URBAN UNDERREPRESENTED MINORITY STUDENTS IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH: AN ANALYSIS OF THE DIFFERENCES BETWEEN DEVELOPMENTAL ASSETS AND ACADEMIC ACHIEVEMENT

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ABSTRACT

URBAN UNDERREPRESENTED MINORITY STUDENTS IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH: AN ANALYSIS OF THE DIFFERENCES BETWEEN DEVELOPMENTAL ASSETS AND ACADEMIC ACHIEVEMENT

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The purpose of this study is to determine the relationship between the developmental assets and academic achievement of urban underrepresented minority male and female students in a specialized science, technology, engineering, and math program, and the developmental assets and academic achievement of urban underrepresented minority male and female students in traditional comprehensive high school programs. The findings of the study provide information regarding the influence of gender, school setting, and developmental assets that may help impact student achievement for underrepresented minorities in the areas of science, technology, engineering, and math. The study findings also contribute to developmental assets theory and the influence of the theory as it relates to underrepresented minority students, academic outcomes, and the influencing factors internal and external to school.

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DESIGN OF THE STUDY

In response to the Committee on Prospering in the Global Economy report, *Rising Above the Gathering Storm* (National Research Council, 2007), former President George W. Bush signed into law the America COMPETES Act in August 2007, designed to support additional initiatives to improve the nation's competitiveness including funding authorizations to states to seed additional specialized high schools to their systems. According to a statement from former President Bush, the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act provided a comprehensive strategy to help keep America the most innovative nation in the world (Bush, 2007).

According to a 2010 report by United States Secretary of Education Arne Duncan, in the last decade, international competition in higher education and the job market has grown dramatically. As a result, students in the United States will be expected to compete globally with peers in Canada, China, India, European countries, and other rapidly developing states (Duncan, 2010). Additionally, a study from the National Bureau of Economic Research reports that students in other countries are already catching up with or surpassing students in the United States, especially in the critical STEM fields of science, technology, engineering, and mathematics. From the same study, it was reported that China will award more PhDs in engineering and the sciences than any other country in the world, including the United States, the current title holder (Li, 2010).

In 2009, President Obama announced plans to launch the "Educate to Innovate" Program designed to help improve participation and performance of American students in STEM (science, technology, engineering, and math) and increase the nation's focus on improving STEM education in the United States (Obama, 2009b). This initiative demonstrates the current administration's effort to help strengthen the pipeline of students into STEM fields and builds on an extensive amount of research and policy reports demonstrating the need to promote STEM education in order to maintain the United States' competiveness in the global economy (Anderson & Kim, 2006; Chen & Weko, 2009; Dowd, Malcolm, & Bensimon, 2009).

Factors influencing academic achievement among underrepresented minorities have been an important issue in K–16 education and the STEM workforce. Some claim that the ability to achieve the goal of keeping America the most innovative nation in the world will rely heavily upon the academic attainment and achievement of underrepresented minority students (URM's) in STEM. According to a 2006 report from the American Council on Education:

> The nation's changing demographics and continued need to remain globally competitive make it clear that colleges and universities must increase the number of Hispanics and African Americans earning degrees in science, technology, engineering, and math (the STEM fields). Thirty-nine percent of people under age 18 in the United States are persons of color and this percentage will continue to increase (U.S. Census Bureau, 2000), placing young people of color at the vanguard of the next generation. It is upon this generation that the nation places its hopes for continued economic competiveness in the Information Age. (Anderson & Kim, 2006, p. 1)

Women and three racial/ethnic groups—African American, Hispanics, and American Indians are considered underrepresented in science and engineering because they constitute smaller percentages of science and engineering degree recipients and of employed scientists and engineers than they do of the population (National Science Foundation [NSF], 2011). Differences in participation of men, women, and various racial/ethnic groups are rooted in differences in current and historic participation in science and engineering higher education, as well as differences in educational attainment and in precollege course taking and achievement (Malcolm & Malcolm, 2011).

According to the 2011 National Science Foundation Report, recent trends in undergraduate enrollment reflect growth in and the changing composition of the U.S. college-age population. Most notably, underrepresented minorities are an increasing fraction and whites are a decreasing fraction of undergraduate students (NSF, 2011). Policymakers have confirmed the relevance and urgent nature of the need for improved academic achievement for all students in STEM with the legislative activity resulting in decades of federally supported programs designed to help improve the URM–STEM pipeline (National Research Council, 2011). Despite an increase in URM enrollment at the college undergraduate level and the fact that high-achieving URM students at the high school level are interested in pursuing scientific or engineering careers, a disproportionate number of minorities are leaving the college STEM pipeline.

> Minorities are underrepresented in STEM education programs and in the STEM workforce. By minority status, only 9% of all first-time STEM freshmen were African Americans, only 7% were Hispanics, and only 1% were Native Americans in contrast to 83% Caucasians and Asian Americans. Additionally, under-represented minorities in STEM fields experience the highest attrition rates of 44% compared to Asian students at 26% and Caucasian students at 25%. (Mitchell, S. 2011, p. 24)

Consequently, URMs continue to be underrepresented among STEM PhD recipients and in the STEM workforce.

According to the Association for the Study of Higher Education (ASHE) 2011 Education Report, eight factors in K–12 school settings are responsible for URM’s lack of academic achievement in the areas of STEM:

1. School district funding disparities
2. Tracking into remedial courses
3. Underrepresentation in Advanced Placement courses
4. Unqualified teachers

5. Low teacher expectations
6. Stereotype threat
7. Oppositional culture
8. Premature departure from high school (Museus, S. D., Palmer, R. T., Davis, R. J., & Maramba, 2011, p 29).

The report provides specific examples of each of the eight factors, including larger class sizes for URMs, resulting in reduced budget allocations in neighborhoods with high poverty rates.

Clearly a plethora of research exists regarding the lack of URMs in STEM. But the question remains: Why does the underrepresentation of minorities in STEM exist?

1.1 Statement of the Problem

Research supports the claim that high school is the key stage at which students form their impression of science and engineering related careers which may influence their future career decisions (Subotnik, Tai, Rickoff, & Almarode, 2008), and high school environments have the potential to positively or negatively influence the formation of STEM orientation (Legewie & DiPrete, 2012). Research also indicates that the future of STEM depends on our nation's ability to engage all student populations, including diverse populations (URMs), at all stages of the STEM pipeline (Frehill, 2011).

At the same time, despite this need, many URM students with strong SAT scores, impressive grades, and success in high school honors math and science courses leave the college science pipeline (Summers & Hrabowski, 2006). Furthermore, only 16% of URM college students who choose STEM in college will complete their course of study in five years (Museus, Palmer, Davis, & Maramba, 2011). Developmental assets research (Benson, Scales, & Syvertsen, 2011) would explain this anomaly in terms of the underdevelopment of internal and external assets, those assets that influence academic achievement and career decisions linked to the college STEM pipeline.

