportionately lower with women earning 20 percent of the engineering bachelor's degrees and 17 percent of the engineering doctoral degrees, and minorities (blacks and Hispanics) only receiving five percent of the bachelors and doctoral degrees in the sciences (Augustine, 2007, p. 49).

2. The Role of Education Plays in Maintaining Our Technological Advantage and National Security

Technological advantage and education is not only essential to our economy but to our security and way of life. In a 2009 speech before the National Academy of Sciences, President Obama renewed his commitment to education in the field of mathematics and science stating, "Our future depends on it" (Wadsworth, 2010, p. 14). Former President Bill Clinton stated, "Where once nations measured their strengths by the size of their armies and arsenals, in the world of the future knowledge will matter most" (Augustine, 2007, p. 16).

Science has largely vanished from the national conversation (Walsh, 2010, p. 39). The technological eminence of America made the twentieth century the "American Century." Since 1901, of the 530 Nobel Laureates in physics, chemistry, or medicine, more than 200 have been Americans. This technological innovation helped spur on the American inventive and entrepreneurial spirit that helped to establish such economic giants as Apple, Ford, IBM, Boeing, and Google. The federal government played a critical role in the fueling of this innovation by developing a science and engineering initiative and funding following the Soviets launch of Sputnik in 1957 (Walsh, 2010, p. 41).

The United States investment in scientific R&D has remained constant at 2.7 percent in the 1980s while South Korea and Japan have greatly increased this ratio (Walsh, 2010, p. 41). China investment in scientific R&D grew by 20 percent between

1996 and 2007, compared to six percent in the U.S. (Walsh, 2010, p. 41). The U.S. appears to be losing interest in the sciences, with only about a third of bachelor's degrees being issued in science and engineering, compared to 63 percent in Japan and 53 percent in China (Walsh, 2010, p. 42). Once at the top of the counties in terms of the ratio of science and engineering degrees to its college aged population, the U.S. now ranks near the bottom of 23 countries (Walsh, 2010, p. 41). U.S. ranked eighth in the world in terms of GPD spent on R&D (Walsh, 2010, p. 41). In took less than a decade for the U.S. to move from a trade surplus to a trade deficit. In 1990, the U.S. had a technology trade surplus of $40 billion, and just 10 years later, in 2000, it had a $50 billion trade deficit (Augustine, 2007, p. 20). As a result, the U.S. has become a net importer of high technology goods (Augustine, 2007, p. 20). Of the world's leading information technology companies, only one of the top 10 is based in the United States (Augustine, p. 17). According to the Academies of Science, almost 60 percent of all of the patents applied for with the U.S. Patent and Trademark Office in the field of information technology originate in Asia (Augustine, 2007, p. 18).

Maintaining a highly educated and innovative workforce is also critical to our national security and defense capabilities. Defense related innovation has provided a number of critical technologies, such as the Internet, communications and weather satellites, global positioning systems, and nuclear power. However, the defense science and engineering workforce has declined from 45,000 to 28,000 scientists during the 1990s (Augustine, 2007, p. 59). With the increasing number of foreign born students obtaining advanced science degrees and engineering degrees in the U.S., and the decreased interest of U.S. students in the sciences, the problem of the shrinking skilled labor force is exacerbated further by the reduction in numbers of U.S. citizens in these fields who can obtain the requisite security clearances (Augustine, 2007, p. 59). With the development of such cutting edge military technology such as the digital computers, stealth capabilities, precision guided missiles, nuclear propulsion, and space surveillance, it is easy to see why President Bush stated, "science and technology have never been more important to the defense of a nation and the health of the economy" (Augustine, 2007, p. 59).

Realizing the difficulties of facing the U.S. military, countries like China are using new technologies to develop a new army for the twenty-first century based on the use of information technology to wage information warfare (IW) and electronic warfare (EW). China is currently looking for alternative methods, such as IW, to attack the United States. This "Net Force" would be made up of highly skilled soldiers who make up a shock brigade of network warriors, information protection troops, an information corps, electronic police, and a united network (Tsai, 2006, p. 69). Because of the use of emerging technologies as warfare agents, our knowledge of these technologies and our technological advantage over competing countries around the world will be even more crucial to our national security in the future.

In January 2011, open source information began reporting that the Chinese J-20 stealth fighter would be operational much sooner than previously expected. What is most important about the new Chinese stealth aircraft is that more of it is being manufactured from composites of Chinese made technologies, as opposed to imported technologies. This change is showing greater capabilities of Chinese military technology, which is being driven by its expanding technology. According to the Chinese Defense Minister Liang Guanglie, this industrial capability is expected to speed up during this next five year plan, which runs from 2011 through 2015, when China is expected to implement military modernization (Grevatt, 2011, p. 2). In speaking about the importance higher education and innovation, China's President Hu stated, "the worldwide competition of overall national strength is actually a competition for talents, especially innovative talents" (Augustine, 2007, p. 45).

3.   The Declining Interests of Our Domestic Population in Pursuing the Hard Sciences

The STEM majors are often considered to be the most demanding and strenuous college majors, specifically because of the rigorous coursework and stringent grading. The STEM majors are comprised of various areas of study, such as engineering, including electrical and computer engineering or bioengineering, mathematics, chemistry, and physics. A 2010 Wake Forest University study was conducted to determine why so many students begin college interested in STEM education, but why so few finish with

advanced science degrees. According to the study, the difficulty of the program and the stringent grading discouraged many students from continuing in STEM degree programs (Rask, 2010, p. 5). Are American students lacking the desire and sense of a social imperative to have another national "Sputnik" moment as they did in the 1950s? Concerns for the American adolescents' educational outlook often revolve around their perceived determination, preparedness, and social values. In a 2003 U.S. Census Bureau ethnography report of U.S. high school students, only 10.6 percent indicated that "hard work," was one of their core values (USCB, 2003, p. 13).

Studies are also showing that an alarming number of U.S. students are failing to come to school adequately prepared. Self-regulation is the ability of students to take the necessary steps to ensure they are prepared to learn. A self-regulation activity, such as coming to school prepared and with the necessary books is an indicator of student engagement and is necessary for the learning process. In 2002, approximately 26 percent of student in the U.S. came to school chronically unprepared (National Center for Education Statistics, 2007, p. 53). This included coming to school without their homework done, without the necessary supplies, or without their textbooks. Even more concerning is the fact that the number has increased eight percent from 1990 (National Center for Education Statistics, 2007, p. 53).

The concern for U.S. adolescents not having the determination and drive to succeed in an increasingly competitive industrial society was documented in research articles over 50 years ago. In a classic 1959 study on adolescents, psychologists; James Coleman wrote in the *Harvard Education Review* (an excerpt in the *2006 Education Next magazine*):

> We are beset by a peculiar paradox: in our complex industrial society there is increasingly more to learn, and formal education is ever more important in shaping one's life chances; at the same time, there is coming to be more and more an independent "society of adolescents," an adolescent culture which shows little interest in education and focuses the attention of teenagers on cars, dates, sports, popular music, and other matters just as unrelated to school. (Coleman, 2006, p. 41)

According to Coleman, the study showed that adolescents cared more about achieving status in the eyes of other adolescents. The only way to keep the occasional overachiever from feeling isolated from the crowd was to change the norm of the culture.

Funding and academic policies have focused on addressing the curricula, facilities, teachers, and equipment, but very little has focused on addressing the "collective failure" referred to in the that resulted in our lack of foresight of the emerging global competition in education and technology, and ultimately our declining global educational rankings (Augustine, 2007, p. 6). We are misaligned in the ways societies and communities prepare for education. Policymakers can require students to attend school and control the content and delivery of the curriculum, but little attention is given to the reception of the teaching by the students or the responsibility of the student to value the lesson. Greater attention to the shaping of the adolescent culture needs to be considered in an effort to bring student values more in line with that of the schools.

4.   The Need for a New Approach to Educational Policies and Programs

With the advancing technological capabilities of our rivals in the international arena, the ability of the United States is at a critical tipping point. The importance of the education system and the need to develop a strategic plan to support the continued advancement of the studies of science and technology is an important part of the President's 2010 *National Security Strategy* (White House, 2010). In addition, advancing the United States' science and engineering educational capabilities is essential to supporting the Department of Homeland Security (DHS) *Quadrennial Homeland Security Report* (QHSR) and combating many of the threats therein. Specifically, it is essential for a leading science and engineering educational program to address the threats and global trends listed by the QHRS:

- High-consequence and/or wide-scale cyber-attacks, intrusions, disruptions, and exploitations
- Economic and financial instability
- Sophisticated and broadly available technology (Department of Homeland Security [DHS], 2010, p. viii)

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According to the DHS, our economic vitality and national security depend on a vast array of critical networks, systems, and services, and therefore securing cyberspace has become one of the homeland security community's most important missions. One of the key strategic homeland security outcomes from the *Quadrennial Homeland Security Review* that is specific to educational facilities includes Mission 4, securing cyberspace:

> Academic institutions produce and homeland security partners sustain a cyber-security workforce that meets national needs and enables competitiveness, Goal 4.2; Promote Cyber-security Knowledge and Innovation. (DHS, 2010, pp. 54–56)

Education plays an important role in each of the critical infrastructure sectors established under Presidential Policy Directive 21 in 2013 (see Figure 1).
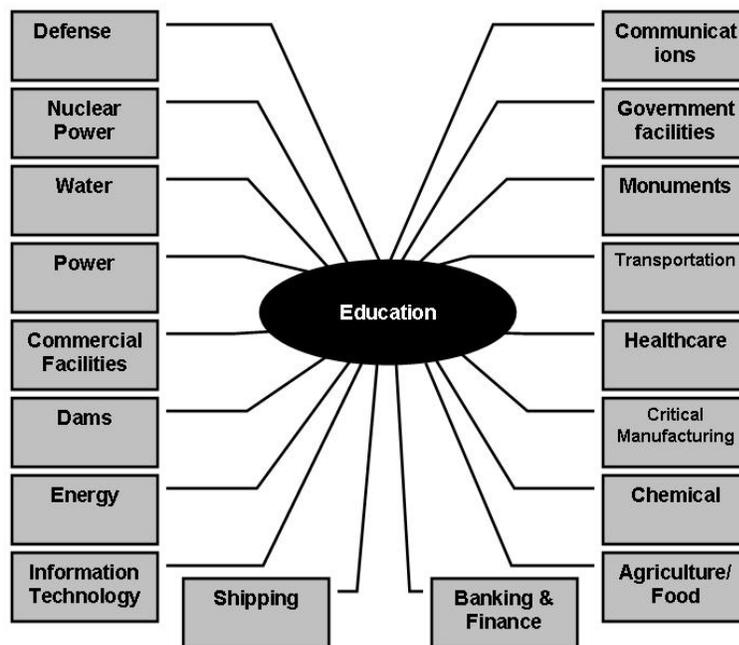
Figure 1.   Interdependency of Education with the DHS Established Critical Infrastructure Sectors (after personal communications with T. Lewis, January 2011)

Executive Order 13434 National Security Professional Development, established a policy to promote the education, training, and experience of current and future professionals in national security positions in order to prepare them for the emerging

threats, to include high technology national security issues (2010, p. 650). However, in the past several decades, the United States has not been able to implement policies to reverse the declining interest and success in STEM education.

C.   TENTATIVE SOLUTION

In order to maximize the consumption of the educational opportunities afforded, current policies and programs must provide greater focus on the development of the positive collective interests of the students to excel in school and to develop a sense of social responsibility towards success. Two social theories, Albert Bandura' social learning theory and Travis Hirschi's social control theory, play an important role in the development of future educational policies to create a strategic shift in America's youth towards excelling in math and science.

In 1997, Stanford University psychologist Albert Bandura published research on a concept of human learning called the social learning theory. Bandura's social learning theory is based upon the importance of observation and imitation in the learning process and development of social values within groups. According to the social learning theory, significant learning occurs through the observation of peer's behaviors, attitudes, and emotional reactions. These observations are then modeled by other members of the community. New behaviors within a community can often occur as a result of the modeling and the reciprocal interaction based upon cognitive, behavioral, and environmental interactions. The process through which learning occurs under the component processes underlying observational learning are:

(1)   Attention, including modeled events (distinctiveness, affective valence, complexity, prevalence, functional value) and observer characteristics (sensory capacities, arousal level, perceptual set, past reinforcement),

(2)   Retention, including symbolic coding, cognitive organization, symbolic rehearsal, motor rehearsal),

(3)   Motor Reproduction, including physical capabilities, self-observation of reproduction, accuracy of feedback, and

(4)   Motivation, including external, vicarious and self-reinforcement (Bandura, 1977, p. 22).

Though he often contributed with theoretical advances regarding delinquency in the criminal justice field, Hirschi's (1969) social control theory is very applicable toward the development of an effective social learning environment, specifically because of the need for future policy to focus on the transformation of a percentage of today's youth from a condition of perceived social disorganization. Hirschi's social control theory states that individuals with strong social ties are less likely to break those ties and diverge from the norm and bring discredit upon themselves or the group (Agnew, 1985, p. 47). Social control theory focuses on four important social bonds that if strong, help to develop social convergence on the norms of the group. These four bonds include: attachment, commitment, involvement, and belief (Agnew, 1985, p. 47). Attachment is described as the affection or respect that a person has toward significant individuals in their life, such as teachers, parents and peers (Agnew, 1985, p. 47). Commitment is a person's actual or anticipated investment activities that may result in self or social improvement, such as getting an education (Agnew, 1985, p. 47). Involvement refers to the amount of time an individual spends on activities such as doing one's homework or reading (Agnew, 1985, p. 47). Lastly, belief is the individual's commitment toward the values established by their social environment (Agnew, 1985, p. 47). By developing policies that focus on instilling a positive outlook in these four bond areas, we can begin to create a strategic shift in social and cultural values affecting U.S. students.

The development of positive social values can be further supported through self-emulation by the group. Self-emulation is the desire to do as well, if not better, than the other people within the group. By developing the concept among peers of the value of education and success in education, you reinforce a positive improvement cycle within the community. In other words, *success breeds success*. Emulation strengthens the constant improvement and development of the members of the group.

In addition to social control methodologies and emulation to enhance the values and learning with a community, educational policies aimed at addressing the lack of the perceived educational desire in today's adolescence also need to address the concept of self- efficacy. Self-efficacy, sometimes referred to as self-actualization, is an individual's sense of his or her own capabilities. Self-efficacy is a person's inherent belief as to his or

her capability to succeed through determination or exertion to reach his or her goal. It is a very important part of the learning cycle. Leading psychologist in the area of social learning and efficacy, Albert Bandura, believes that self-efficacy and motivation are closely tied to each other, and that a person's motivation for behavior is directly related to one's sense of self capability. According to his research, a person's level of efficacy directly relates to how they view difficult tasks. Individuals with a strong sense of self capability view difficult tasks as challenges and are able to develop successful means to address the challenge. A higher level of self-efficacy enables the individuals to feel a greater sense of control over the challenge and enables them to sustain their effort longer and recover faster in the event of failure (Rhodes, 2007, p. 14). A high level of self-efficacy in students has shown that they are more likely to take more difficult tasks, such as the STEM studies, and be successful at them (Rhodes, 2007 p. 15).

Although self-efficacy has shown to play an important role in a person's motivation and capacity to respond to challenges, group influence has demonstrated to be a stronger influence. Studies have shown that the influence of the group is often a greater factor on the actions of the individual than is the controlling aspect of self-actualization (Meldrum, Young & Weerman, 2009, p. 364). This finding supports the importance of the collective performance of the group and stresses the importance of educational policies aimed first at evolving the collective performance and then at the development of self-actualization.