1.2 Orienting Theoretical Framework

Developmental Assets theory is the lens used to conceptualize and orient this study. The developmental assets framework grew out of extensive scientific research in child and adolescent development (Benson et al., 2011). As shown in Table 1.1, the developmental assets framework includes a total of 40 assets. The assets are categorized into two groups, 20 internal assets and 20 external assets, each with four subcategories.

Table 1.1 Developmental Assets Framework

Internal Assets (20)	External Assets (20)
Commitment to learning	**Support**
1. Achievement motivation	1. Family support
2. School engagement	2. Positive family communication
3. Homework	3. Other adult relationships
4. Bonding to school	4. Caring neighborhood
5. Reading for pleasure	5. Caring school climate
	6. Parent involvement in schooling
Positive Values	**Empowerment**
6. Caring	7. Community values youth
7. Equality and social justice	8. Youth as resources
8. Integrity	9. Service to others
9. Honesty	10. Safety
10. Responsibility	
11. Restraint	
Social Competencies	**Boundaries and Expectations**
12. Planning and decision making	11. Family boundaries
13. Interpersonal competence	12. School boundaries
14. Cultural competence	13. Neighborhood boundaries

Table 1.1 – Continued

15. Resistance skills	14. Adult role models
16. Peaceful conflict resolution	15. Positive peer influence
	16. High expectations
Positive Identity	**Constructive use of time**
17. Personal power	17. Creative activities
18. Self-Esteem	18. Youth programs
19. Sense of Purpose	19. Religious community
20. Positive View of Personal Future	20. Time at home

Note. Adapted from Advances in Child Development and Behavior: The contribution of the developmental assets framework to positive youth development theory and practice by Benson, P. L., Scales, P. C., & Syvertsen, A. K., 2011, Chapter 8 pp. 197–230. Copyright 2005 by Search Institute.

1.2.1 External Assets

External assets are positive experiences students should acquire from the socializing systems of a community (Benson, 2006). They relate to students' support, empowerment, boundaries and expectations, and constructive use of time, the four external assets subcategories. Support is evidenced in a caring school climate, one in which the school provides a supportive and encouraging environment. The research has shown that when underrepresented minority students receive support through teachers, counselors, and their peers, they can achieve post-secondary goals (Reddick, Welton, Alsandor, Denyszyn, & Platt, 2011).

Empowerment comes from a community that helps students have a sense of feeling valued, and allows underrepresented minority students to view themselves in a positive light. The research has also shown that the students' ability to feel good about their strengths and skills and ability to pursue STEM careers also contributes positively to student post-secondary STEM retention (Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010).

Boundaries and expectations consist of providing rules and consequences as they relate to the community and school, including the high academic expectations of school personnel. Study findings also reveal students typically indicate having future academic expectations of attaining at least a college degree, partially attributed to their experience of moderate to high levels of school support in their academic environment (Trask-Tate & Cunningham, 2010).

Constructive use of time can be described as student involvement in extracurricular programs with adult school personnel that care and help nurture student growth. Mahoney and Cairns (1997) argued that school extracurricular activities serve as a protective mechanism against early school dropout. For all persons, participation in extracurricular activities was related to significantly lower rates of early school dropout.

1.2.2 Internal assets

On the other hand, internal assets focus on students' inner life or the competencies needed to help guide decision making and actions. Therefore, internal assets relate to students' commitment to learning, positive values, social competencies, and positive identity (Benson, 2006). One important factor that contributes to students' commitment to learning, according to Cernkovich and Giordano (1992), is school bonding because it contributes to students experiencing success and academic achievement in school.

The research has shown that student positive values are influenced in environments in which they observe adult modeling of positive behaviors in both the school and community environments, and the majority of the positive value assets focus on personal character. Benson (2006) argued that each personal character asset is an important factor in predicting non-engagement in risk behaviors and multiple positive outcomes, including school success.

Social competencies assets emphasize healthy interpersonal relationships (Benson, 2006). Study findings suggest that knowing and being comfortable with people of differing ethnic and racial backgrounds is an important factor in allowing students to form healthy interpersonal relationships in schools (Hunter & Elias, 2000). Furthermore, as the global landscape continues to diversify, social competencies assets will be important assets for students entering the future workplace and society.

Positive identity can be described as the asset that highlights students' perspective of their self-worth and sense of purpose. Simmons and Blyth (1987) suggest that self-esteem is less common among girls than boys in schools. Therefore, students' school setting may help positively impact their sense of purpose, self-esteem, and positive outlook for the future.

Developmental assets framework focuses on students' perception of caring relations, high expectations, and meaningful participation within the home, peer group, school, and community environments. According to the research, the factors that impact academic achievement include social environments supported by relationships with adults and peers, and high expectations (Wasonga, 2002). In fact, it is conceivable that URMs who participate in a specialized STEM environment designed to provide access to caring relationships with adults, positive peer interactions, a supportive environment, and high expectations can potentially have the opportunity to realize substantial academic outcomes.

Such experiences with and participation in caring relationships and supportive environments can develop ties and links that can be quite important. History has shown that "African Americans and Latinos lack access to informal networks that provide information about, and entrance to desegregated institutions and employment" (Wells & Crain, 1994, p. 533). They lack the assets that come from such environments and relationships. Access to these assets is essential because, according to Wells and Crain (1994):

> People on the bottom of the social structure, including African American students from low-income families, have more to gain than white and wealthy students from the use of weak ties because these ties will invariably link them to more affluent and better connected people, whereas strong ties usually connect them to family and close friends who are also poor. (p. 534)

Therefore, the purpose of the framework is to identify specific factors that contribute to promoting the healthy development of adolescents regardless of ethnicity and gender (Developmental Assets, 2011). The latest research on developmental assets adds to the growing evidence that comprehensive, asset-based approaches to education and youth development have tremendous potential to contribute to the academic success of students from all backgrounds and in a wide range of communities (Scales & Roehlkepartain, 2003). There is growing evidence that studying developmental assets (both internal assets and external assets), academic achievement, and exactly what schools and communities are doing to get positive results may lead to better understanding and implications for suggested policy and program improvements (Scales & Roehlkepartain, 2003).

1.3 Purpose of the Study

This research study examines the relationship between internal and external developmental assets, and academic achievement among urban underrepresented male and female minorities in a specialized high school STEM program setting and in traditional comprehensive high school settings.

1.4 Hypotheses

Multiple hypotheses have been tested in this study. They focus on an overall assessment of student developmental assets profile (DAP) results and differences in terms of gender and school setting:

Interaction effect hypothesis: There is no significant interaction between gender and School setting (traditional or STEM specialized) on mean DAP scores.

Main effect hypothesis 1 (gender): There is no significant mean difference on the DAP instrument between male and female students.

Main effect hypothesis 2 (student setting): There is no significant mean difference on the DAP instrument between students attending traditional and STEM specialized institutions.

1.5 Procedures/Methods

The project explores the relationships between internal and external developmental assets, and academic achievement among urban underrepresented minority students. Female and male students in a science, technology, engineering, and math (STEM) focused high school setting will be compared to female and male students in traditional comprehensive high school settings.