D.   CRITIQUE OF LITERATURE

Significant scholarly literature is available supporting the interdependent role education plays in maintaining a number of our critical systems and the cascading effect declining global educational ratings can have on these systems and ultimately our national security. The foundation developed in lower- and upper- level educational systems is critical to maintaining our technological advantage and supporting our national security, but this foundation can be affected by a changing economy through educational funding (see Figure 2).

Figure 2.   Criticality of Education in National Security, the Economy, and
Technological Advantage (after R. Bergin, personal communications,
February 2011)

Gaps in the literature that require additional research include the further analysis of how social learning theories can be applied in education to increase the sense of urgency, responsibility, and nationalism in America's students with the aim of developing greater success in STEM education. Additional research is warranted in the analysis of policies and programs, both domestic and international, with the aim of identifying areas where strategic policy recommendations could be made in order to reduce the declining interest of American students in the sciences and develop a social imperative towards learning.

E.   SIGNIFICANCE OF RESEARCH

This research provides educational policy and program developers with a historical perspective on a time when America was able to rally its STEM capabilities to overcome great adversity and to provide them options to increase the educational longevity of our domestic population is pursuing the hard sciences. This research helps to

support policies to ensure sufficient graduate level output in the area of science and research to support domestic companies, and our homeland and national security agencies, while reducing our reliance on foreign educated resources.

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III. PROGRAM EVALUATION

Educational policies and programs are currently provided by a number of organizations, including the federal government (including the Department of Defense), local and state governments, private industry, non-governmental organizations, and community based organizations. These policies can operate independently, but more often they operate in support of one another (see Figure 3).

Federal Education Policies

Private Business and NGO's

Community Program

State and Local Governments
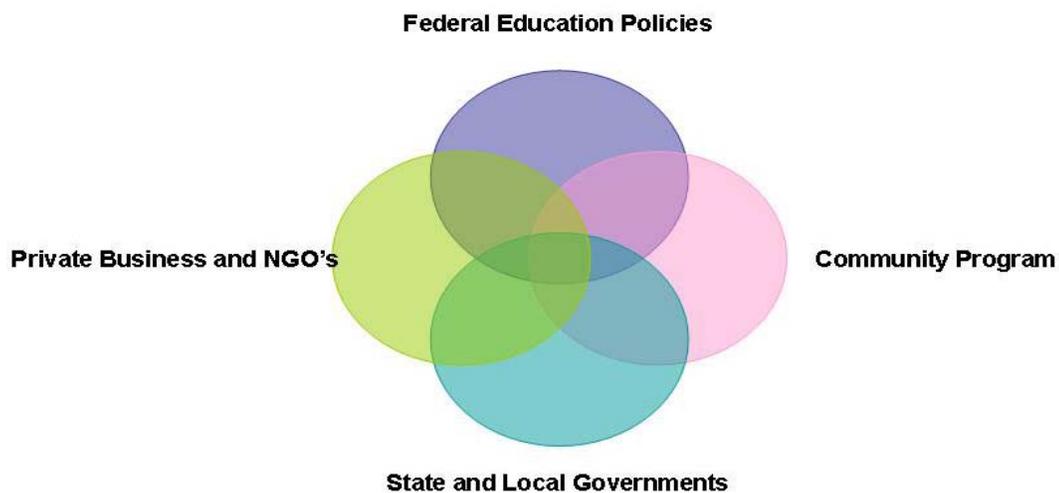
Figure 3.   Interrelation of State, Federal, NGA and Community Based Education Programs

A.   METHODOLOGY

This policy analysis evaluated a number of policies and programs with the focus of identifying deficiencies in the policies and synthesizing recommendations for future policies. Policies were analyzed for substantive issue in design and to choose an alternative that will lead to the desired outcome. According to Eugene Bardach, substantive issues in the design of a policy are usually one of two types. First is in the management of cases involving some sort of treatment, or behavioral changing regiment, such as communities receiving education from government resources. The second issue in design involves policies that address the collective as opposed to the individual (Bardach, 2009, p. 24.). This policy analysis determined if a number of current policies

and programs, both from the government and private sector, have included steps to address the improvement of the collective when it comes to the ensuring maximum consumption of educational resources. Policies were evaluated based on a sense of efficiency, specifically how are they maximizing the public interest (Bardach, 2009, p. 36). Specifically, the evaluation of the selected policies and programs focused on the incorporation and use of the following social learning theories:

- Social learning theory
- Social control theory
- Self-efficacy
- Emulation

In essence, these policies were analyzed to determine how and to what extent they are impacting the drive of students to learn. In addition, the evaluation also included the review of an international educational policy that has been successful in cultivating social interests in education and the development of a national imperative towards education. This international policy was evaluated in order to determine best practices that may be incorporated into future U.S. policies.

B.   EVALUATION FORMAT

The analysis of the policies and programs will be formatted in the following fashion:

- Overview of the program: This section provides a synopsis of the program and its main goals. This section also explains the origin of the policy.

- Description of program methodology: The method in which the policy recommend delivery or the application of its recommendations or programs. Specifically, this section focuses on how the policy is aimed at affecting the social or self-values regarding education.

- Target audience: this section will identify the target of the policy or program.

- Analysis on level of policy/program focused on developing student engagement, both on the individual and group level. This section will evaluate the impact that the policy or programs have on the social values and individual values regarding education.

- Successes or issues: Based upon statistical data and reports, this section will summarize any program success or issues with a focus on social

values and individual values regarding education. This policy analysis will construct alternatives strategies and policies recommendations to mitigate the problem of America's declining interest in the math and sciences and to strengthen the math and science skills of U.S. students in the hopes to reverse America's declining global educational rankings. Through the analysis of these programs and policies, strategic policy recommendations will be made to promote the interest of our domestic population in pursuing higher level STEM education in order to support our technological advantage, our national economy and ultimately our national security. This analysis will also focus on ways that the federal and state governments, NGO's and the media can support the interests of America's students in STEM education.

C.   PROCESS

This process will utilize the policy analysis and evaluation of a number of current policies, programs and initiatives from the various stakeholders in order to develop strategic policy recommendations to develop a national imperative within communities to pursue science and math education in order to support our economic prosperity and national security. In addition, an analysis of the international policies utilized in a democratic country that has successfully cultivated a social imperative towards education will be evaluated and best practices incorporated into policy recommendations (see Figure 4).

Policy Development
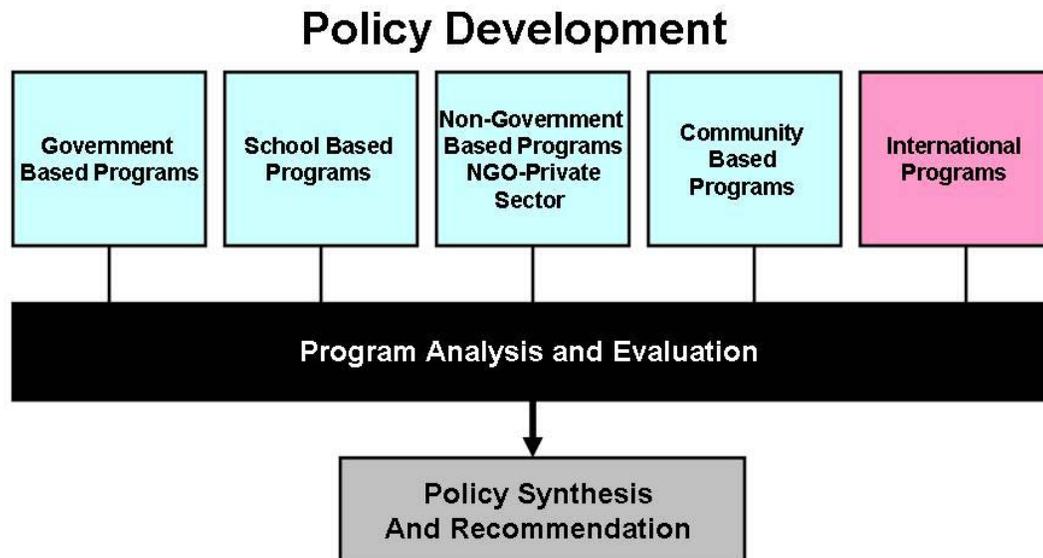
Figure 4.   Policy Analysis Process

D.   SELECTED POLICIES FOR ANALYSIS

During the course of this research, a number of government, non-government organizations (NGO) and private corporations, schools, and community programs were evaluated. The programs evaluated consisted of the following:

Federal government programs:

- No Child Left Behind; Elementary and Secondary Education Act (ESEA)
- The American Recovery and Reinvestment Act
- COMPETES Authorization Act
- The Investing in Innovation Fund
- The National Defense Education Act, Current STEM Initiative, and the Gifted
- U Teach and Teach for America
- Race to the Top
- Educate to Innovate

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Non-government based education programs:

- Time-Warner Cable, Discovery Communications, Sesame Street
- National Lab Day
- Exxon-Mobile
- Bill and Melinda Gates Foundation- Early College High School Initiative
- Google Educate
- FIRST
- Intel

Community based education programs

- Change the Equation

International comparison

- Finland's Educational System (Virtuous Cycle)

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IV. EDUCATIONAL POLICY AND PROGRAM ANALYSIS

A. INTRODUCTION

While considerable attention is focused on the federal government for establishing educational policies and mandates, the role of the federal government in controlling state educational policies is very limited. The Tenth Amendment of the Constitution of the United States delegates a majority of the individual state authority to the states themselves. The Tenth Amendment states; "The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people." The Constitution did not delegate the power to regulate elementary or secondary school to the federal government. The impact that this has on the development and analysis of these educational policies is significant. While the federal government may develop an overarching educational policy, the states are giving individual autonomy and significant flexibility on how this is implemented. As a result, a single federal policy can result in 50 significantly different state level implementation programs. The varying state and NGO educational policy implementations create a significant challenge at developing a standard set of criteria or matrices with which to provide analysis of the policies and programs. However, the analysis provided in this research will focus on how each of these programs contributes to students' success in STEM education.

B. NO CHILD LEFT BEHIND, THE ELEMENTARY AND SECONDARY EDUCATION ACT

One of the largest federal policy initiatives aimed at overhauling America's education system and reinvigorating the declining global educational competiveness of America's schools was the No Child Left Behind (NCLB) law. The NCLB law was originally started under President Bush's administration in 2001 and reauthorized in 2010 by President Obama through the ESEA. According to the Department of Education, the ESEA was implemented to reestablish the United Stated higher level education supremacy by the year 2020 (U.S. Department of Education 2010, p. 1). The ESEA built on reforms already started under the American Recovery and Reinvestment Act (ARRA)

of 2009 and focuses on four areas of reform: (1) Ensuring teacher and principal effectiveness, (2) Providing information to families and schools to improve student's learning, (3) Implementing standards that would ensure graduating students were college or career ready, (4) Improving achievement in America's lowest performing schools through monitoring and intervention plans (U.S. Department of Education, 2010, p. 3). The ESEA focuses significant attention on the development of teacher and principal evaluation criteria and tracking data in order to ensure the best are being hired and retained. The ESEA continue the incentives under the Race for the Top program and the Investing in Innovation Fund that supports school reforms focused on the development of better performing schools.

The ESEA is more of a broad range of policies that sets flexible recommendations for the states to reach the 2020 goal. Although the ESEA sets the goal of producing college or career ready students, the Department of Education recognizes that four out of every 10 U.S. college students require remedial education classes once they get to a two or four year college. The ESEA policy recommends that the states governors establish the necessary standards to ensure that the students of tomorrow are adequately prepared (U.S. Department of Education, 2010, p. 7). The ESEA program recommends that states work with four year universities or work with other states to develop effective levels of performance that will ensure future students do not have to undergo remedial education in university or college. The ESEA also allows for incentives or rewards to go to the school systems that help to raise achievement levels through developing or replicating "communities of practice" to share best practices.

Furthermore the ESEA places a lot of emphasis on standardized test based accountability and continually focuses on turning around the lowest performing schools. Test based accountability is considered to be a low cost strategy. Extensive effort under the ESEA is made to categorize low performing schools and to develop intervention plans. Once categorized, the ESEA makes a number of very radical and aggressive recommendations to transform the schools from replacing the principal and half of the staff to closing the school and sending the students elsewhere. Very little evidence or specific directions are provided by this program. Radical personnel changes such as these

can have a dramatic effect on the students, where the interaction between the student and the teacher is the primary determinant of student success (U.S. Department of Education, 2010, p. 13). It should be noted that these dramatic changes in a student's school can also have serious negative consequences on a student's sense of attachment and commitment that is often associated with their social learning environment and may instead contribute to a sense of social disorganization. In addition to drastic measures to transform schools, the ESEA also provides incentives and resources to help hire, retain, and train effective principals and teachers.

The ESEA acknowledges that many of our failing students "attend schools and live in communities with insufficient capacity to address the full range of their needs" (U.S. Department of Education, 2010, p. 31). The ESEA proposes a "Cradle to College" approach recommending that services need to be provided to address everything from community and family support to crime and safety in our schools in order to achieve its goals. The ESEA will provide grants to support community development that will foster better school performance. As part of the Race for the Top program, the ESEA will provide grant funding to schools and school districts that develop effective comprehensive plans that promote greater learning capabilities and who share and implement these ideas with other schools, districts, and states.

The ESEA will continue the Innovating In Ideas (i3) program that was started in 2009 under the American Recovery and Reinvestment Act of 2009 (U.S. Department of Education, 2010, p. 36). The i3 program will provide funding to school districts that develop evidence-based plans to utilize innovative practices in the classroom to increase learning. Preference in funding will be provided to schools that implement innovative ideas aimed at increased STEM learning capabilities. According to the Department of Education's implementation plan for the ESEA entitled, *Blueprint for Reform, the Reauthorization of the Elementary and Secondary Education Act*, this new policy aims to redefine the federal role in educational policies offering states less of a compliance mandate and more of a flexible approach to reinvigorating the educational outlook of the United States (2010). This 41-page blueprint pales in comparison to the level of specificity offered in the 671 page No Child Left Behind law.

While the ESEA pushes constant evaluation of the students and the raising of standards, the ESEA provides no supporting facts concerning the benefits of raising student standards. Knowing that new educational policies are often accompanied by an initial drop in test scores, administrators and politicians are unlikely to challenge the established standards.

Additionally, in relation to STEM education the ESEA focuses on providing grants to assist states in transitioning to higher standers in STEM education and strengthening STEM education through support to high need districts to implement high quality instruction in at least math or science (U.S. Department of Education, 2010, p. 26). Although little guidance is given to the states, they will be required to develop comprehensive, evidence-based plans to provide high quality STEM instruction. In addition, while the ESEA does mention being able to partner with those in the community with STEM expertise in order to raise the level STEMS learning, especially in underrepresented groups. However, no guidance or specifics are given on how to develop these partnerships and enhance learning. The ESEA also addresses the initiative to provide more accelerated Advanced Placement (AP) programs and college level studies.

Schools will have the opportunity to apply for a number of sub grants to develop and support these opportunities. Priority in the issuance of these sub grants will be to the schools that have low graduation rates and serve low income communities (Department of Education, 2010, p. 29). ESEA focuses extensive support to high need schools and districts, which ensures equitable distribution of the resources in an effort to raise all of the student scores, and not just those of the poor performing students of low performing school and/or students can actually have a negative impact on the students and the administration by reducing their sense of self-efficacy and replacing it with a sense of collective failure. In addition, the labeling can result in some of the more talented and gifted students, seeking attendance elsewhere and not contributing positively to the social learning environment, and promoting self-emulation of the other students in the classroom.