1.5.1 The Researcher

As long as I can remember I have had an interest in science. As a result, after gaining acceptance to a Historically Black University (HBCU), I selected Biology as my course of study and subsequently completed a Bachelor of Science degree. During my undergraduate journey, I was able to apply and gain acceptance to participate in several programs designed to enhance minority participation in the sciences. Fortunately, I was selected to participate in two very instrumental programs that I believe have significantly influenced my decision to conduct this study.

During the summer of my second year in college, I attended the University of Washington (Seattle) in order to participate in the Minority Medical Education program funded by the Robert Wood Johnson Foundation. The program is designed to provide a summer enrichment experience for minority college students who possess the academic qualifications that would gain entrance to medical school. The primary purpose of the program is to better prepare minority students for the rigors of selection into medical school.

Additionally, I was one of five students selected to participate in the National Institutes of Mental Health Career Opportunities in Research (NIMH-COR) program at Grambling State University. The NIMH-COR program was a two year program specifically designed for four-year colleges or universities that serve the majority of students from one or more racial/ethnic minority groups, including African Americans, Hispanics, Native Americans and Alaska Natives, and Asians/Pacific Islanders. Due to the fact that persons belonging to these racial/ethnic groups are underrepresented in biomedical and behavioral sciences research relevant to mental health–related fields, the NIMH-COR program provides access to training programs that provided special research training to participants. The experiences are designed to improve qualifications for entry into advanced research career training programs leading to doctoral-level or M.D. research career degrees.

Immediately after graduation, I received three job offers to begin conducting research in biomedical laboratories at the University of Texas Southwestern Medical Center. I chose to begin my professional career in the Molecular Cardiology Department. Although I thoroughly enjoyed research, I began to think about the future and how other students (like me) might have the opportunity to access the world of science as I did. Therefore, in 2001, I transitioned to a career in education and began teaching eighth-grade science.

In 2006, shortly after receiving a master's degree in educational leadership, I began my career as a public school administrator. In 2007, I accepted the position as principal of a specialized STEM high school in a large urban school district. I served as principal of a specialized STEM school for the past five years. This experience enabled me to have the opportunity to work with a large population of underrepresented minority students in a unique high school setting. Despite all of the research regarding underrepresented minority students underachieving in science, technology, engineering, and math, I was fortunate to witness the opposite phenomenon in this school setting. As a result of the outstanding student academic achievement, the school has earned numerous awards and national recognition.

I currently serve the district as an executive director. In this role, I am responsible for supervising and providing instructional support for 13 campuses within a large urban school district. Fortunately, the specialized STEM school is one of the 13 schools I have been assigned. I now have the pleasure to work with 13 campuses to continue improving academic achievement for all students.

1.5.2 Data Needs

To complete this study, three sets of data were needed. The first was students' assets, external and internal developmental assets. It is essential to understand and document students' perceptions of their relationships with adults at home, school, in the community, and with peers (external assets), and the students' commitment to learning, positive values, social competencies, and positive identity (internal assets).

The second set of data included student standardized test scores. Eligible students were those who had taken the norm referenced Iowa Test of Basic Skills during the eighth grade (2008–2009 school year) and scored a combination of 160 points on the reading and math portion of the Iowa Test of Basic Skills assessment.

The third set of data included gender and ethnicity. This data was provided by the school district.

1.5.3 Data Sources

To achieve the research objectives, data from URM students enrolled in an urban STEM high school and URM students enrolled in a traditional comprehensive high school setting were needed. The population for this study was underrepresented minority students enrolled in high schools located in a school district located in a southwestern metroplex. The sample included 71 11^{th}-grade URM students enrolled in a specialized STEM high school setting and 71 11^{th}-grade URM students enrolled in traditional comprehensive high school settings. Table 1.2 presents these enrollment demographics.

Table 1.2 Specialized STEM High School Enrollment and

Sample Comprehensive High School Enrollment

STEM High School Enrollment		
Ethnicity	Total number of students	Percentage of student population
Hispanic	222	57.5
African American	71	18.4
White	48	12.4
Asian/Hawaiian/ Pacific Islander	39	10.1
American Indian/ Alaska Native	4	1.0
Two or more	2	0.5
Sample Traditional Comprehensive High School Enrollment		
Ethnicity	Total number of students	Percentage of student population
Hispanic	1,616	74.3
African American	258	11.9
White	247	11.4
Asian/Hawaiian/ Pacific Islander	32	1.5
American Indian/ Alaska Native	17	0.8
Two or more	6	0.3

Note. School district located in a southwestern metroplex based on federal ethnicity and race values.

1.5.4 Data Collection

The developmental assets profile (DAP) questionnaire was the survey instrument used to collect student responses. The DAP questions were developed by the Search Institute and the school district was provided with the necessary permissions to administer the survey and use the results for education research. The study was conducted entirely in a southwestern metroplex school district. The district's Research Review Board (RRB) approved the study (reference#11-031, see Appendices) in spring 2012. A letter provided by the Districts RRB granted permission to use any data collected solely for the purposes of the approved study.

The DAP survey consists of 58 questions and responses were measured with a four-point Likert scale:

- Not At All or Rarely
- Somewhat or Sometimes
- Very or Often
- Extremely or Almost Always

According to Benson, Scales, and Syvertsen (2011), three million surveys administered over the past 20 years have confirmed that the more developmental assets individuals possess, the better off they are across academic, psychological, social-emotional, and behavioral indicators of well-being. As a result, the asset framework appears to have comparable validity across young people's gender, race/ethnicity, geographic residence, and socioeconomic background. Therefore, student responses from the developmental assets profile survey were used to determine assets. Ethnicity, gender, and the results from the 2008–2009 norm referenced Iowa Tests of Basic Skills test administration were collected from the district's database and matched to the students taking the Search Institute survey.

To achieve the research objective, a sample of 71 11^{th}-grade URM (54 male and 17 female) students in an urban specialized STEM high school setting and a sample size of 71 11^{th}-grade URM (47 male and 24 female) students enrolled in urban traditional comprehensive high school settings are included in the study. The variability of the ratio of females to males in each school setting depended upon whether students met the established criteria to participate in the study. Chapter 3 provides a detailed rationale and requirements for student eligibility to participate. For students to enroll in the specialized STEM high school, specific assessment scores are required. Therefore, in order to compare like students enrolled in comprehensive high school settings (in which assessment scores are not required for enrollment), the same eligibility requirement has been applied to determine the student sample size. Students eligible to participate must have taken and scored a combination score of 160 points on the reading and math portion of the Iowa Test of Basic Skills test during the eighth grade (2008–2009 school year) with no score in the combination lower than 65% in either reading or math.

1.5.5 Analysis of Data

The statistical procedure Analysis of Covariance (ANCOVA) statistical analysis tool was used to analyze the collected data. The independent variable was the school setting (STEM vs. Comprehensive) and the dependent variables were results measured by the DAP developmental assets profile survey administered during the 2011–2012 school year. The covariate was the results from the nationally normed Iowa Test of Basic Skills administered to study participants during grade eight (2008–2009 school years). The 2 x 2 ANCOVA compared the differences between URM student assets at a specialized science, technology, engineering, and math school setting and traditional comprehensive high school settings**.** The number of eligible students determined the effect size of the study. SPSS software was used to analyze the data.

1.6 Significance of the Study

This study is designed to contribute to the theory, research, and practice in STEM education. The focus of the study is the relationship between developmental assets and academic achievement of urban underrepresented minority female and male students in a specialized science, technology, engineering, and math program and in a traditional comprehensive high school program.

1.6.1 Theory

The findings of this research study have the potential to provide information regarding the influence of developmental assets that may help impact student achievement for underrepresented minorities in the areas of science, technology, engineering, and math. This project will contribute to the understandings about the strength of Development Assets Theory and the influence of the theory as it relates to underrepresented minority students' academic outcomes and the influencing factors internal and external to school.

1.6.2 Research

Although several researchers have explored the cause of the underrepresentation of URMs in STEM, the problem continues to persist. According to the National Center for Education Statistics, over 65% of the college students entering STEM majors do not complete a degree within six years of beginning their college career (Gonzales et al., 2008). Moreover, the Higher Education Research Initiative reports that the number of URMs matriculating through a STEM degree program is significantly less. It is hoped that findings from this study will add to the research knowledge base and help move the K–16 research community toward a solution.

1.6.3 Practice

The findings of this study can help shape future policy and practice that may help support and strengthen the STEM pipeline in the United States. By determining differences between underrepresented minorities in specialized STEM focused settings and underrepresented minority students in traditional high school settings, the findings potentially provide us with the foundational blueprint for future K–16 STEM focused programs designed to increase minority student successful participation in STEM. As a result of this addition to the knowledge base, improved STEM outcomes for underrepresented minorities in K–16 could positively translate into an increased number of URMs being prepared for college, choosing STEM, and persisting in STEM fields in the future.

1.7 Summary

The purpose of the research study is to explore the relationships among external assets, internal assets, and academic achievement while focusing on urban underrepresented minority students. Therefore, the problem to which the study is directed is the analysis of internal and external assets that influence academic achievement among URMs in a specialized STEM environment and traditional comprehensive high school settings.

The DAP survey results were used to gather information on students' perception of their assets. The questionnaire also requested information on race, gender, and grade levels. The developmental assets survey results, Iowa Test of Basic Skills results, gender, and ethnicity were examined. In addition, students' survey results and Iowa Test of Basic Skills are included in the data collection process.

1.8 Reporting

This chapter has provided an overview of the study and its design. Subsequent chapters provide an in-depth analysis of the relevant and related literature (Chapter 2), research methods and procedures (Chapter 3), data and results of the study (Chapter 4), and conclusions, discussion, and implications of the research findings (Chapter 5).

CHAPTER 2

LITERATURE REVIEW

> We know that the progress and prosperity of future generations will depend on what we do now to educate the next generation. Today I'm announcing a renewed commitment to education in mathematics and science….Through this commitment, American students will move from the middle to the top of the pack in science in math over the next decade for we know that the nation that out-educates us today will out-compete us tomorrow.

President Obama
Remarks at the National Academy
of Science Annual Meeting
April 27, 2009

This chapter examines literature related to underrepresented minorities in science, technology, engineering, and math, and the relationship between developmental assets and academic achievement. The literature review is organized into four sections. The chapter begins with an overview of underrepresented minorities in science, technology, engineering, and math (STEM), United States changing demographics, and the potential impact to global competiveness. Then, relevant STEM-related education policy is discussed, as well as underrepresented minority students' academic achievement in K–16 STEM education. Next, high school setting and STEM orientation as it relates to males and females are presented. Lastly, the review addresses developmental assets theory and academic achievement.

2.1 United States Changing Demographics and STEM Global Competiveness

The United States population is becoming more diverse and international competition and involvement in science and engineering are increasing (Li, 2010; Humes, K., Jones, N. A., & Ramirez, R. R., 2011). According to the National Action Council for Minorities in Engineering, between 2010 and 2050, the relative percentage of the United States population considered to be non-Latino white is expected to decline from 65% in 2010 to 46% in 2050. As Figure 2.1 shows, by 2050 Latinos will account for 30% of the United States population and Asians will account for 8%. Furthermore, 43% of school-aged children (aged 5–17) are African American, Latino, American Indian or Asian/Pacific Islander American and underrepresented minorities account for 34% of the age 18–24 United States population (Frehill, 2011). As a result, the critical need for continued conversation, research, and focus on underrepresented minority groups and their untapped potential as a future source of talent in the areas of science, technology, engineering, and mathematics is strengthened.

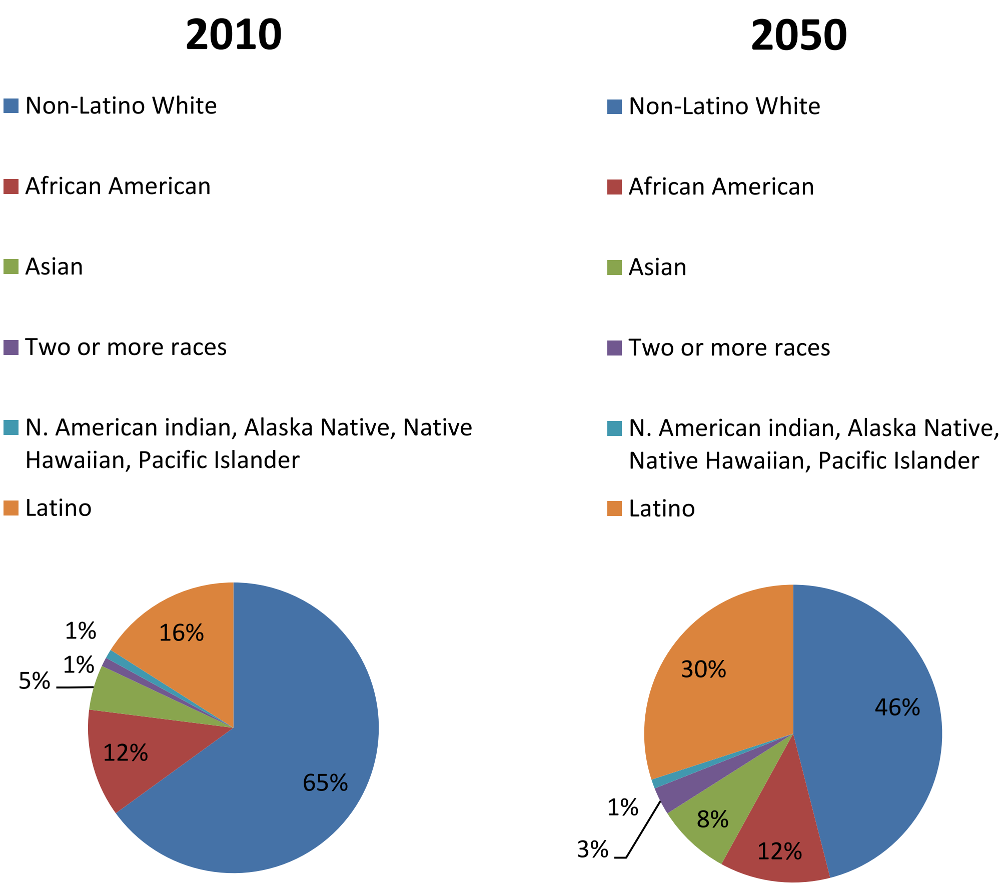

Figure 2.1. Projections of the population by race, (a) 2010 and (b) 2050. Adapted from the *2011 NACME Data Book: A Comprehensive Analysis of the "New" American Dilemma* by L. Frehill, 2011, p. 1. Copyright 2011 by the National Action Council for Minorities and Engineering.