Opponents of the ESEA have focused on a number of areas where they believe the policy is flawed. In a National Education Policy Center (NEPC) October 2010 report, the ESEA was found lacking in the development of an effective accountability model and cited that the policy has an ineffective intervention model for low performing schools (Mathis & Welner, 2010, p. 3). In addition, the ESEA policy is criticized for being based on non-empirical based data, but on the information provided by special interest groups, government documents, and media reports instead (Mathis & Welner, 2010, p. 4). The policy is also considered to be flawed due to its over reliance on standardized test scores, which many believe would cause the instructors to "teach to the test" at the expense of other subjects. Not only did the NEPC cite this as a concern, but the authors believe that it would result in instructors teaching a narrowed spectrum of the curriculum that uses rote memorization over higher order critical thinking skills, which is essential to developing new and innovative ideas (Crawford, Daniel & Patel, 2011, p. 3).

C.   THE AMERICAN RECOVERY AND REINVESTMENT ACT

The American Recovery and Reinvestment Act (ARRA) supports the ESEA through the provision of annual funding. In 2009, the ARRA supported education through the administration of $53.6 billion in funding that is administered by the Department of Education.

Part of the ARRA is the Investing in Innovation (i3) fund. The Investing in Innovation fund provides funding to support the expansion of educational programs that have been successful in developing student's STEM capabilities. The program develops partnerships between school and organizations through matching fund programs and educational opportunities to help improve student achievement, increase high school graduation rates, or increase college enrollment and completion rates. The Investing in Innovation fund has supported a number of programs from transforming STEMS teachers to developing student success in AP biology. However, funding for this program has been greatly reduced from $650 million in 2010 to $150 million in 2011, which resulted in only 23 projects being funded (U.S. Department of Education, 2011).

While the ARRA provides a massive influx of monies to the education system, almost 82 percent of the funds went towards subsidizing the cuts in educational spending implemented by the states to meet their budgets (U.S. House of Representatives, 2009). This stop-gap measure has not been enough to make up for the budget shortfalls and many states have had to cut teacher positions and increased classroom student populations.

D.   AMERICA COMPETES AUTHORIZATION ACT

The America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act was established in 2007 as a means to address the concerns associated with the innovative capacity of the U.S. The COMPETES act was developed to address the lack of funding and attention being given the area of STEM education from kindergarten to graduate school (Stine, 2009, p. i). In addition to funding, the COMPETES Act focuses on developing students who are proficient in math and interested in the sciences. The act was reauthorized in the America COMPETES Reauthorization Act of 2010.

The COMPETES act also contains an educational component that focuses on retaining and training STEM teachers and providing more STEM learning opportunities for kids. The support for educators and students comes in the form of new scholarships and educational certification programs and funding of various STEM learning opportunities such as the ESEA in support of the COMPETES Reauthorization Act. Many of these policies focus on high needs schools (Stine, 2009, p. i). The focus on these lower performing schools in lower socioeconomic areas have led many to believe that the main goal of the COMPETES Reauthorization Act supporting programs was to promote social equity goals (McDonnell, 2008, p. 9). Although the America COMPETES Reauthorization Act received bipartisan support, there were many who believed that this was not actually necessary and that the act may not be the best way to address competitive concerns, citing the various perspectives on competitiveness, whether it be from a market share point of view, foreign investment or workforce, and wages (Stine,

2009, p. 5). Regardless of the method used to determine competiveness, the act was developed based upon critical assumptions (Stine, 2009, p. 13):

- A basic understanding of STEM is necessary for everyone, and that American lower education (K-12) does not have enough students proficient or interested in STEM education.

- Not enough American students are receiving STEM degrees as compared to our competitors and this has far reaching impacts on the capabilities of our workforce.

- STEM research and capability is an important to our economic growth.

Many are concerned with the lack of interest of American students and teachers in STEM education and feel that developing ways for them to interact with current scientists in the field would be an excellent mentoring and motivating program. As part of the COMPETES act, the Department of Energy (DOE) has developed a number of such programs offering these opportunities. Science and math teachers have historically come from education departments within universities. However, a program of the COMPETES act, which has been recognized as a successful method of retaining highly qualified teachers in the classroom, takes students in science and engineering and provides them with stipends and scholarships in exchange for committing to teach for a number of years (Stine, 2009, p. 254). Referred to as the Robert Noyce Scholarship program, it is very similar to the Department of Education's Teaches for a Competitive Tomorrow and the UTeach program. The act also promotes current students in the STEM curriculum to obtain teaching certificates through the Department of Education.

Since this is an authorization act, future programs cannot be funded until appropriations are provided to the act. Oftentimes, future congresses will fund part of the act at an expense of another (Stine, 2009, p. i). Many of these policies focus on high needs schools (Stine, 2009, p. i). Although the act received bipartisan support, there were many who believed that this was not actually necessary and that the act may not be the best way to address competitive concerns, citing the various perspectives on competitiveness, whether it be from a market share point of view, foreign investment or workforce and wages (Stine, 2009, p. 5).

Opponents to the COMPETES act vary in position, but those favoring an investment strategy with less government control believe that the market is a better indicator of what technologies to invest in and worry about the possibility of political pressure influencing funding allocations (Stine, 2009, p. 15). In addition, transformational research initiatives, which are considered high-risk, high-reward research, are often denied funding. In FY2004, over $2 billion of grant requests to support highly rated transformational technology projects were denied, which resulted in a number of possibly missed opportunities (Stine, 2009, p. 18). In 2008, the National Science Foundation reported that no funds had been dedicated to transformative research.

As part of the COMPETES act, the Department of Energy (DOE) has developed a number of programs to address the lack of interest of American students and teachers in STEM education and feel that developing ways for them to interact with current scientist. However, the Bush administration did not believe that this is a DOE responsibility and did not support aspects of the act, such as the Specialty Schools in Math and Science, Experimental Based Learning Opportunities, Summer Institutes, and the National Laboratories Centers of Excellence (Stine, 2009, p. 23). Though it was has not been funded in the 2008 and 2009 fiscal years, in the FY2010 appropriations, the DOE Specialty Schools for Science and Mathematics pilot received $30 million (Stine, 2009, p. 30). Through establishing partnership and STEM organizations and programs such as the Department of Energy's STEM outreach initiatives the America COMPETES act has the ability to positively develop social/ observational learning environments through the use of mentors and hands on programs. These partnerships can have a positive impact on student perceived self-actualization capabilities and group influence.

E.   THE NATIONAL DEFENSE EDUCATION ACT

Following the launch of Sputnik by the Soviet Union in 1957, Congress passed the National Defense Education Act (NDEA) to counter what appeared to be a superior education system in Russia (Jolly, 2009, p. 50). The NDEA provided a massive influx of funding into the education system, $1 billion over four years. The initial funding was designated for capable students without the means to pay for higher education. The

NDEA also recognized gifted students as an underdeveloped resource and focused on ways they could be developed to better support society. Immediately following WWII, there were no Department of Education Personnel assigned to gifted education and less than four percent of cities with a population over 2,500 had special programming for gifted students (Jolly, 2009, p. 51). Although discussed prior to the launch of Sputnik, the topic of the capabilities of rapid learners in STEM programs took off quickly along with the fears of the American public.

Programs that started under the NDEA and continue today as a very successful advancement include specialized high schools or magnet schools, and dual enrollment high school science programs (Jolly, 2009, p. 51). The gifted program under Title V of the NEDA also helped to develop some of the most comprehensive aptitude testing that were administered to almost every high school student.

While the NDEA has focused on supporting the academic achievement of the gifted student, it is in contrast with the NCLB act, which focuses on achieving a basic proficiency for all (Jolly, 2009, p. 52). As a result, many gifted students are not advanced in schools where the focus is on the under achiever. A 2006 review of the funding provided to gifted and talented programs revealed that approximately half of the $3 billion in funding available under the NDEA was not utilized. As a result, the Academic Competitiveness Council (ACC) made a number of recommendations to ensure better identification of needs and programs, better alignment of objectives, and improved coordination with K-12 education system in order to ensure better use of funding resources (Jolly, 2009, p. 52).

Through the establishment of AP classes, gifted and talented (GT) programs and magnet schools, the NDEA focuses on one of the strongest aspects of the social learning theory, which is group influence. Studies have shown that the influence of the group is often a greater factor on the actions of the individual than is the controlling aspect of self-actualization (Meldrum, Young, & Weerman, 2009, p. 364).

F.   UTEACH PROGRAM

A critical part of improving student success is bringing the best teachers into the classroom. According to the National Academy of Sciences 2007 report, 69 percent of middle school students are taught by math teachers who did not major in math and do not have teaching certificates in math. The percentages are even worse for the physical sciences; they indicate that 93 percent of the physical science teachers in middle school neither majored in science nor have a teaching certificate in science teachers (NAS, 2007, p. 114).

In response to the concerns for the domestic K-12 STEM education capabilities, the UTeach Institute was started at the University of Texas in 2006. The program's goal was to develop a greater cadre of certified teachers who were educated in the areas of advanced STEM education in the hopes of bringing more highly qualified and motivated teachers into the classrooms. The UTeach Institute was born from an innovated teacher preparation program started at the University of Texas in 1997 (The UTeach Institute, 2013). UTeach has expanded to 34 U.S. universities and is focused on developing and progressing teacher capabilities and preparedness in the area of STEM education. The UTeach program allows science and math majors to simultaneously earn a teaching certificate in their subject of expertise in four years instead of five. The National Science and Math Initiative has cited the program as a "*best practice*" and has supported the replication of the UTeach program to 33 universities by providing a $2.2 million grant to each university (Aarrison & Olson, 2012, p. 10).

According to the UTeach program projections, it will have reached 3.5 million students by 2019 (The UTeach Institute, 2013). The program is supported by a number of strategic partners to include: Exxon Mobil Corporation, Texas Instruments Foundation, Michael and Susan Dell Foundation, as well as a number of state education systems and over 50 universities.

The National Academy of Sciences paper referenced the UTeach program, citing, that American doesn't need any more studies, they need implementation (Aarrison and Olson, 2012, p. 11). The UTeach program was developed to replicate success. Students

who have been taught by professors from the UTeach program have averaged SAT and grade point averages higher than other students (National Academy of Science 2007, p. 117). In addition, a large number of the graduates of the UTeach program are electing to remain in the classroom as instructors (National Academy of Science 2007, p. 117).

UTeach has proven to be a very successful program. It has effectively trained and certified instructors in dual fields of science and math in order to make them more effective STEM educators. By developing effective hands-on learning environments, shortening the required time commitment for certification, reducing the financial burden, and partnering with current practitioners in science and technology, the UTeach program has the ability to positively develop social/ observational learning environments through the use of mentors and hands-on programs. These partnerships can have a positive impact on *student* perceived self-actualization capabilities and group influence.

G.   RACE TO THE TOP

In 2009, the Obama administration announced a competitive program through the Department of Education in which states would compete against other states for substantial educational funding. The Race to the Top is a competitive four year grant program designed to focus on sustainable education reforms in the areas of; rigorous and quality assessments, attracting quality teachers, supporting informative data systems, using innovation to turn around lagging schools, and demonstrating effective education reforms (Executive Office of the President of the United States, 2009). Through the program, student achievement would be linked to teacher and principal performance ratings in an effort to increase teacher performance and student achievement. However, in the short time period since the inception of the Race to the Top program (RTTT), critics have pointed out that this program is not about major changes in education, but about being able to cultivate across the state support for an educational program that for many has turned out to be too costly of an effort, both in cost and time (MacCluskey, 2010). Some states such as Colorado have elected not to participate in future Race to the Top endeavors.

In the first phase of RTTT school year (SY) 2010–2011 there were initially 11 states and the District of Columbia participating in the Race to the Top grants. The 12 localities states are: Delaware, the District of Columbia, Florida, Georgia, Hawaii, Maryland, Massachusetts, New York, North Carolina, Ohio, Rhode Island and Tennessee. Year two of the RTTT program included SY 2011–2012 and expanded to 19 states by including Pennsylvania, Rhode Island, New Jersey, Louisiana, Arizona, Colorado, and Illinois. In year two of the program, President Obama has requested a budget of almost $1.9 billion to continue the RTTT program (U.S. Department of Education, n.d.-a).

At the end of each school year, each participating state published a year end state specific report outlining their current accomplishments and issues through the Department of Education. Although the RTTT program incorporates a number of areas to address for enhancing education, this analysis will focus specifically on the areas of the RTTT program implemented to address the declining STEM educational rankings. The annual report by the Department of Education includes an overview of the programs implemented and the performance measures utilized in measuring the states' advances in the area of STEM education. A review of the Department of Education year end progress reports on the original 12 participating states provided the following accomplishments towards the performance measures utilized by the states for STEM education (U.S. Department of Education, n.d.-a).

1.   Delaware

The year-end report showed that in SY 2010–2011 Delaware held three STEM council meetings, implemented four high school STEM courses, and piloted one "Engineering is Elementary" course in its grade K-5 programs. In Phase two RTTT, SY 2011–2012, Delaware held four STEM council meetings, implemented four high school STEM courses, and piloted six "Engineering is Elementary" courses in its grade K-5 programs. In addition, the Delaware RTTT program focused more on developing underachieving schools in the state.

Results from the NAEP proficiency testing in mathematics for fourth and eighth graders for the SY 2010–2011 showed no noticeable improvements from 2009 (U.S. Department of Education, n.d.-b).

2.   District of Columbia

For the initial year of RTTT, the District of Columbia had very little in the state sponsored plan to advance STEM studies. The plan only listed a baseline of 43 percent of students scoring at proficient or advanced levels in tenth grade with no target number identified. In addition, the plan called for a coordinated statewide plan for STEM development by 2011, which based upon its own measurement, failed to implement (U.S. Department of Education, n.d.-c). According to the District, it expects more advancement once the Office of the State Superintendent of Education begins implementation of the project plan (U.S. Department of Education, n.d.-c).

However, in the second phase of the RTTT program covering SY 2011–2012, the District made no additional advancement in the area involving the emphasis on STEM, instead the indication is that the anticipated implementation of the DC STEM learning network will now be fall of 2013 (U.S. Department of Education, n.d.-c).

3.   Florida

In the initial year of the RTTT program, the state of Florida set goals to increase the enrollment of students in STEM course. From the 2009–2010 school year to the 2010–2011 school year, Florida increased enrollment in RTTT approved STEM courses from 95,292 to 112,514 students (U.S. Department of Education, n.d.-d). In addition, Florida incased the enrollment in accelerated STEM courses during that same period from 83,064 to 91,960 students (U.S. Department of Education, n.d.-d). STEM accelerated courses include those listed as advanced placement, international baccalaureate, Advanced International Certificate of Education, dual enrollment, and industry certification courses.

In the second year of RTTT, the 2011–2012 school year, Florida showed a smaller increase in the number of students enrolled in STEM courses, increasing from

112,514 to only 115,098 students. However, this still was above its approved target of 101,905 students, which was actually lower then what the school year started with. In the second year of RTTT, the number of students enrolled in accelerated STEM courses increased from 91,960 to 100,255 students, also beating the target of 88,122 students (U.S. Department of Education, n.d.-d).

4. Georgia

The state of Georgia developed two performance measures for the evaluation of the RTTT impact on the advancement of STEM education. In the first phase of the RTTT in the 2010–2011 school year, Georgia measured the advancement of STEM education by increasing the number of students taking advanced STEM courses developed through the Center for Education Integrating Science Math and Computing. In the first year of the program, Georgia did not submit a report for the number of students participating in the advanced STEM classes, but in the second phase of the RTTT program the number of students was reported to be 598 (U.S. Department of Education, n.d.-e). A majority of these students were participating in an advanced distance calculus program (587) and the remaining (11) were participating in Proofs and Problems in Numbers Theory and Algebra (U.S. Department of Education, n.d.-e). In addition, Georgia measured the success of its program by the number of teachers participating in Center for Education Integrating Science Math and Computing internship for teachers. For the 2010–2011 school year, 10 teaches participated in this fellowship program. For the second year of the program 2011–2012 school year, 23 teachers were participating in the program (U.S. Department of Education, n.d.-e).

5. Hawaii

The state of Hawaii developed a very specific set of measure for its students and teachers with which to evaluate their success under the RTTT program. These matrices included measuring the proficiency in math and sciences of the students, as well as those who were considered native, or partially native, or disadvantaged. The program also measured the number of highly qualified math and science teachers.

A summary of the results of the Phase I and Phase II of the RTTT are listed in Table 1.

Table 1.   Hawaii Race to the Top STEM Performance Measures (from U.S. Department of Education, n.d.-f)

Performance Measure	2010–11 SY	2011–12 SY	Target
Proficiency in Mathematics—Overall	55%	58.6%	64%
Performance Measure Proficiency in Mathematics—Disadvantaged	45%	49.4%	57%
Proficiency in Mathematics—Hawaiian/Part-Hawaiian	44%	47.9%	55%
Proficiency in Science—Overall	31%	33.1%	64%
Proficiency in Science—Disadvantaged	21%	24%	57%
Proficiency in Science—Hawaiian/Part Hawaiian	20%	21.9%	55%
Highly Qualified Math Teachers	NA	82.1%	100%
Highly Qualified Science Teachers	NA	86.9%	100%

A review of the results indicates that all of the measures fell short of the target levels established in Hawaii's SY 2011–2011 plan. Proficiency for the K-12 students in mathematics for the first two years of the program only increased by 3.6 percent to 58.6 percent and proficiency in science only increased by 2.1 percent to 33.1 percent. However, both fell short of the target level of 64 percent established by the state (U.S. Department of Education, n.d.-f).

6.   Maryland

In the initial phase of the RTTT program SY 2010–2011, Maryland developed a series of career pathways to allow students to explore the skills and requirements to succeed in STEM careers. The Maryland Center for Technology Education (CTE) developed programs within 10 broad careers categories, including Biomedical Science Program, Information Technology Program, which includes a CISCO and Oracle Academy, Computer Science, and Pre-Engineering (U.S. Department of

Education, n.d.-e). In the second phase of the RTTT program, Maryland developed a more aggressive series of programs to advance STEM studies. In order to enhance the students who are mentored by professional practitioners with the establishment of STEM internships, co-ops, and lab experiences for all interested high school students and college students. While this program's success has yet to be measured, Maryland has identified it as a step to increase the number of STEM college graduates 2013 by 40 percent and to increase its global competitiveness. Based upon the established initiatives, Maryland increased the students participating in

- the biomedical sciences from 983 students in SY 2010–2011 to 1,348 students in SY 2011–2012,

- IT Networking Academy from 1,513 students in SY 2010–2011 to 1,616 students in SY 2011–2012,

- Computer sciences from 1,638 students in SY 2010–2011 to 1,903 students in SY 2011–2012, and

- Engineering from 9,940 students in SY 2010–2011 to 11,530 students in SY 2011–2012.

According to the state report at the end of 2012, Maryland exceeded its target increases in the measured areas (U.S. Department of Education, n.d.-e).

7. Massachusetts

Massachusetts developed a RTTT plan that focused on three strategies to enhance STEM education. These strategies focused on the following three areas: individualized STEM instruction, expanding the supply of effective STEM educators, and increase the preparedness of underrepresented groups to enter higher level STEM education and careers. The state worked to revamp the individual education through enhanced curricula and the development of new STEM classroom designs. In an effort to increase the supply of STEM educators, Massachusetts has elected to participate in the UTeach program, and it is undertaking a rigorous professional development program for science and advance placement instructors. In addition, under the RTTT program Massachusetts is developing a teacher mentoring program. In order to better prepare math teachers to be more effective in the classroom, 148 educators are receiving advance math training and instructor mentoring (U.S. Department of Education, n.d.-f). Additionally, to I order to

develop college readiness among underrepresented groups, Massachusetts is in the process of core requirements, including implementing a four year mathematics requirement for all high school students that are aligned with entrance requirements of state colleges and universities (U.S. Department of Education, n.d.-f). This MassCore program will help to ensure that all students are afforded the opportunity to participate in STEM education. Furthermore, Massachusetts is utilizing the Massachusetts Comprehensive Assessment System to monitor student's capabilities in math and science.

As a result of the involvement in the RTTT program, Massachusetts has seen an increase of students completing the MassCore program from 50 percent of the students in SY 2010–2011 to 70 percent in SY 2011–2012 (U.S. Department of Education, n.d.-f). As part of the RTTT, Massachusetts has set a goal of increasing the students' overall MCAS scores by 15 percent between 2009 and 2014 (U.S. Department of Education, n.d.-f). However, in the first two phases of the RTTT, the state has only seen an increase of 0.9 percent from the MCAS score in SY 2010–2011 of 57.1 percent to the 58 percent in SY 2011–2012 (U.S. Department of Education, 2013).

8. New York

As part of the RTTT program, the state of New York has develop policies to help promote the opportunity for more school districts to participate in Career and Technical Education (CTE) initiatives to advance student participation in STEM education. The New York Board of Regents has approved CTE programs that focus on 16 career areas, which are aligned with common industry standards. As a result of the New York State participation in the RTTT initiative, in SY 2010–2011, the number of graduates with concentrations in the STEM areas was 9,840 students (U.S. Department of Education, n.d.-g). These students were from the 2006 cohort. In the same year, the graduation rate for the students focusing in the CTE STEM concentration was 84.7 percent (U.S. Department of Education, n.d.-g). For the second phase of the RTTT initiative, New York focused on the K-12 curricula and provided particular focus on the ninth and tenth grade curricula in an effort to increase performance and participation in the critical middle

grades. Updated CTE graduation rates for the SY 2011–2012 have not been released by the state of New York (U.S. Department of Education, n.d.-g).

9. North Carolina

For the first phase of the RTTT, North Carolina focused on developing STEM focused magnet schools. In SY 2009–2010 North Carolina did not have any STEM centric schools. As part of the RTTT program, North Carolina established two new STEM anchor schools through the New Schools Project. In that same time period, North Carolina opened one STEM affinity school through the New Schools Project (U.S. Department of Education, n.d.-h). North Carolina's advances in STEM education appeared to accelerate considerably under the second phase of the RTTT. In phase II, North Carolina utilized RTTT funding along with the New Schools Project to build 20 new STEM focused schools. This will be comprised or four anchor schools and 16 affinity schools that will each align with one of the anchor schools. These schools will include new curricula focused on invigorating interest in the STEM sciences, especially in areas facing economic hardships. North Carolina identified four focus areas for their STEM initiatives; Aero Space, Security and Automation; Health and Life Science; Energy and Sustainability; and Biotechnology and Agriscience (U.S. Department of Education, n.d.-h). The completion of the new schools in SY 2011–2011 consisted of one new anchor school for a total of three and 10 new affinity schools for a total of 11 new affinity schools. The addition of these new 14 schools exceeded the target set in North Carolina's RTTT initiative for SY 2011–2012 (U.S. Department of Education, n.d.-h).

10. Ohio

In phase one of RTTT, the Ohio Department of Education (ODE) held a symposium on the new program and allowed schools to meet with a number of organizers for various STEM education programs. The schools were then allowed to apply for grant funding under the "Other Schools Model" category in an effort to allow it to pursue emerging STEM education initiatives. In the first phase of RTTT, Ohio reported a K-12 student enrollment in STEM programs as 1,428 students (U.S. Department of Education, n.d.-i). Ohio set a target of doubling this amount by SY 2013–2014. Also in the initial

year, Ohio reported the enrollment in STEM majors in public universities as 106,903 students (U.S. Department of Education, n.d.-i). Again, Ohio set the goal to double this amount by SY 2013–2014. In phase II of the RTTT, Ohio reported a K-12 student enrollment in STEM programs to be 4,059 students, which exceeded its goal of doubling the enrollment by 2014. Also in the second phase, Ohio reported enrollment in STEM majors in public universities at 118,937(U.S. Department of Education, n.d.-i). This was an increase of almost 12,000 students over the previous year. During this phase, the ODE through Ohio STEM Learning Network (OSLN), established six STEM training centers throughout the state. These centers are affiliated with a higher education institution and were developed to provide training and technical assistance to the developing STEM K-12 schools, to include teacher development and STEM industry partnerships. The OSLN also focuses on economically deprived areas and underrepresented students (U.S. Department of Education, n.d.-i).

11. Rhode Island

In Phase I of the RTTT, Rhode Island had 32 local education agencies (LEA) participating in the STEM initiatives with the plan of rolling out its established programs throughout the state education system. In SY 2009–2010, Rhode Island had no grade standards for the expected learning levels within the areas of technology and engineering. In SY 2010–2011, the state implemented one grade span standards in the area of technology and engineering. Rhode Island also focused on increasing the number of LEA developing science and mathematics programs with rigorous standards. Between SY 2009–2010 and SY 2010–2011, Rhode Island increased the LEAs that were developing rigorous standards from four to nine and further increased the number of LEAs adopting these rigorous standards to 22 in SY 2011–2012 (U.S. Department of Education, n.d.-j).

12. Tennessee

In the first phase of the RTTT, the state of Tennessee developed programs and measures that focused on high school student's preparedness for college and high tech careers. In SY 2009–2010 and SY 2010–2011, Tennessee reported that 24 percent of the high school graduates met college or career preparedness guidelines in math. Also in SY

2009–2010, Tennessee reported that 18 percent of the high school graduates met college or career preparedness guidelines in science (U.S. Department of Education, n.d.-k). However, this numbers drop to 17 percent in the second phase of the RTTT during the 2010–2011 school year (Department of Education, n.d.-k).

H.   SUMMARY

The target audience for the RTTT fund is primarily K-12 lower education students. States are able to apply for funding to support a variety of initiatives that may be unique not only to the state, but to a specific grade or curriculum. A component of the fund focuses efforts to assist disadvantaged students and English as a second language (ESL) student. The fund also provides support and funding to turn around under performing schools.

During the first two years of the RTTT grant, the initial participating states received a total of $791 million (Department of Education, n.d.-a). Each of the states was allowed to develop a unique and individualized approach to increasing student achievement. The various STEM initiatives implemented by these states ranged from Ohio, which held a series of symposiums, to North Carolina, which built a series of new STEM centered schools. The RTTT program provided no guidance or standards that the states were required to implement. The amounts of funding received by the schools and the results in the first two years of the program were equally mixed. For example, Delaware had one of the lower two year RTTT investments of approximately $38 million and had an increase of eighth grade proficiency in math of 12.2 percent (Department of Education, n.d.-a). On the other hand, Florida received the highest two year RTTT investment of $146 million and actually experienced a decrease in eighth grade math proficiency, from 63.8 percent to 57.9 percent, during the first two years of the RTTT (Department of Education, n.d.-a).

Table 2.   Department of Education Race to the Top Fund (from (Department
                            of Education, n.d.-a)

| State	Phase I SY 2010–2011		Phase II SY 2011–2012		Total State RTTT Funding
	Phase 1 Funding	Mathematics*	Phase 2 Funding	Mathematics*	
Delaware	$10,957,844	61.9%	$27,631,133	74.1%	$38,588,977
District of Columbia	$12,653,826	58.5%	$4,643,206	56.7%	$17,297,032
Florida	$24,433,943	63.8%	$121,691,274	57.9%	$146,125,217
Georgia	$10,766,666	86.5%	$58,998,334	77.7%	$69,765,000
Hawaii	$3,151,033	57.3%	$7,326,612	58.8%	$10,477,645
Maryland	$17,927,336	66.3%	$39,971,785	69.5%	$57,899,121
Massachusetts	$11,159,215	52.1%	$38,918,545	52.6%	$50,077,760
New York	$1,417,687	60.2%	$51,434,752	61.7%	$52,852,439
North Carolina	$17,590,612	84.3%	$86,511,551	85.0%	$104,102,163
Ohio	$24,807,357	74.9%	$60,883,100	80.2%	$85,690,457
Rhode Island	$2,530,154	54.2%	$16,605,352	58.4%	$19,135,506
Tennessee	$51,790,749	34.6%	$87,337,249	44.3%	$139,127,998
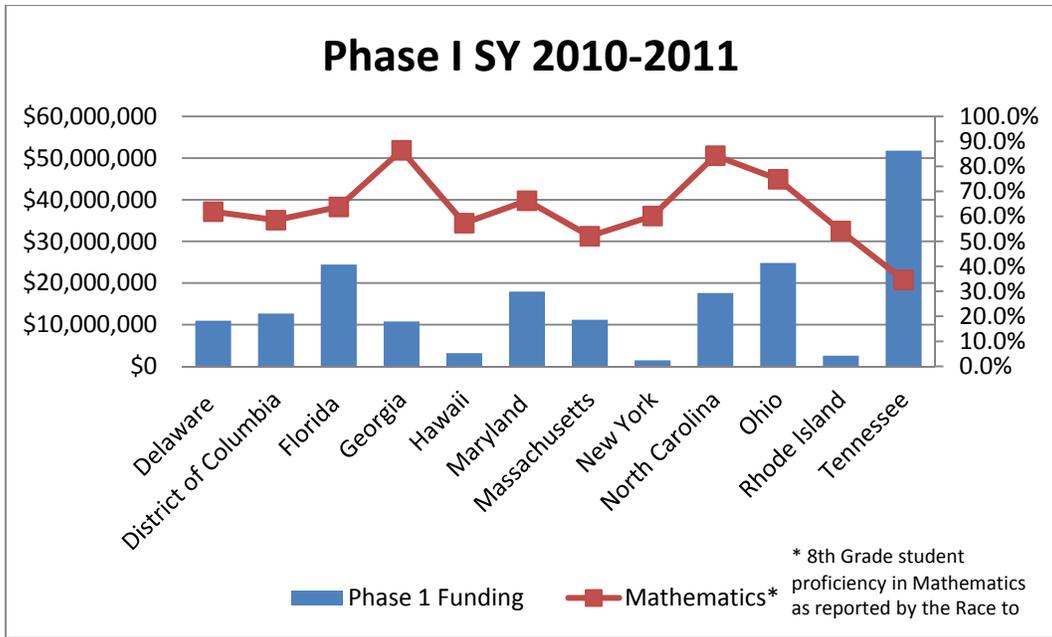
Figure 5.   RTTT Fund Phase I State Funding Compared with Eighth Grade Math Proficiency (from Department of Education, n.d.-a)
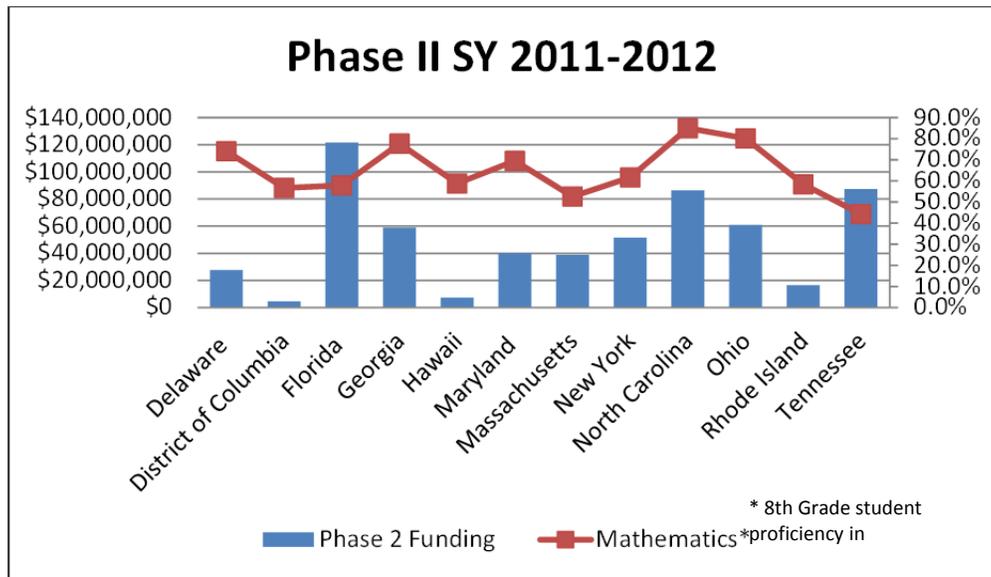

Figure 6.   RTTT Fund Phase II State Funding Compared with Eight Grade Math Proficiency (Department of Education, n.d.-a)

However, in the short time period since the inception of the Race to the Top (RTTT) program, critics have pointed out that this program is not about major changes in education, but about being able to cultivate across-the-state support for an educational program that for many, has turned out to be too costly of an effort, both in time and money for it to create effective change (MacCluskey, 2010).