The Business–Higher Education Forum (2005) asserts, “For America to increase its scientific and technological base, more students from the African American and Hispanic subgroups must reach high levels of performance in mathematics and science. To succeed, America must eliminate its achievement gaps” (p. 6). Historically, underrepresented minorities have not been a dominant force in science and engineering disciplines (National Science Board, 2008). Furthermore, underrepresented minorities generally lack participation in higher level science and math courses in high school and earn fewer undergraduate and graduate degrees in science and engineering (Frehill, 2011). While underrepresented minorities consist of 25% of the total population, they earn 16.2% of bachelor degrees, 10.7% of master’s degrees and 5.4% of doctorate degrees in the areas of science and engineering (National Science Board, 2008).

In September 2010, the Prepare and Inspire: K–12 Education in Science, Technology, Engineering, and Math (STEM) for America’s Future Report provided one of four key areas of National needs for STEM education related to underrepresented minorities in STEM. The report alerted policy makers to the National need of closing the achievement and participation gap in STEM. The Prepare and Inspire report (President's Council of Advisors on Science and Technology [U.S.], 2010) states the following:

> Our national needs cannot be met without drawing on the full potential of our Nation. The United States cannot remain at the forefront of science and technology if the majority of its students–in particular, women and minorities underrepresented in STEM fields—view science and technology as uninteresting, too difficult, or closed off to them. We must close the achievement and interest gap in STEM subjects among racial, ethnic, and gender groups. Closing these gaps cannot be limited to helping students and groups at the remedial level in STEM subjects. It also requires unleashing the full potential of all our students who have not historically been drawn to STEM fields. STEM education needs to recognize and cultivate untapped talent. Many of our future STEM experts can and must come from traditionally underserved populations. STEM fields will

greatly benefit from drawing on a diversity of perspectives, cultures, and ideas. Given these goals, STEM education must be aimed at multiple levels and at everyone. We must ensure that struggling students reach STEM proficiency. In parallel, we must deeply engage proficient students and attract high-achieving students from all groups to STEM subjects. (p. 16)

Furthermore, the National Academies of Sciences Report, Rising Above the Gathering Storm: Energizing America for a Brighter Economic Future (National Research Council, 2007) provided a comprehensive overview of the status of science and technology in the United States in addition to indicators related to global competition. A portion of the report identified the following indicators related to global competition and K–16 STEM education:

- Fewer than one third of U.S. 4th-grade and 8th-grade students performed at or above a level called "proficient" in mathematics; "proficiency" was considered the ability to exhibit competence with challenging subject matter. Alarmingly, about one third of the 4th graders and one fifth of the 8th graders lacked the competence to perform even basic mathematical computations.
- In 1995, U.S. 12th graders performed below the international average for 21 countries on a test of general knowledge in mathematics and science.
- U.S. 15-year-olds ranked 24th out of 40 countries that participated in a 2003 administration of the Program for International Student Assessment (PISA) examination, which assessed students' ability to apply mathematical concepts to real-world problems.
- In South Korea, 38% of all undergraduates receive their degrees in natural science or engineering. In France, the figure is 47%, in China, 50% and in Singapore, 67%. In the United States, the corresponding figure is 15%.

- Some 34% of doctoral degrees in natural science (including the physical, biological, earth, ocean, and atmospheric sciences) and 56% of engineering PhDs in the United States are awarded to foreign-born students.
- Estimates of the number of engineers, computer scientists, and information-technology students who obtain 2-, 3-, or 4-year degrees vary. One estimate is that in 2004, China graduated about 350,000 engineers, computer scientists, and information technologists with 4-year degrees, while the Unites States graduated about 140,000. China also graduated about 290,000 with 3-year degrees in these same fields, while the US graduated about 85,000 with 2-or 3-year degrees. Over the past 3 years alone, both China and India have doubled their production of 3- and 4- year degrees in these fields, while the United States' production of engineers is stagnant and the rate of production of computer scientists and information technologists doubled.
- About one third of U.S. students intending to major in engineering switch majors before graduation.
- There were almost twice as many U.S. physics bachelor's degrees awarded in 1956, the last graduating class before Sputnik, than in 2004. (pp. 15–16)

Gereffi, Wadhwa, Rissing, and Ong, (2008) asserted that statistics published regarding engineering graduates in the United States, China, and India are often misleading figures. They contended that there is a lack of quality, due to the fact that despite high demand, many engineers in China and India remain unemployed although there is high demand for their services. Gereffi et al. (2008) argue that quality will have the biggest impact on fueling innovation; therefore, the key educational issue should focus not only on quantity, but more importantly on quality.

As a result, the importance of providing quality science education for all students, including racially diverse groups, has become an urgent matter. According to the Business–Higher Education Forum (2005):

> The United States is losing its edge in innovation and is watching the erosion of its capacity to create new scientific and technological breakthroughs. Increased global competition, lackluster performance in mathematics and science education, and a lack of national focus on renewing its science and technology infrastructure have created a new economic and technological vulnerability as serious as any military or terrorist threat. (p. 3)

2.2 Underrepresented Minorities in K-16 Science, Technology, Engineering, and Math Education Policy

Due to the rapid demographic changes occurring in the United States, underrepresented minorities and K–16 STEM education must continue to be at the forefront of the conversation when considering the future United States STEM workforce (May & Chubin, 2003). Although policymakers, federally funded programs, and research studies have targeted the topic of underrepresented minorities and STEM, the problem persists and the issues continue to permeate into all relevant areas including the future of K–16 STEM education and the STEM workforce in the United States (Harper & Newman, 2010). In 1993, the National Science and Technology Council (NSTC) was established to coordinate science and technology policy in order to develop national goals related to federal funding of science, technology, engineering, and mathematics (STEM) education. The Science, Technology, Engineering, and Mathematics (STEM) Education Portfolio Report produced by NSTC in December 2011, was prepared in response to the requirements of the *America Competes Reauthorization Act* of 2010. The report provided a detailed inventory of federal STEM education programs that policymakers can reference in order to develop a more strategically focused funding plan as it relates to areas that may lead to significant impact in improving K–16 STEM education and strengthening the STEM career leaky pipeline as shown in Figure 2.2.