The RTTT program creates an unnecessary competition among the states who are considered to be "*together*" in the fight to save our children and to support our national security. The unequal distribution of hundreds of millions of dollars to a limited number of states further exacerbates the sense of educational inequality among school systems. In addition, with little guidance or oversight provided to the states, the wide variety of initiatives implemented by the states under this program, albeit that some may be very effective, does not appear to be the best use of educational funds.

I. EDUCATE TO INNOVATE

Educate to Innovate is not a specific act or policy but a federal program. The Educate to Innovate Program focuses on the development of STEM education as a national priority. In 2010, President Obama stated that the goal of the Educate to Innovate program is to help return U.S. students to a top ranking in math and science within a decade (The White House Office of the Press Secretary, 2010). The Educate to Innovate Program combines the efforts of the education community with the private/public sector to advance student interest and involvement in science and technology. The two main goals of the Educate to Innovate is to increase the effectiveness of STEM education through collaborations with corporations, philanthropic organizations and schools, and to further develop career opportunities in STEM for underrepresented groups (National Science Foundation [NSF] Committee on Equal Opportunities in Science and Engineering, 2011, p. 1). The program partners with a number of industry leaders to promote innovation and interest in the sciences. These partnerships support students' interest through the use of interactive games, the media, and hands-on learning. This program focuses on the development of community interest through the establishment of a National Lab and media messaging to kids by companies like Time-Warner Cable,

Discovery Communications, and Sesame Street. The program develops student interest in STEM studies through national STEM design competitions and coordinates support from the local community and business leaders. The program showcases support from the White House through the annual White House Science Fair established to show commitment from the highest office and to promote interest in math and science. The target audience for Educate to Innovate is primarily students, specifically lower and secondary students. Through the development of STEM learning centers, media support, and the use of effective mentors from the S&E fields, the Educate to Innovate program begins incorporate a number of social learning values to promote STEM education such as student self-emulation and self-efficacy. The program has evaluated interactive methods with can reach today's adolescents and begin to spark their interest in STEM studies. The use of interactive games, the media, and hands-on learning has shown an appeal to today's generation of K-12 students.

J. NON-GOVERNMENT BASED EDUCATION PROGRAMS

Non-governmental support for the advancement of STEM education has not only been an important part of many of the government programs, but many have also developed a number of educational programs on their own. Many of the businesses participating in the STEM initiatives are the ones most affected by our domestic declining science and engineering capabilities. Companies such as Time Warner, Microsoft, Intel, Bechtel and Google have committed hundreds of million dollars to initiatives to increase the American student's STEM capabilities in the hope of maintaining a growing economy at home and developing a more educated workforce for the future.

1. Time Warner Cable's Connect a Million Minds (CAMM)

In response to the declining global rankings of American students and the growing concern for future global competitiveness, Time Warner Cable (TWC) implemented the Connect a Million Minds (CAMM) educational initiative to try to increase students' interest in the sciences and ability to succeed and excel in the strenuous education. CAMM is a five year, $100 million cash educational investment program

aimed at reversing our declining STEM capabilities. As part of the CAMM program, TWC will leverage its media assets to increase student awareness of the dynamic field of STEM in hopes of developing the interest of school-aged children. TWC has developed a series of public service announcements (PSA) aimed specifically at challenging public perception. In addition, the CAMM program is developing STEM afterschool programs designed to augment students' daily educational program. The CAMM program has established a connectivity network to link other similar STEM programs in order to increase the availability of resources to the students, parents, and educators.

The CAMM program will utilize current TWC employees to act as mentors and facilitators to provide events such as STEM summer camps and robotics competitions in an effort to not only develop students' interest, but to elicit the self-efficacy needed to succeed in these demanding curricula. The CAMM program is part of President Obama's Change the Equation STEM education initiative (The White House Office of the Press Secretary, 2010). Through the CAMM program, TWC has partnered with a number of other non-governmental and community based STEM initiatives, such as the Coalition for Science After School (CSAS) and the For Inspiration and Recognition of Science and Technology (FIRST) program (Time Warner, n.d.).

What is of particular importance about the Time-Warner Cable initiative is the use of the media as an outreach tool to reach America's youth. Studies have shown that exposure to media such as television, when not excessive, can have a positive relationship between entertainment media consumption and trust (Romer, Hall-Jamison & Pasek, 2009, p. 76). Adolescents today are major consumers of entertainment and the use of this vehicle to elicit interests in STEM studies has the capability of reaching a large portion of the targeted audience. In addition, the effective use of media to provide a positive message can be used to build social capitol in adolescents by developing a common culture through the exposure to information they can share (Romer et al., 2009, p. 78). With the establishment of the CAMM program and the media resources available, Time-Warner Cable has positioned itself in a position to effectively use this level of trust and media to promote a common culture around STEM education.

2. National Lab Network (Formerly National Lab Day)

In a 2009 address to the National Academy of Science, President Obama called for the members to come up with ways to show young people what it means to be a scientist and to show them the accomplishments that can be made through science. In response, the National Academy of Science, in partnership with organizations such as the Bill and Melinda Gates Foundation, National Science Teachers Association, the American Chemical Society, the Catherine T. MacArthur foundation, and other federal science agencies developed the National Lab Day initiative. The goal of National Lab Day is to establish volunteer opportunities for scientists to partner with teaching professionals in an effort to bring continuing interest and support for the STEM studies into the classroom (NSF, National Lab Day, n.d.). National Lab Day became was renamed the National Lab Network (NLN) due to the fact that participating scientist believed that the original name gave the impression that this was only important for one day a year, when supporters believed it to be a critical year round endeavor. The goal of the NLN is to provide the resources to innovative instructors to allow them to bring creative and sustainable learning opportunities to the classroom. The National Lab Network matches current practitioners from all fields of science and technology with classroom educators in an effort to provide the necessary resources to promote innovative teaching. The National Lab Network focuses on bringing successful students and practitioners into the classrooms and after school programs to act as role models and mentors. This approach provides positive influences for the students and supports student emulation of the visiting practitioner. The National Lab Network initiative focuses on the educational advances of the K-12 students (National Lab Network, n.d.).

The goal of the National Lab Network (formerly National Lab Day) is to establish volunteer opportunities for scientists to partner with teaching professionals in an effort to bring continuing interest and support for the STEM studies into the classroom (NSF, n.d.). The exposure to successful practitioners in the field of science can begin to instill a number of social learning values in adolescents. These values can include the importance of preparing for class and self-regulation, as well as providing the student with an understanding of the benefits of hard work by explaining the rewards of their studies and

research. Instilling the values of hard work into today's future STEM scientists is important, especially when a U.S. Census Bureau ethnography report of U.S. high school students indicated that only 10.6 percent indicated that "hard work" was one of their core values (USCB, 2003, p. 12). This approach provides positive influences for the students and supports student emulation of the visiting practitioner. The National Lab Network initiative focuses on the educational advances of the K-12 students (National Lab Network, n.d.).

3.   Bill and Melinda Gates Foundation

The Bill and Melinda Gates Foundation has been a major supporter of educational and humanitarian issues around the world. One of the primary focuses of the Gates Foundation is to advance STEM education in the United States. The Gates Foundation has supported a number of STEM education initiatives across the country from the Washington STEM Network in Seattle, Washington, to the TechBoston program in Boston, Massachusetts. TechBoston was developed with support of the Gates Foundation and the National Science Foundation as a STEM model school within the Boston Public School (BPS) system. The school was developed in 2002 and is focused towards grade 6–12 students, specifically disadvantage kids. Although located in one of Boston's tougher neighborhoods, TechBoston has developed a safe and nurturing learning environment where students feel a sense of commitment and security that will allow higher levels of learning to take place. Students are provided with an effective learning environment, from certified teachers, effective curricula, technology, and exposure to practitioners in STEM industries. Students are provided with a positive social learning environment that promotes self-efficacy and emulation in the classroom that has shown to continue into higher educational opportunities. The performance levels at TechBoston have exceeded state and local averages. The graduation rate at TechBoston is 83 percent, which is 20 percent higher than the city-wide average, and 94 percent of the students who graduate attend two- or four-year colleges and universities (Ferrante & Zacharias, 2011).

In a recent Massachusetts Comprehensive Assessment System test, 65 percent of the students scored at the proficient or advanced level on the mathematics test.

TechBoston has partnered with some of the best universities in the area, including the University of Massachusetts and the Harvard Medical School in order to attract and train the most qualified teachers. The instructors at TechBoston undergo extensive training and classes in transformational education in order to prepare them to have the greatest impact in the classroom. TechBoston has been called a model school for the Boston School System and the administration is looking to use the program as a template for other schools (Ferrante & Zacharias, 2011).

In addition, by partnering with key universities TechBoston is able to provide some of the best teaches in order to ensure the greatest transformative learning opportunity. The whole school approach furthers the social leaning environment by developing the collective interest of the students to excel in school and to develop a sense of social responsibility in conjunction with success. By providing a school where all students are exposed the enhanced learning environment, there are greater opportunities for social learning through the students' observation of peer's behaviors, attitudes, and emotional reactions. These observations are then modeled by other members of the community. This observational learning can also have a significant impact on student motivation through the observation of success surrounding the student (vicarious) and self -reinforcement (Bandura, 1977, p. 22). In addition, the whole school approach will also benefit from many aspects of the social control theory that can contribute to the building of community within the group. According to the social control theory, the social bonds of: attachment, commitment, involvement, and belief, help to develop social convergence on the norms of the group (Agnew, 1985, p. 47).

4. Intel Corporation

The Intel Corporation has been watching the STEM education headlines closely, continually concerned for the declining STEM capabilities of America's youth and its impact on our future innovative capability and the economy (Angel, 2012). As a result, the Intel Corporation through the Intel Education program has been sponsoring educational initiatives both in the United States and abroad in the hopes of developing the best and brightest minds for America's future. One of the high school initiatives that Intel

Education has implemented was a partnership it developed with Lynbrook High School in San Jose, California. The Intel Corporation sponsored the school with grant funding to help attract and train the best educators, and outfitted the school with some of the latest technology to help support learning. As a result, student achievement at Lynbrook School has skyrocketed with the school regularly placing finalists in international science and national math competitions. The school was also awarded the 2011 Intel School of Distinction as a result of the success of its teachers (Honda, 2012). As a result of the partnership the environment developed in the school, has been seen as the driving force behind the student achievement and dedication. The Lynbrook High School is being utilized as a successful STEM educational model for other schools in California.

Knowing the interest that American youth have in pop culture, the Intel Corporation formed a connection with the future STEM students when on January 25, 2011 the Intel Corporation named the lead singer of the Black Eyed Peas, Will.i.am, as its Director of Creative Innovation. Knowing the singer's extreme popularity and interest in emerging technology, Intel will be taking the new director on the road to various events in an effort to further ignite the imagination of future scientists. Will.i.am of Intel has also partnered with the STEM youth promotion initiative FIRST helping to sponsor robotics and technology competitions and support the expanding interests in STEM studies.

5. Google

Another high technology corporation seeing the need to further promote student interest in STEM studies through the establishment of various education programs is Google. Google has initiated a number of programs to support STEM education, including the Google RISE Award, grant support for a number of STEM learning centers, and partnerships with universities to support STEM education.

In order to promote innovative thinking and the continued interest in STEM studies, Google has implemented the Google RISE award. The Roots in Science and Engineering (RISE) award is designed to fund resources and programs for K-12 schools that implement various STEM enrichment programs. School programs, such as robotics competitions, aeronautical programs, and computer science programs, can be awarded

grants ranging from $5,000–$25,000 to support the continuation of successful programs (The UTeach Institute, n.d.).

In December 2011, Google announced that it will be providing $40 million to promote various forms of STEM of education (Koebler, 2011). In addition, a total of $14.7 million was earmarked for the support of STEM studies, specifically funding 16 STEM learning centers (Koebler, 2011). Nine of the 16 STEM learning centers are located within the U.S. Some of the learning centers being supported by Google include: Generating Genius DC Public Education Fund, the Computer History Museum, Girlstart, Teach for All, The Tech Museum for Innovation, and the Science Gallery (Koebler, 2011). Google has also partnered with the California State University System and the California STEM Learning Network through the establishment of a $25,000 grant award designed to promote continued STEM initiatives.

Some of the learning centers being supported by Google include: Generating Genius DC Public Education Fund, the Computer History Museum, Girlstart, Teach for All, the Tech Museum for Innovation, and the Science Gallery (Koebler, 2011). Google has also partnered with the California State University System and the California STEM Learning Network to promote continued STEM initiatives.

The Google Educate program helps to cultivate pockets of communities of interest that are focused on the sciences. These communities of interest play an important role in Bandura's social learning theory, which states that significant learning occurs through the observation of peer's behaviors, attitudes, and emotional reactions. These observations are then modeled by other members of the community. New behaviors within a community can often occur as a result of the modeling and the reciprocal interaction based upon cognitive, behavioral, and environmental interactions. Studies have shown that the influence of the group is often a greater factor on the actions of the individual than is the controlling aspect of self-actualization (Meldrum, Young & Weerman, 2009, p. 364). In addition, the Google Educate initiatives can have a positive effect on an individual's sense of his or her own capabilities also known as self-efficacy. These communities of interest established through programs, such as Google Educate, develop positive social values which are supported through self-emulation by the group.

6. First For Inspiration and Recognition of Science and Technology

The For Inspiration and Recognition of Science and Technology (FIRST) program was started in 1989 as a program to develop young students' interest in science and technology. In the 24 years since its founding, over 300,000 students have participated in the FIRST program, many of whom have been involved in the FIRST robotics and science competitions. The Board of Directors of FIRST is made up of representatives from some of the leading technology corporations in the Unites States, including Xerox, Time-Warner, Boston Scientifics, The Boeing Company, Google, Walt Disney, BAE Systems, Microchip, and General Motors. The Board of Directors, advisors, and leadership at FIRST have implemented a five year strategic plan (2012–2017) aimed at developing the next generation of innovators. The success of the FIRST program is based its mentoring program and values development program. The values promoted through the FIRST program include: teamwork, cooperation, respect, self-confidence, mutual gain from competition, communication skills, and leadership. The FIRST program has expanded to 60 countries and over 250,000 students and 100,000 mentors and coaches participated in the 2011–2012 FISRT program (FIRST, n.d.). By 2017, FIRST predicts that it will reach an enrollment of almost half a million students. In addition to the hands on and mentoring programs, FIRST provides students with access to millions of dollars in scholarship funding, with the 2013 scholarship availability of over $16 million (FIRST, n.d.).

The FIRST program has the ability to positively develop social and observational learning environments through the use of mentors and hands-on programs. The partnerships established with the top executives in the technology industry and the mentoring opportunities provided will have a positive impact on the motivation and emulation of the students within the community.

K. COMMUNITY-BASED EDUCATION PROGRAMS

1. Change the Equation

Although many of the non-governmental and mentoring based STEM support programs were previously reviewed, they can also be considered part of the community based educational programs because of their partnership with afterschool programs such as the Coalition for Science After School, boys and girls clubs, and neighborhood recreation centers. Many of these programs, such as FIRST, CAMM, and the National Lab Network, are integral parts of community based programs and also participate in President Obama's Change the Equation initiative, which is considered to be a community based 501(c) 3 organization (The White House Office of the Press Secretary, 2010). The Change the Equation Initiative was announced in September 2010, and it is a collaboration between schools, private industry, philanthropic organization, and community based organizations. It is aimed at increasing student interest and success in STEM education, specifically for the underrepresented groups and girls (NSF Committee on Equal Opportunities in Science and Engineering, 2011, p. 1). Change the Equation provides resources and monitors various state progress in order to develop empirical data to support various STEM initiatives. In addition, Change the Equation provides guidance on educational policies regarding the advancing of STEM studies, such as the adoption of common standards, develop standard assessment, development of a common assessment scoring protocol, align curricula and resources to help all students exceed. In addition, they use common data and research to evaluate STEM development, and the retention of qualified and effective teachers.

Like many of the other initiatives paired with industry leaders, the Change the Equation helps to develop communities of interests. The resources and mentors provided to these communities will positively influence the development of the social and observational learning environments of the group. The partnerships established with the top executives in the technology industry and the mentoring opportunities provided will have a positive impact on the motivation and emulation of the students within the community. The Change the Equation program is also one of many programs that focus

on developing the interests of girls, one of the least represented communities in the STEM industry.

L. INTERNATIONAL EDUCATIONAL PROGRAMS

1. Finland's Virtuous Cycle

In the early 1970s, Finland had an economy that was largely based on natural resources; however, the country experienced low educational levels and a high disparity between the wealthy and poor. Little focus was provided to science and engineering within the Finnish education system. The country had private schools for the wealthy and basic limited educational for everyone else. In the 1980s, the Finns conducted a curriculum review and decide to eliminate private schools and develop an early childhood programs. These early childhood development centers provide age appropriate learning and focus on developing a high level of self-regulation by instilling an early sense of responsibility within the children to learn. They developed compulsory education system up to the ninth grade and available dual educational program after that. Currently, 99 percent of the students complete the compulsory education and 90 percent complete the secondary education (Darling-Hammond, 2010). School size and class size in Finland are fairly small with the average school size of 300 students and the average class size of 20 students (Darling-Hammond, 2010). All students receive free meals at school and free health care. Finland ensures that the necessary funding for the schools is available and the necessary resources are there for those who need them. As a result of its policy changes, by 2006 Finland has been able to maintain a variation gap in its student achievement of only 5 percent, whereas most developed nations had a variation of 33 percent. What is an important observation is that even though Finland has seen an immigration increase, these immigrants to Finland appear to be succeeding on the same level as the Finnish population (Darling-Hammond, 2010). In addition, as a result of these changes within Finland's education system, the country has seen a dramatic increase in the student's global rankings; it now ranks in the top scores for 15-year-olds in language, math, and science among other Organization for Economic Cooperation and Development (OECD) nations (Darling-Hammond, 2010).

The people of Finland has worked to reduce or eliminate what they consider to be educationally stifling policies, such as: standardization of curriculum enforced by frequent external tests; narrowing of the curriculum to basic skills in reading and mathematics; adoption of educational ideas from external sources, rather than development of local internal capacity for innovation and problem-solving; and adoption of high-stakes accountability policies, featuring rewards and sanctions for students, teachers, and schools (Darling-Hammond, 2010).

Based upon its curriculum review, Finland has eliminated grade and curriculum testing and ranking and has moved to the use of school-based, student-centered, open-ended tasks, which are part of the curriculum. This change from the standardized testing has been considered the reason for Finnish students' success on the international exams (Darling-Hammond, 2010). In addition, Finland has placed a large emphasis on the equitable distribution of funding and resources, but it does not endorse a sense of competition among its LEAs. In a classroom in Finland, one is more likely to see students working through different learning stations, taking responsibility for their own progress than to see a teacher lecturing for long periods of time in front of the classroom. The development of the sense of responsibility for one's own learning progress or self-regulation instills a sense of independence and critical thinking that helps to develop the student's metacognitive skills and problem solving capabilities (Darling-Hammond, 2010).

Schools in Finland are well maintained and the teachers are very professional. Finland's society has come to value the role of educator and places them on the same social standing as doctors and lawyers. Teaches receive three years of intensive education tuition free. This allows teachers to graduate from college and begin teaching debt free. Finland's education system takes on a decentralized approach, with minimal centralized policies and limited national standards. Teachers require a master's degree and university teachers are required to successfully complete a year of apprenticeship with a designated master teacher. Selection for the coveted teaching positions in Finland is very competitive and only 15 percent of the applicants selected becoming teachers (Darling-Hammond, 2010). The teachers are trained in the research based method of instruction

and focus on providing the students with effective problem solving skills. The goal of Finland's teacher preparatory system is to keep the best and the brightest are in the schools.

The Finnish have implemented their educational through restructuring in a systematic and consistent method across the country. This has been a long-term national endeavor, one that Finland has been committed to and has seen positive results. Finland has enacted national guidelines, funding, and teacher development to provide the greatest chance of success. In an effort to ensure success and equitable distribution of educational resources, it was cautious not to allow different districts to enact varying educational policies. Similar strategies have been employed with positive results at the state or provincial level in high-scoring Australia, New Zealand, and Canada, and provinces like Hong Kong in China (Darling-Hammond, 2010).

The Finnish educational policies are built on diversity, trust, and respect for all within the early developmental and educational programs. Educators are regarded with high social status and provided a rigorous preparatory education at no cost. The children of Finland are provided with high quality early childhood development, which begins to build the students' sense of responsibility for learning and the foundation of their creative and innovative thinking processes. The children continue into small, clean, well prepared schools, where teachers are given a high level of trust and authority, and provide instruction in a low stress environment. Finland has seen a very high level of success from this model and it continues with the student into upper level education. This foundation of learning has developed a sense of commitment and responsibility within the system for the students of today, to become the teachers of tomorrow, continuing this virtuous cycle.

The paradigm shift for the Finnish education system consists of a number of critical steps that build a foundation for effective learning with the highest level of trust and community support. Finland committed to ensuring that the necessary funding and resources are available to all schools and implemented single educational policies across the country, rather than allowing individual educational district to implement policies that changed every couple of years. The initiatives implemented under the Finnish educational

system were successful in developing an effective social learning environment across the country. The early childhood program instills an early sense of community and responsibility (self-regulation) and self-actualization in the young children and prepares them to succeed as they progress through school.

The Finnish approach has developed schools where the sense of community is valued and where students are provided with a positive social learning environment that promotes self-efficacy and emulation in the classroom. The whole school approach implemented throughout Finland furthers the social leaning environment by developing the collective interest of the students to excel in school and to develop a sense of social responsibility in conjunction with success. By providing a school where all students are exposed to the enhanced learning environment, the Finns further the opportunities of social learning through the students' observation of peers' behaviors, attitudes, and emotional reactions. These observations are then modeled by other members of the community though emulation. In addition, the whole school approach will also benefit from many aspects of the social control theory, which can contribute to the building of community within the group through the social bonds of: attachment, commitment, involvement, and belief, help to develop social convergence on the norms of the group (Agnew, 1985, p. 47).

V.   ANALYSIS RESULTS

A.   IDENTIFICATION OF TRENDS IN THE RESULTS

There are a number of noteworthy trends discovered during this analysis. Funding is one of the primary trends noted in all of the policies and programs. Because of the Tenth Amendment and the inability of the federal government to dictate educational policies at the state level, the federal level of involvement has been basically reduced to a funding source for schools. Although the United States has seen billions of dollars provided by the federal government for education, a large amount of this funding has gone to fill budget cuts in educational spending at the state level. Additionally, although the federal government has provided a number of additional funding opportunities, these have often been tied to competitive processes between the states or the implementation of assessment testing, which may contribute to expanding disparities in educational availability and decreasing sense of community.

The ability for policies and programs to develop and reach the communities of interest and the inverse relationship to their effectiveness has been noted in a number of polices. Programs like the No Child Left Behind and the ESEA are able to be compulsory for all students, but they also receive the most criticism as being ineffective and even detrimental. In essence, the federal government has the capability of developing programs that can reach the greatest number of students but which appear to be the least effective. While the National Defense Education Act and programs like the Gates Foundation's Early College High School Initiative and the Intel Corporation's Lynbrook High School Initiative provided very effective and promising results in the students, they only reached a very limited community.

Another noted trend in the results was the need for quality teachers. Effective teachers ware considered to be one of the most critical components of all of the policies and programs evaluated. Ensuring that teachers received the proper training and certification is referenced as being necessary for the success of federal, state, NGO and private corporations, and community based programs. Proper teacher selection and

certification was noted as helping to build effective social learning environments and impacting the transformative learning opportunities and modeling within the classroom.

Utilizing partnerships with non-governmental organizations, including practitioners in the STEM workplace, assisted in enhancing the social learning environment of the program. The analysis revealed that programs that contained this component achieved the greatest result and longevity. The exposure to successful practitioners in the field of science can begin to instill a number of social learning values in adolescents. These values can include the importance of preparing for class and self-regulation, as well as providing the student with an understanding of the benefits of hard work by explaining the rewards of their studies and research. Instilling the values of hard work into today's future STEM scientists, especially when a U.S. Census Bureau ethnography report of U.S. high school students, indicated that only 10.6 percent indicated that "hard work," was one of their core values (USCB, 2003, p. 12). This approach provides positive influences for the students and supports student emulation of the visiting practitioner.

Commitment to enhancing educational programs has to be a long-term effort. Major programs, such as the No Child Left Behind / ESEA, underwent major changes between the Bush administration and the Obama administration. Education is a major political topic and each of the recent presidents has made it a focus of his campaigns, often making critical changes in the policies during his term. From President Clinton, who implemented a number of educational policies during his administration (White House, 1997, p. 5) to President Bush, who signed the No Child Left Behind (NCLB) Act into law on January 8, 2002, regular changes such as these can lead to a more disorganized implementation of the policy and be detrimental to the overall expected outcome of the programs. This is especially damaging when teachers are undertaking five year teaching degrees and face changes in standards or requirements in the middle of their programs.

Although a number of the educational programs reviewed helped to develop an effective social learning environment, other than a few programs utilizing media outreach, very little attention or effort is given to shaping the overall adolescent culture in

an effort to bring adolescent values more in line with that of the schools. For over half a century, we have seen the interests of today's youth sift away from education to that of "Cars, dates, sports, popular music, and other matters just as unrelated to school," (Coleman, 2006, p. 41). These policies lacked a component to address the shaping of the adolescent collective of today in order to develop the sense of social responsibility towards learning.

In reviewing the federal and state educational policies, there is an overarching substantive issue in the design of the policies in that none of the policies address the social responsibility of the student to learn in an effort to ensure the most effective and efficient consumption of the public good: education. Instead, the focus of the federal policies is to place the responsibility solely on the educational system through the mandated accountability for teacher and school administration's performance, and on narrowly focused standardized testing that often results in instructors, "teaching to the test." It also results to limiting exposure to more transformative learning opportunities that could lead to greater completion advanced STEM education in higher learning environments.

Like many of the other initiatives paired with industry leaders, the Change the Equation helps to develop pockets of communities of interests. The resources and mentors provided to these communities will positively influence the development of the social and observational learning environments of the group. The partnerships established with the top executives in the technology industry and the mentoring opportunities provided will have a positive impact on the motivation and emulation of the students within the community.

In reviewing the non-governmental and the community based educational programs and policies; there is an overarching substantive issue in the design of the policies in that these programs are only capable of reaching a very limited number of the identified community. These programs are only able to provide resources to the students who are fortunate enough to be part of the selected community or who have the drive or social support to seek and enroll them in such programs. As a result, these programs can

end up creating greater inequality in the deliverance of a higher quality educational opportunity and thereby increasing the educational variance among students.

The analysis of the Finish educational policy provides insight into one of the greatest educational advances in a little over three decades. The key components of this program are that it was a national long-term imperative that included a restructuring of the education system from pre-school through secondary education. Unlike many of the educational policies in the United States that often have the longevity of the current political administration, the Finish committed generations of students to this program. Finland has moved away from many of the policies that our current educational program rely on such as: standardization of curriculum enforced by frequent external tests; narrowing of the curriculum to basic skills in reading and mathematics; adoption of educational ideas from external sources, rather than development of local internal capacity for innovation and problem-solving; and adoption of high-stakes accountability policies, featuring rewards and sanctions for students, teachers, and schools (Darling-Hammond, 2010). Students are exposed to a problem solving focused curriculum that involves a component of self-regulation that contributes to the students' sense of responsibility for learning and the foundation of their creative and innovative thinking processes.

VI. POLICY RECOMMENDATIONS AND CONCLUSIONS

A. INTRODUCTION

According to the Georgetown University's Center for Workforce and Education Center report on STEM, by the year 2018, 5 percent of the jobs or eight million STEM centered jobs will exist in the U.S. economy (Carnevale, 2011, p. 5). However, there is a growing concern for the capability of education system and the students to keep up with the educational requirements for these positions. We have reached a crisis stage in our STEM capabilities that is poised to threaten our national economy and our national security. Although President Clinton, President Bush, and now President Obama have each made the return of our global rankings of our education to the top a national priority, they have not succeeded in making it a national imperative.

B. ROLE AND SIGNIFICANCE OF RESEARCH

The declining STEM educational capability of our domestic population has a number of significant impacts, including economic, technological, and homeland/national security concerns for the United States. A more highly educated workforce contributed to overall increase in economic growth of 3.4 percent per year from 1958 until 1999 (Kodrzycki, 2002, p. 43). According to Federal Reserve statistics, during a 15-year period ending in 2004, the net worth of families led by college graduates increased by 61 percent, while those led by high school dropouts rose by only 12 percent (Augustine, 2007, p. 32). In addition, the global increase in the S&E capacity also creates a number of issues for the United States, including the exportation of high tech jobs, a growing technology deficit, loss of transformative research capacity, and impact on domestic technology corporations.