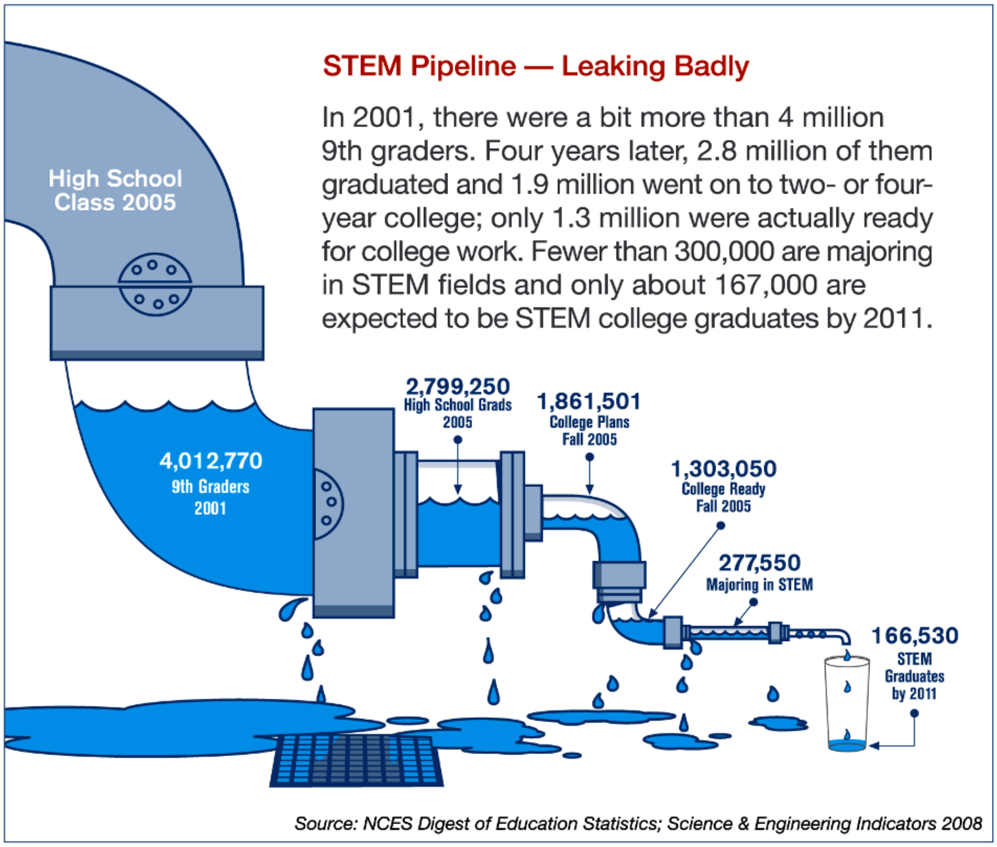

Figure 2.2. Leaky STEM Pipeline (National Center for Education Statistics, 2008).

The Federal Science, Technology, Engineering, and Mathematics Education Portfolio (Federal Inventory of STEM Education Fast-Track Action Committee, 2011) major findings included:

- Of the total of $3.4 billion spent by Federal agencies on STEM education investments, $967 million is spent on activities that target the specific workforce needs of science mission agencies. As these agencies' missions are quite different from one another, their workforce needs are also quite different—whether they are for a national workforce of biomedical researchers to fulfill the mission of the National Institutes of Health or a workforce of transportation engineers needed to fulfill the mission of the Department of Transportation. This finding does not rule out the possibility that in some cases there may be overlapping skill-set needs among disparate workforces, which could be addressed by joint training opportunities or other collaborative endeavors.

- The remaining $2.5 billion (7.2%) is spent on broader STEM education, and this spending is dominated by the expenditures of the National Science Foundation (47% of that $2.5 billion, or $1.2 billion) and the Department of Education (40% of the $2.5 billion, or $1 billion).
- The Federal government spends $1.1 billion on investments that have the primary goal of targeting groups that are underrepresented in STEM. In addition, nearly every other STEM education investment has this as a secondary goal.
- Twenty-four investments, with a total budget of $312 million, have the primary goal of improving teacher effectiveness, with most of that funding going to teacher professional development. Improving teacher effectiveness is a secondary goal of an additional 101 investments. Together, improving teacher effectiveness is a primary or secondary objective of 49% of all Federal STEM education investments.
- Of the broader STEM education investments, 86% have been evaluated since 2005 to identify how they can be improved, to test their impact, or both. Summative evaluations (evaluations of impact) have been conducted on 59 of those investments. Thirty-three of the summative evaluations were either randomized control trials (8 evaluations) or pre–post designs with matched comparison groups (25 evaluations) evaluation designs that can illustrate causality. The other 26 summative evaluations used other designs. Agency mission-specific workforce education investments have been less thoroughly evaluated; only 40% of these investments have been subject to any kind of outcome data collection. (pp. xii–xiii)

Additionally, in preparation for the reauthorization of the America COMPETES Act of 2010, the National Science Technology Council on STEM Education (CoSTEM) was created in February 2011 to devise a five-year STEM strategic plan designed to advance the state of American STEM education. In February 2012, CoSTEM released the Coordinating Federal Science, Technology, Engineering, and Mathematics (STEM) Education Investments: Progress Report which provided an outline of the following objectives proposed to reach STEM education improvement goals:

- Use evidence-based approaches. Ensure Federal STEM investments incorporate what is known about effective STEM education and evidence-based practices in STEM education.
- Identify and share evidence-based approaches. Conduct STEM education research and evaluation to identify evidence-based practices and assess program effectiveness. Enhance sharing of research and evaluation findings across agencies and with the public.
- Increase efficiency and coherence. Ensure Federal STEM education investments are coordinated in order to utilize and leverage Federal resources efficiently.
- Identify and focus on priority areas. Align a subset of the Federal STEM education investments to focus on Federal STEM education priority areas in a coordinated manner. The four priority areas identified are: Effective K–12 STEM teacher education, engagement, undergraduate STEM education, and serving groups traditionally underrepresented in STEM fields. (Federal Coordination in STEM Education Task Force, 2012, p. 13)

Two of the goals provided in the CoSTEM Progress Report identified undergraduate STEM education and serving groups traditionally underrepresented in STEM fields as priority areas of focus. In fact, there are so many colleges and universities focusing on remediating students when they arrive on campus for the first day of classes, that the number of students matriculating through engineering or technology programs have been on a steady decline (Schachter, 2008). In addition, when comparing American students to their international peers, the achievement gap is even more profound; not just for specific student groups, but for all students.

According to the Trends in International Mathematics and Science Study (TIMSS), American students rank ninth place (among 46 Nations) for the 2007 TIMSS administration. (Gonzales, P., Williams, T., Jocelyn, L., Roey, S., Kastberg, D., & Brenwald, S, 2008).

In 1995, the United States ranked 28th out of 41 countries. According to Bracey (2009), U.S. scores as well as ranks have actually risen for 8th graders and they have been stable for 4th graders. Researchers claim there is almost universal recognition that the effectiveness of a country's educational system is a key element in establishing competitive advantage in what is an increasingly global economy (Martin, Mullis, Foy, & Olson, 2008).