Unbeknownst to most Americans, we have entered an arms race of intellectual capacity, a race America is not well positioned for future success. In speaking about the importance higher education and innovation, China's President Hu stated, "the worldwide competition of overall national strength is actually a competition for talents, especially innovative talents" (Augustine, 2007, p. 45). China has implemented a massive

educational and military modernization program, and it has developed a significant cyber offensive initiative. The Department of Defense has recognized that China has developed a capacity of disruptive military technology that can compete militarily with the United States and may potentially overtake America's military advantages in time. Although President Obama has developed a cyber-security initiative, he has recognized that America does not have enough appropriately educated domestic citizens to fill the critical position. This declining STEM capacity has also resulted in a number of critical high-technology manufacturing needs to be moved overseas, which further national security concerns for the United States. Other countries such as Russia and Germany have also undergone educational initiatives in an attempt to compete with the United States.

C. REVIEW OF RESEARCH QUESTION

1. Primary Research Question

What strategic policy recommendations can be made to promote the interest of our domestic population in pursuing higher level STEM education in order to support our technological advantage, national security and economic wellbeing?

There are a number of strategic policy recommendations that can be made to promote the interest of our domestic population in pursuing higher level STEM educational initiatives. The primary policy recommendation is to develop properly trained and certified teachers, supported by a long-term national educational policy that aligns our domestic student capacity with emerging global trends. The UTeach program focuses on placing highly effective teachers, often practitioners in the field, in the classroom. The National Academy of Sciences listed the UTeach program as a model program that was not only responsible for raising student's SAT scores but, more importantly, for keeping students in the classroom and interested in the sciences (Augustine, 2007, p. 73).

The TechBoston program has also benefited from utilizing certified teachers in the classroom. The performance levels at TechBoston have exceeded state and local averages. The graduation rate at TechBoston is 20 percent higher than the city-wide

average, and 94 percent of the students who graduated attend two- or four-year colleges and universities (Ferrante & Zacharias, 2011).

However, the greatest recommendation to support increased success in the STEM studies is the development of a long-term national education strategy that starts from pre-school through college and ensures all of the necessary funding and resources are available to the schools. The analysis of the Finish educational policy provides insight into one of the greatest educational advances in a little over three decades. The Finnish program focused on a long-term educational program, well beyond that of political term limits, to develop students' problem solving and self-regulating capabilities. They moved away from many of the policies we are currently implementing because they were considered to be stifling to the student's capabilities (Darling-Hammond, 2010).

Currently, individual states set their own policies, which results in a patchwork of varying approaches for each state. In addition, these policies must ensure educational programs are fully funded at the state and national levels, and that schools are provided with the necessary resources that can contribute an effective learning environment instead of one of constant program cutting and perceived disorganization. The practice of states having to drastically cut educational budgets is resulting in the delay or suspension of a number of educational initiatives, which further impacts student self-actualization through the perception of lack of commitment by the school system. In 2013, states reduced educational spending an average of 28 percent less per than they did in 2008 (Oliff, 2013, p. 1).

2.   Secondary Research Questions

a.   *In What Ways Can the Education System Contribute to the Strategic Priority of STEM Education in Support of our National Security?*

The use of offensive technology based intrusion and weapons systems represent the greatest threat to the future security and freedom of the United States. Educational facilities that can develop and sustain our domestic students' capabilities and interests in STEM curricula will be essential for the future success of our country. As seen in the whole school approach of the TechBoston and the Lynbrook High School, the

development of entire school facilities, supported by well-educated and certified teachers with the necessary resources, provides the best example of how the education system can contribute to this strategic priority. The TechBoston program transformed an inner city school with support from the National Science Foundation and the Gates Foundation. A whole school approach with the Early College High School Program was also developed with a high level of success at the Lynbrook High School in San Jose, California (Angel, 2012). Both initiatives focused on developing a whole school approach to improvement, as opposed to developing limited access programs or after school programs, in order to develop a safe and nurturing learning environment where students feel a sense of commitment and security that will allow higher levels of learning to take place. Students are provided with effective curricula, technology, and exposure to practitioners in STEM industries. The TechBoston and Lynbrook School programs focus on developing schools where students are provided with a positive social learning environment that promotes self-efficacy and emulation in the classroom that has shown to continue into higher educational opportunities. The whole school approach furthers the social learning environment by developing the collective interest of the students to excel in school and to develop a sense of social responsibility towards success.

By providing a school where all students are exposed to the enhanced learning environment, furthers the opportunities for social learning through the students' observation of peer's behaviors, attitudes, and emotional reactions. These observations are then modeled by other members of the community. This observational learning can also have a significant impact on student motivation through the observation of success surrounding the student (vicarious) and self -reinforcement (Bandura, 1977, p. 22). In addition, the whole school approach will also benefit from many aspects of the social control theory, which can contribute to the building of community within the group. According to the social control theory, the social bonds of attachment, commitment, involvement, and belief, help to develop social convergence on the norms of the group (Agnew, 1985, p. 47).

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b.   ***In What Ways Can NGOs and Private Corporations Contribute to the Strategic Priority of STEM Education in Support of our National Security?***

Non-governmental organizations and the private/public sector companies play a critical role in supporting the STEM educational initiative. The NGOs are at the forefront of the global technological race and experiencing the threat of global competition of a regular basis. NGOs are in a unique position to inform policymakers of the strategic needs facing high technology companies, in order to develop a workforce to compete in the future. In addition, NGOs are capable of providing mentors who are current practitioners in the field who can significantly contribute to the social learning environment and self-actualization of students. As we have seen in the Intel Corporations support for STEM education at the Lynbrook School in San Jose, California, Furthermore, NGOs and corporations can often times provide the funding and innovative ideas, absent political pressures, needed to make effective schools (Angel, 2012). For example, with Time Warner's Connect a Million Minds program and the Bill Gates Foundation's support for TechBoston, we have seen model programs developed that provide the basis for replication elsewhere (Ferrante & Zacharias, 2011). NGOs and private corporations such as Time Warner and the Bill and Melinda Gates Foundation are also in the position to leverage available media resources, such as television and Internet, to help shape adolescents' social views and develop a social imperative to learning.

c.   ***In What Ways Can Government and Military Organizations Contribute to the Strategic Priority of STEM Education in Support of our National Security?***

Government and military organizations can contribute to the STEM initiative in a number of critical areas, including the implementation of a national education policy, cultivating community support for STEM education, the identification of emerging technologies, enhanced educational opportunities, and mentoring opportunities. The implementation of a long-term, fully supported national education is the key component of the STEM educational initiative. This national policy must exhibit a commitment to the students that outlasts political term limits. The government, working with NGOs, is responsible for developing a program to cultivate and sustain community support for the

STEM initiative through educational messages, school programs and media campaigns. The Department of Defense has also realized that there is a critical shortage of computer and electrical engineers and has implemented a number of programs to develop domestic interest in these areas (Department of Defense, 2013). It has established the Science, Mathematics and Research for Transformation (SMART) Scholarship for Service Program. The SMART program is only available to U.S. citizens in support of future scientists and engineers capable of obtaining security clearances. In addition, the National Security Agency has also partnered on a number of programs to advance interest in STEM education including the Scholarship for Service (SFS) Program.

Much like NGOs, the military has realized the issues created by the educational deficiency through the lack of a properly educated workforce and the need for remedial training. As a result, it is in a position to inform policymakers and educational institutions of areas in science and engineering requiring additional focus by educational institutions as well as emerging technologies in order to ensure that the United States maintains a properly educated domestic workforce. Expanding the current military educational opportunities for both lower and higher education will continue to spark interest and innovation while also providing effective mentors to help sustain both student interest and support as they progress into higher level and more challenging curricula.

d.   In What Ways Can the Community Contribute to the Strategic Priority of STEM Education in Support of our National Security?

The development of a national imperative towards the advances of STEM education is an essential component to reestablish the United States as a global leader in science and engineering educational scoring and production. Other countries like China, Singapore, and Finland look at their scientists as national heroes and hold their teachers in the highest social status. Critical to this initiative is the development of community support for education and a sense of social responsibility toward learning and succeeding in the hard sciences. Communities are key to this initiative by placing a high level of importance and prestige in learning in order to develop and sustain student interest in STEM education. The influence communities play on their students' social identity can help develop a students' value of hard work and self-actualization, leading to greater

success in school. In addition, mentors through community organizations are in a position to reach and connect with students on specific levels that is unique to their particular environment. Committees also play a critical role to developing and sustaining trust in teachers and their local educational facilities.

Under the educational initiatives started by the Finland in the 1980s, communities played a key role in the success of this program. Members of Finnish society supported the change and realized that great teachers were critical to the success of their children, and they provided the teachers with a high level of support and trust. Teachers experienced a high level of trust in autonomy in providing the core educational requirements. By providing a school where all students are exposed to a high level of trust in the teachers, they further the opportunities of social learning through the students' observation of peer's behaviors, attitudes, and emotional reactions (Agnew, 1985, p. 47).

The Change the Equation Initiative was announced in September 2010 is a collaboration between schools, private industry, philanthropic organizations and community based organizations, which aimed at increasing student interest and success in STEM education, especially for the underrepresented groups and girls (NSF Committee on Equal Opportunities in Science and Engineering, 2011, p. 1). The partnerships established with community organizations and industry leaders have had a positive impact on the motivation and emulation of the students within the schools.

e.   In What Ways Can the Media Contribute to the Strategic Priority of STEM Education in Support of our National Security

The role of the media in addressing the priority of STEM education cannot be understated. The media is critical to brining this crisis to the forefront of American society and working to change the culture of learning in America and the "collective failure," noted by the National Academies of Science. The capability of the media to reach today's adolescents must be effectively leveraged to shape their collective interests and sense of community towards succeeding in education. Studies have shown that exposure to media, such as television, can have a positive relationship between entertainment media consumption and trust (Romer et al., 2009, p. 76). Adolescents

today are major consumers of entertainment, and the use of this vehicle to elicit interests in STEM studies has the capability of reaching a large portion of the targeted audience. In addition, the effective use of media to provide a positive message can be used to build social capitol in adolescents by developing a common culture through the exposure to information they can share (Romer et al., 2009, p. 78). The Department of Education and representatives of the various sources of the media must work to develop media catalysts capable of reaching various identified markets in order to develop greater recognition of scholastic success in students. This media initiative must also include greater recognition of the importance and role that teachers play in the future success of our country. Developing community trust and respect for teachers is a critical part of developing the social learning environment for students and has been an important part of the success of the Finnish national education program. Finland's society has come to values the role of educators and places them on the same social standing as doctors and lawyers (Darling-Hammond, 2010). Media corporations such as Time Warner and their Connect a Million Minds initiative have shown encouraging results in sparking the interests of students in STEM education (Ferrante & Zacharias, 2011).

D. SUMMARY OF THE PROBLEMS FACING THE U.S. EDUCATION SYSTEM

The U.S. education system is plagued with a number of issues that have contributed to the inability of the schools to illicit and sustain interest in the STEM curricula and the decline in global STEM rankings of American students. The U.S. has suffered from frequent changes in educational initiatives that are often tied to changes in political administrations. A change in our educational outlook is going to take a number of generations to fully realize and both policy and support must exhibit this sense of commitment. However, even more damaging is the constant budget crisis facing local education systems, and the subsequent increase in class sizes and decreases in teacher availability that has resulted in too many schools focusing on meeting the minimum requirements instead of pushing for the maximum student potential. In addition, our educational policies have often implemented accountability based tracking and testing that has resulted on narrowly defined standards instead of developing students equipped

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with critical thinking skills and complex problem solving capabilities. The schools and teachers have often suffered from lack of community support and low social standards, as well as student, parent, and community apathy that needs to be addressed as a national priority.

E.   POLICY RECOMMENDATIONS

America has been experiencing a decline in our global STEM capacity for decades, and we are beginning to face a critical time when our lack of action may result in our loss of technological advantage. A paradigm shift in our educational outlook will take time to implement. America needs to develop an immediate sense of urgency in the implementation of educational changes. In order to affect this change, policymakers are going to have to consider a number of policy recommendations synthesized from the evaluation of the educational policies and programs evaluated in this research.

The development of a bi-partisan national educational policy that endures political tenures is one of the most critical steps America can take in addressing the educational crisis we are facing in STEM education. Far too often, major educational initiatives undergo substantial changes with the inauguration of new administrations. These changes delay and reduce expected impacts and create a sense of disorganization with both students and teachers. America needs a national educational policy that aligns national objectives with K-12 curricula and education. The policy needs to develop effective teacher selection and certification criteria, reduce reliance on narrowly focused assessment testing, and include critical thinking and transformative educational capabilities as seen in some of the domestic NGO school-wide programs and the international programs. We are also suffering from the negative impact of polices that label and focus mainly on poorer preforming schools and students—at the expense of the fewer higher performing resources.

Educational funding is as critical a priority as is the development of a national educational policy. States have undergone hundreds of millions of dollars of educational cuts every year for the last several years. These cuts are sometimes offset by federal government grants that are seen as major educational initiatives by the public, but really

these only act as stop gap measures. Schools are spending more time on cost cutting and budget issues than developing future emerging educational initiatives and on the research itself. Researchers are facing difficulties obtaining support for high cost/high risk transformative research that can lead to great advances in the sciences. Future educational policies must include unwavering commitment to educational funding. State education systems must not be faced with yearly budget cycles that result in repeated cuts that will ultimately impact our technological advantage and national security. Future educational policies must include a committed five- to 10-year spending plan that is on a higher level of maintaining than is military spending. We are seeing foreign countries committing to educational spending levels that are having a positive impact on their global STEM educational standings. Along with the funding commitment, future policies must include additional funding and resources for teachers and for domestic students successfully completing advanced degrees in STEM education. Funding policies should also eliminate programs that increase competition among states, such as the Race for the Top educational program, that result in a far too varied approach to advancing the STEM priority and may actually result in a greater disparity of educational resources.

America urgently needs to consider an early national childhood development program that focuses on developing an early responsibility (self-regulation) towards learning and begins expose children to early innovative and transformative learning environments. Innovative creativity is an area where America has always excelled, and we need to instill policies that focus on further developing this resource. The early childhood programs should include social services support, such as guaranteed nutritious meals and healthcare in order to ensure students are provided with the necessary elements to support effective learning.

Finally, future educational policies must include the development of social responsibility and a national imperative towards learning. This inclusion of the media will be critical to the effectiveness of this policy. Educational polices must focus on changing adolescent's values and provide greater recognition for scholastic success. This paradigm shift will take time to implement and will be supported by an effective childhood development program. In order to benefit from another "Sputnik Moment,"

America needs to realize and understand the treat it is facing by a declining STEM capability and the role education plays in our future security. Future educational policies must include initiative in the shaping of collective interests and developing cohesion as a result of external threat, much as it did in the 1940s and 1950s when faced with the advances in space exploration of a nuclear Soviet Union.

F. POSSIBLE ADDITIONS TO IMPORTANCE OF POLICY

In developing this research, a number of additional areas of importance have been identified in relation to future educational policy development. In the 1940s and 1950s, America responded to the threat of nuclear weapons and a space race with the Soviet Union through educational and innovative initiatives referred to as the "Sputnik Moment." An important part of the 1950s initiative and America's future educational policy initiative in the shaping of collective interests and developing cohesion as a result of external threat and initiating transformative learning based upon threat of foreign dominance. In addition, America has suffered from an ineffective policy of educational sustainment and strategic foresight in order to build resilience and emergence in education in order to be prepared to address future needs.