The research also suggested that the underrepresentation of minorities in the fields of math, science, and engineering is a direct correlation to the lack of preparedness these students receive in the K–12 setting (Adelman, 2006). On the whole, it is easy to imagine that the preservation of a K–16 system that fails to adequately prepare students in the areas of science, technology, engineering, and math (STEM) will potentially lead to a global economic crisis for the United States.

2.3 Underrepresented Minorities Academic Achievement in K-16 STEM Education

Underrepresented minorities have noticeably been absent in the areas of Science, Technology, Engineering, and Math as it relates to STEM careers, graduate and undergraduate level degree attainment, and rigorous course taking in high school (National Science Board, 2010). Over the past several decades, researchers have provided results that clearly communicate the problems related to underrepresented minorities and academic achievement in STEM.

Overall, findings have shown that the STEM pipeline is virtually leaking at every critical education milestone, including: underrepresented minorities' enrollment in college, STEM major selection, bachelor's degree completion, enrollment in graduate school, and advanced degree completion, which essentially has resulted in drainage of URMs from the STEM talent pool (Malcolm & Malcolm, 2011).

Harper and Newman (2010) argue:

> that the scholarship on minority student achievement in these fields is the antithesis of what the fields themselves supposedly represent. That is, STEM is often thought to be about innovation, efficiencies, and problem solving, yet most research concerning scientists, mathematicians, and engineers of color focuses almost exclusively on problems, failures, and stagnation—the same issues that researchers have studied over and over again for more than three decades. (p. 1)

In their book published thirteen years prior, Seymour and Hewitt (1997) substantiated the claim that most research of the day focused on the cause for disparities among underrepresented minorities and science and math education. In an attempt to identify the main factors contributing to minority STEM underachievement, they sustained that the nation experienced a decrease of underrepresented minority talent due to the following three main factors:

1. Science and math education failed to foster literacy in the population.
2. Too few undergraduates and graduates were recruited to meet the nation's future needs.
3. The sciences recruited too exclusively among white males.

Essentially, Seymour and Hewitt (1997), provided extensive evidence to support the claims related to undergraduate student decline in science and math related majors.

In 2000, Bonous-Hammarth published the results of a longitudinal study that suggested underrepresented minorities experienced significantly greater attrition from STEM majors than white students. The results of the study showed that female underrepresented minorities showed the highest percentage of attrition, followed by underrepresented minority males. Furthermore, Leggon and Pearson (2009) emphasized the importance of focusing on improving underrepresented male and female minority participation in STEM. They asserted that the most important factor must not focus primarily on demographics and the future demand for U.S. STEM talent, but a more important focus should be to develop the underrepresented minority untapped talent pool in order to improve the quality of innovation these individuals would bring to the STEM field (Leggon & Pearson 2009).

The key to increasing and sustaining the number of underrepresented minorities in STEM majors will rely on students' experiences in the K–12 classroom. Berryman (1983) suggests that by the time students reach high school, the decision to pursue STEM reaches a peak and begins to decline thereafter. Several studies (Astin, 1993; Berryman, 1983; Oakes, 1990) point to inadequate preparation in math and science as the main cause for underrepresented minorities' underachievement and lack of persistence in STEM. The assertion that high-rigor math and science courses serve to eliminate minority students from the STEM pipeline is prevalent (Sells, 1980). The research also indicates that underrepresented minorities either drop out of school (see Figure 2.3) or opt out of challenging courses (see Figure 2.4) early in their education due to structural obstacles such as tracking (Oakes, 1990). Overall, dropout rates have declined, but the fastest growing underrepresented minority population, Latinos, continue to have the highest dropout rate among all groups. Additionally, underrepresented minorities have increased enrollment in rigorous STEM courses while in high school, but the fact remains that overall, underrepresented minorities are less likely to take key mathematics and science courses when compared with Asian students and non-Latino white youth.

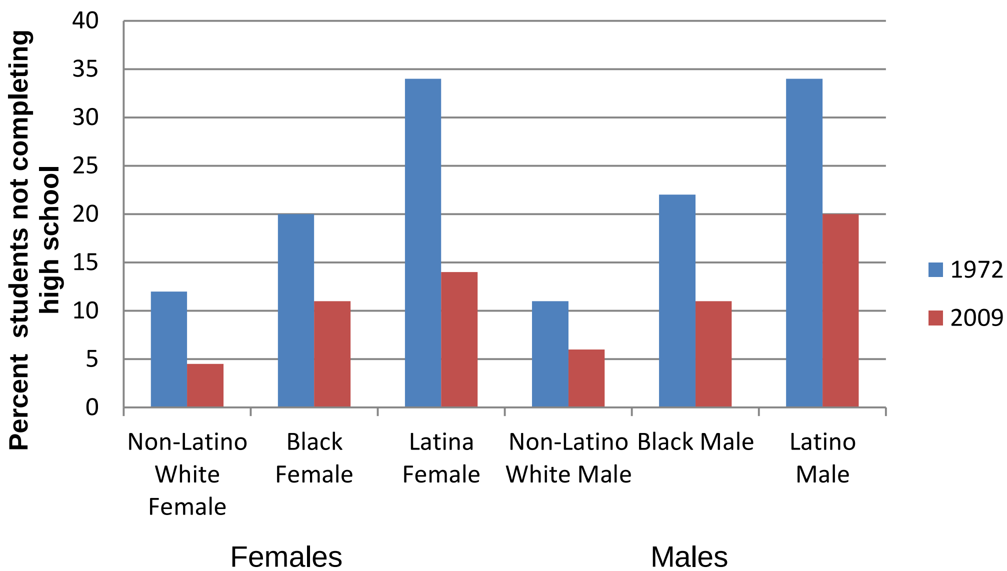

Figure 2.3. High school non-completion rates by sex and race/ethnicity, 1972 and 2009. Adapted from the *2011 NACME Data Book: A Comprehensive Analysis of the "New" American Dilemma* by L. Frehill, 2011, p. 1. Copyright 2011 by the National Action Council for Minorities and Engineering.

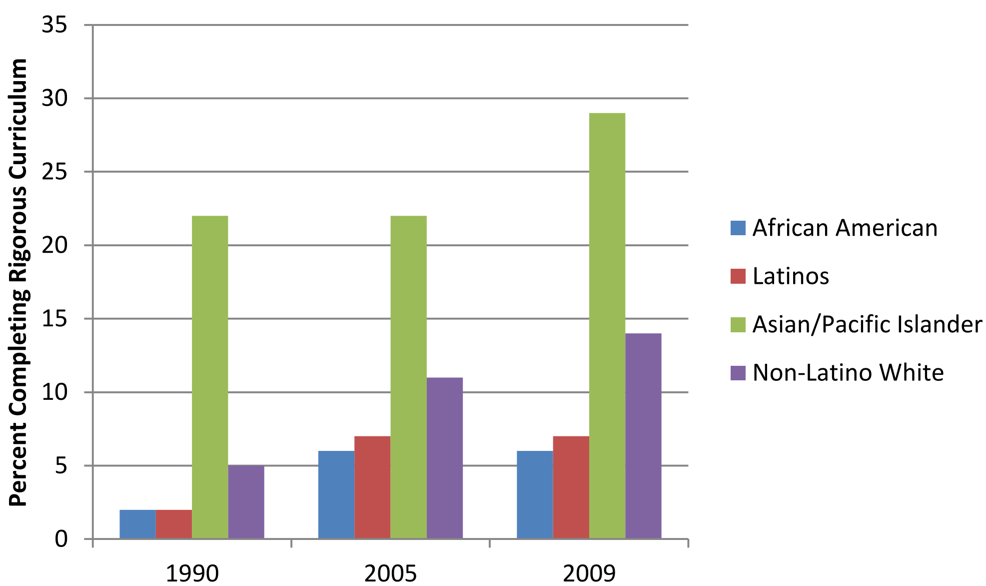

Figure 2.4. Percent completing rigorous high school curriculum by race/ethnicity. Adapted from the *2011 NACME Data Book: A Comprehensive Analysis of the "New" American Dilemma* by L. Frehill, 2011, p. 1. Copyright 2011 by the National Action Council for Minorities and Engineering.