G. FUTURE RESEARCH RECOMMENDATIONS

Through this analysis, a number of future research recommendations were identified related to educational polices and America's declining STEM global educational rankings. Additional research on the topic of developing an effective social imperative in relation to supporting educational initiatives would be very beneficial to future policymakers. Specifically, research to address the role of demographics and the effect that trust in the government has in the development of a social imperative will be essential as future initiatives are developed. With the critical role that media will play in the changing America's outlook on education, additional research is warranted in the areas of the use of the media in shaping collective interests or developing community cohesion. Finally, additional research is recommended on addressing the impact of the Tenth Amendment on the development of an effective national education policy.

H. CONCLUSION

The United States is at a critical tipping point with the declining global ranking of its domestic students in STEM sciences, the increased global STEM capabilities of countries like China and Russia, and an increased reliance on critical foreign manufacturing, all of which threaten our national security. Massive budget cuts in education and ever changing educational priorities have prevented the U.S. from implementing an effective national educational policy that is capable of reversing this worrisome trend. The United States has not experienced a national imperative towards the sciences since the Cold War and space race elicited a "Sputnik moment" among its student population. That being said, whole school approaches, such as TechBoston, and national initiatives, such as the Finnish Education System, have proven highly effective at increasing student interest and success in the STEM studies. These successful programs focus on providing sufficient funding, resources, and highly capable teachers, in conjunction with long-term educational policies and programs that elicit the capabilities and interests of the students. The U.S. needs to develop a more aggressive social imperative among its student culture to focus on emulating the top global performers in science, technology, and math. Through the incorporation of more educational policies and programs aimed at developing a social infrastructure that supports excelling in STEM studies, the U.S. will have a greater chance in reversing its global educational rankings, retaining our technological superiority, and consequently reinforcing our national security.

Without an effective educational system, we are placing our national security at risk. Concerns over our declining educational capabilities have been on the forefront of American news headlines and governmental reports since the 1960s. Nevertheless, members of American society have failed to neither realize the gravity of the threat facing us nor realize what consequences our educational choices have in defending country.

We have entered into a high stakes, highly competitive global race for technological advantage. Countries are facing energy, economic, and national security crises largely based on their domestic technological capabilities. The emerging

competitiveness of the global education system, in conjunction with the technology race and as it relates to America's domestic student population is well summarized in an analogy by Richard Hodgetts and discussed by N. Augustine in his educational article, "Is America Falling Off the Flat Earth, 2007":

> Every morning in Africa a gazelle wakes up. It knows it must outrun the fastest lion or it will be killed. Every morning in Africa a lion wakes up. It knows it must outrun the slowest gazelle or it will starve. It doesn't matter whether you're a lion or a gazelle—when the sun comes up, you had better be running.

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LIST OF REFERENCES

Agnew, R. (1985). Social control theory and delinquency: A longitudinal test. *Criminology*, *23*(1), 47–61.

Angel, R. (2012, August 14). Intel leads education and inspires the next generation of thinkers. *Wired,* Retrieved from http://www.wired.com/geekmom/2012/08/intel-leads-education/

Augustine, N. R. (2007). *Is America falling off the flat earth?* Washington, DC: National Academies Press. Retrieved from http://www.nap. edu/catalog/12021.html

Bandura, A. (Ed.). (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall.

Bardach, E. (2009). *A practical guide for policy analysis: The eightfold path to more effective problem solving* (3rd ed.). Washington, DC: CQ Press.

Coleman, J. (2006, winter). The adolescent society. *Education Next*, 41–43. Retrieved from http://educationnext.org/files/ednext20061_40.pdf

Darling-Hammond, L. (2010). What we can learn from Finland's successful school reform. Retrieved from http://www.nea.org/home/40991.htm

Department of Defense. (2013). SMART—Science, Mathematics and Research for Transformation. Retrieved August 25, 2013, from http://smart.asee.org

Department of Homeland Security. (2010). *Quadrennial Homeland Security Review Report 2010*. Washington, DC: Department of Homeland Security.

Executive Office of the President of the United States. (2009). *The Race to the Top: Promoting innovation, reform, and excellence in America's public schools. Fact sheet.* Washington, DC: White House.

Ferrante, E., & Zacharias, M. (2011). President Obama highlights success of technology-driven TechBoston Academy. Retrieved February 22, 2013, from http://www.nsf.gov/discoveries/disc_summ.jsp?org=NSF&cntn_id=119075&preview=false

FIRST. (2013). First—For Inspiration and Recognition of Science and Technology. Retrieved March 3, 2013, from http://www.usfirst.org/

Executive Order 13434, 3 C.F.R. (2007).

Goldin, C., & Katz, L. F. (2008). *Why the United States led in education: Lessons from secondary school expansion, 1910 to 1940.* Cambridge, MA: National Bureau of Economic Research.

Gonzales, P., Williams, T., Jocelyn, L., Roey, S., Kastberg, D., & and Brenwald, S. (2009). *Highlights from TIMSS 2007: Mathematics and science achievement of U.S. fourth and eighth-grade students in an international context.* (Special Report No. NCES 2009–001). Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Grevatt, J. (2011, January 7). China's J-20 and the signs of self-reliance. *Jane's Defence Weekly*. http://defence.pk/threads/chinas-j-20-and-the-signs-of-self-reliance.88035/

Honda, M., & Cleveland, P. (2012, January 20). STEM education: Congressman proposes STEM Education Office. *U.S. News and World Report*. http://www.usnews.com/news/blogs/stem-education/2012/01/20/congressman-proposes-stem-education-office

Johnson, N., Oliff, P. & Koulish, J. (2008). *Most states are cutting education.* Washington, DC: Center on Budget and Policy Priorities. Retrieved from http://www.cbpp. org/files/12-17-08sfp. pdf

Jolly, J. L. (2009). The National Defense Education Act, current STEM Initiative, and the gifted. *Gifted Child Today*, *32*(2), 50–53.

Kodrzycki, Y. K. (2002, 4th quarter). Education in the 21st century: Meeting the challenges of a changing world. *New England Economic Review*, 3–18.

Koebler, J. (2011). STEM Education, Google Awards grants to 16 STEM organizations. *U.S.News and World Report*. Retrieved from http://www.usnews.com/news/blogs/stem-education/2011/12/14/google-awards-grants-to-16-stem-organizations

Levine, R. C. (2010). Top of the class. *Foreign Affairs*, *89*(3), 63–75.

Li, Y., Whalley, J., Zhang, S., & Zhao, X. (2008). *The higher educational transformation of China and its global implications.* (Working paper no. 13849). Cambridge, MA: National Bureau of Economic Research.

MacCluskey, N. (2010). Education race to the top hits bottom. Retrieved March 7, 2013, from http://www.cato.org/publications/commentary/education-race-top-hits-bottom

Marginson, S. (2006). Dynamics of national and global competition in higher education. *Higher Education*, *52*, 1–39.

Marginson, S., & van der Wende, M. (2007). To rank or to be ranked: The impact of global rankings in higher education. *Journal of Studies in International Education*, *11*(3/4), 306–329. DOI:10.1177/1028315307303544

Matthews, O., & Nemtsova, A. (2010, May 14). Smart Russia. *Newsweek*. http://www.newsweek.com/2010/05/14/smart-russia.print.html

McDonnell, L. M. (2008). *The changing nature of federalism in education: A paradox and some unanswered questions* (discussion draft). Santa Barbara, CA: University of California.

McNichol, E., & Lav, I. J. (2009). *State budget troubles worsen*. Washington, DC: Center for Budget and Policy Priorities.

Meldrum, R. C., Young, J. T. N., & Weerman, F. M. (2009). Reconsidering the effect of self-control and delinquent peers. *Journal of Research in Crime and Delinquency, 46*(3), 353–376.

National Academy of Science. (2007). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. Washington, DC: The National Academies Press.

National Science Foundation (n.d.). "National Lab Day." Retrieved July 7, 2012, from http://www.nsf.gov/news/special_reports/natlabday/

National Science Board. (1998). *Failing our children: Implications of the Third International Math and Sciences Study* (NSB-98-154; NSB/TIMSS-98-10). Washington, DC: National Science Board. Retrieved from http://www.nsf.gov/nsb/documents/1998/nsb98154/nsb98154.htm

National Science Board. (1999). *Preparing our children: Math and Science Education on the National Interest* (No. NSB-99-31a). Washington, DC: National Science Board. Retrieved from http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsb9931a

National Science Board. (2010). *Globalization of science and engineering research, A Companion to science and engineering indicators 201z* (No. NSB-10-3). Washington, DC: National Science Foundation.

National Science Foundation Committee on Equal Opportunities in Science and Engineering. (2011). *Broadening Participation in America's STEM Workforce: 2009–2010 CEOSE Biennial Report to Congress* (No. CEOSE 11–01). Arlington, VA: National Science Foundation. Retrieved from http://www.nsf.gov/od/oia/activities/ceose/reports/2009-2010_CEOSEBiennialReportToCongress.pdf

Rask, K. (2010). *Attrition in STEM fields at a liberal arts college: The importance of grades and pre-collegiate preferences.* Master's thesis, Wake Forest University, Winston-Salem, NC.

Rhodes, H. J. (2007). *Confronting the challenges of student engagement: A case study of a school-based intervention*. Ph.D. dissertation, Pardee Rand Graduate School, Santa Monica, CA.

Romer, D., Hall Jamieson, K., & Pasek, J. (2009). Building social capital in young people: The role of mass media and life outlook. *Political Communication, 26*(1), 65–83. DOI:10.1080/10584600802622878

Stine, D. D. (2009). *The America COMPETES Act and the FY2009 budget.* (No. CRS RL34396). Washington, DC: Congressional Research Service.

Time Warner. (2013). Time Warner Cable's Connect A Million Minds. Retrieved August 22, 2013, from http://www.connectamillionminds.com/about/

Tsai, W. (2006). *An analysis of China's information technology strategies and their implications for U.S. National security* (Master's thesis). Naval Postgraduate School.

The UTeach Institute. (2013). The UTeach Institute. Retrieved July 20, 2012, from www.uteach-institute.org/about

U.S. Department of Education. (n.d. -a). *Race to the Top, annual performance report*. Retrieved March 25, 2013, from https://www.rtt-apr.us/

U.S. Department of Education. (n.d.-b). *Race to the Top, Delaware report, year 1, SY 2010–2011*. Washington, DC: U.S. Department of Education.

U.S. Department of Education. (n.d -c). *Race to the Top state report, District of Columbia SY 2011–2012*. Retrieved March 25, 2013, from www.rtt-apr.us/state/district-of-columbia/2011-2012/stem

U.S. Department of Education. (n.d -d). *Race to the Top, state report, Florida, SY 2011–2012*. Retrieved March 25, 2013, from www.rtt-apr.us/state/florida/2011-2012/stem

U.S. Department of Education. (n.d.-e). *Race to the Top, state report, Maryland, SY 2011–2012*. Retrieved March 25, 2013, from http://www.rtt-apr.us/state/massachusetts/2010-2011/stem

U.S. Department of Education. (n.d.-f). *Race to the Top, state report, Massachusetts, SY 2011–2012*. Retrieved March 25, 2013, from www.rtt-apr.us/state/maryland/2011-2012/stem

U.S. Department of Education. (n.d.-g). *Race to the Top, state report, New York, SY 2011–2012*. Retrieved March 25, 2013, from http://www.rtt-apr.us/state/new-york/2011-2012/stem

U.S. Department of Education. (n.d.-h). *Race to the Top, state report, North Carolina, SY 2011–2012*. Retrieved March 25, 2013, from https://www.rtt-apr.us/state/north-carolina/2011-2012/intro

U.S. Department of Education. (n.d.-i). *Race to the Top, state report, Ohio, SY 2011–2012.* Retrieved March 25, 2013, from http://www.rtt-apr.us/state/ohio/2011-2012/stem

U.S. Department of Education. (n.d.-j). *U.S. Department of Education, Race to the Top, state report, Rhode Island, SY 2011–201*2. Retrieved March 25, 2013, from https://www.rtt-apr.us/state/rhode-island/2011-2012/intro

U.S. Department of Education. (n.d.-k). *Race to the Top, state report, Tennessee, SY 2011–2012*. Retrieved March 25, 2013, from http://www.rtt-apr.us/state/tennessee/2010-2011/stem

U.S. Department of Education. (2010). *A blue print for reform, Reauthorization of the Elementary and Secondary Education Act.* Washington, DC: U.S. Department of Education.

U.S. Department of Education. (2011). The American Recovery and Reinvestment Act of 2009: Saving and creating jobs and reforming education. Retrieved July 7, 2013, from http://www2.ed.gov/print/policy/gen/leg/recovery/implementation.html

U.S. Department of Education. (2013a). *Race to the Top state report, District of Columbia SY 2011–2012*. Retrieved March 25, 2013, from www.rtt-apr.us/state/district-of-columbia/2011-2012/stem

U.S. Department of Education. (2013b). *Race to the Top, state report, Florida, SY 2011–2012*. Retrieved March 25, 2013, from www.rtt-apr.us/state/florida/2011-2012/stem

U.S. Department of Education. (2013c). *Race to the Top, state report, Georgia, SY 2011–2012*. Retrieved March 25, 2013, from http://www.rtt-apr.us/state/georgia/2011-2012/stem

U.S. Department of Education. (2013d). *Race to the Top, state report, Hawaii, SY 2011–2012, 2013*. Retrieved March 25, 2013, from www.rtt-apr.us/state/hawaii/2011-2012/stem

U.S. Department of Education. (2013e). *Race to the Top, state report, Georgia, SY 2011–2012*. Retrieved March 25, 2013, from http://www.rtt-apr.us/state/georgia/2011-2012/stem

U.S. House of Representatives. (2009). *Making supplemental appropriations for job preservation and creation, infrastructure investment, energy efficiency and science, assistance to the unemployed, and state and local fiscal stabilization for the fiscal year ending September 30, 2009, and for other purposes: Conference report to accompany H.R. 1.* (No. 111–16). Washington, DC: Government Printing office. http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=2 &ved=0CCsQFjAB&url=http%3A%2F%2Fwww.finance.senate.gov%2Flibrary %2Freports%2Fconference%2Fdownload%2F%3Fid%3Dbaf954fc-01f7-47d7- 90bc-dfb3cd036a67&ei=U3AmU7WrCem9yAGo2oDYCg&usg= AFQjCNE_CHQyqt7pwtjtDOQh1Gw1tOs0Mg

United States Census Bureau. (2003). *Generation X speaks out on civic engagement and the decennial census: An ethnographic approach.* Washington, DC: U.S. Census Bureau.

United States Commission on National Security/21st Century. (2001). *Road Map for National Security: Imperative for Change: The Phase III Report of the U.S. Commission on National Security/21st Century* (United States Commission Report No. Phase III). Washington, DC: author. Retrieved from http://www.au.af.mil/au/awc/awcgate/nssg/phaseIIIfr.pdf

Wadsworth, J. (2010). Forging the Solution to the energy challenge: The role of materials science and materials scientists. *Metallurgical and Materials Transactions A, 41A*(5), 1047–1062.

Walsh, B. (2010, July 5). The electrifying Edison. *Time Magazine*, *176*, 39–42.

White House. (2010). *2010 National security strategy*. http://www.whitehouse.gov/sites/default/files/rss_viewer/national_security_strate gy.pdf

White House Office of the Press Secretary. (2010). President Obama to announce major expansion of "educate to innovate" campaign to improve science, technology, engineering and math (STEM) Education. Retrieved from http://www.whitehouse.gov/the-press-office/2010/09/16/president-obama- announce-major-expansion-educate-innovate-campaign-impro

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