A plethora of studies have shown that, in some cases, males and females typically show similar abilities as relating to STEM, but females report less of an interest, resulting in fewer females deciding to take prerequisite courses in high school, which would potentially open the door for graduate opportunities and STEM careers. Sax (1996) substantiates the importance of promoting female interest in science: Females must be provided with female role models and support in order to positively impact the trajectory for female URM students in STEM.

In 1992, Astin and Astin published the results of a longitudinal study conducted to examine the characteristics that contribute to URM persistence in STEM majors. The key findings of the study suggest the following as primary elements required to promote underrepresented minority achievement in STEM:

1. Motivation and encouragement to pursue STEM
2. Academic preparation designed to increase math competence and analytical skills

(Astin & Astin, 1992).

In sum, the impact of the aforementioned data and research studies sustains the sense of urgency as it relates to underrepresented minority students' performance and science and mathematics achievement trends found in K–12 education. Unfortunately, the lack of progress and underrepresented minorities' persistent underachievement in STEM extends into undergraduate education and the STEM career circuit.

2.3.1 Undergraduate Degree Attainment

The President's Council of Advisors on Science and Technology (PCAST) Engage to Excel (2012) report indicates the Obama administration has formally designated increasing the number of students who receive undergraduate degrees in STEM by one million over the next decade as a cross–agency priority goal, one that encourages federal agencies to share best practices and partner in their missions.

The research is clear that students declaring a STEM major upon entering college typically fail to complete the necessary degree requirements during the allotted degree-plan time or, even worse, they drop out altogether. According to the 2008 National Center for Education Statistics report, 65% of students typically do not finish STEM degree requirements by the sixth year after beginning an undergraduate program (Snyder, Dillow, & Hoffman, 2009). Unfortunately, an even more alarming statistic is the fact that underrepresented minorities are by far the worst in completion rates when evaluating STEM degree completion rates for all ethnicities. Hurtado, Eagan, and Chang (2010) reported in the Higher Education Research Institute that only 16% of underrepresented minority students who choose a STEM degree actually finish their programs in five years. African American students are the lowest performing group of all when comparing other ethnicities and their overall rate of STEM degree completion. Only 18.4% of African Americans finish a STEM bachelor's degree in five years; they are preceded by Native Americans (18.8%), Hispanics (22.1%), whites (33%) and Asian Americans/Pacific Islander (42%).

2.3.2 High School Environment

In September 2010, the President's Council of Advisors on Science Technology (PCAST) *Prepare and Inspire: K–12 STEM Education for America's Future* report provides a detailed plan including seven high-priority recommendations, one of which is to create 1,000 new STEM-focused schools over the next decade. The report stated:

> STEM-focused schools represent a unique National resource, both through their direct impact on students and as laboratories for experimenting with innovative approaches. The Nation currently has only about 100 STEM-focused schools, concentrated at the high school level. The Federal Government should promote the creation of at least 200 new highly STEM-focused high schools and 800 STEM-focused elementary and middle schools over the next decade, including many serving minority and high-poverty communities. In addition the Federal Government should take steps to ensure that all schools and school systems have access to relevant STEM expertise. (p. 12)

The research reinforces the sense of urgency in regard to states supporting the development of specialized STEM high schools to support national priorities and improve STEM competitiveness. However, opportunities for students to access specialized STEM high school programs are virtually limited and dependent upon the state of residence. Subotnik, Edminston, and Rayhack (2007) reported that 27 of 50 states currently have specialized STEM high school programs and only a handful of states offer more than five programs each. The states include Michigan (10 schools), Virginia (9 schools), New York and Georgia (8 schools), and Maryland (5 schools).

Additionally, several studies have substantiated the need for a rigorous high school curriculum as it relates to math and science, but an increased focus on high school setting and high expectations for all students has moved to the forefront. Study findings also suggest that teachers play an important role in supporting underrepresented minorities in STEM. Teachers' low expectations can have the potential to negatively impact achievement of underrepresented minorities in math and science courses (Collins, 1992; Oakes, 1990; Thompson, Warren, & Carter, 2004). According to Thompson, Warren, and Carter (2004), teachers tend to treat students based on how they perform on standardized tests. Typically, underrepresented minority students traditionally don't perform well on math and science standardized tests when compared to their white counterparts; therefore, teachers develop higher expectations for white students. The research asserts that teacher expectations potentially influence academic performance for some underrepresented minority students because those low expectations become self-fulfilling prophecies.

Over the past several decades, the research surrounding underrepresented minority students and academic achievement in STEM has primarily focused on areas that contribute to underachievement in these student groups. Although the research regarding successful STEM high school programs is limited as it relates to overall best practices designed to promote entrance and retention into STEM undergraduate degree programs and eventually STEM careers, Legewie and DiPrete (2012) argued that high school environments have the potential to have positive effects on STEM orientation for males and females. The findings suggest that there is a greater impact for females in regard to the high school environments playing an important role in the development of STEM orientation. Moreover, studies have confirmed six additional factors that may contribute to underrepresented minority success, including:

- Parental involvement and support
- Bilingual education
- Culturally relevant teaching
- Early exposure to STEM careers
- Interest in STEM subjects
- Self-efficacy in STEM domains

Black college students enrolled at predominately white institutions were interviewed to ascertain which key factors contributed to their decisions to pursue STEM majors. The results of the study indicated that the students highlighted the importance of their parent's high expectations and the support received to develop good study skills (Russell & Atwater, 2005). On the contrary, parents of Hispanic students may experience difficulty supporting their children due to the cultural and language barriers. Therefore, researchers suggested that schools provide customized support to parents in order to help them better understand how to help their children achieve success in STEM.

In addition, the majority of Hispanic students struggle with English language acquisition. As a result, bilingual students consistently score below average on math and science achievement tests. Consequently, there is a need to incorporate bilingual education into STEM programs in order to positively affect the achievement of Hispanic students (Rendon & Hope, 1996). According to the research, another important factor contributing to underrepresented minority success is culturally relevant pedagogy. Infusing cultural relevance in STEM courses has been shown to have a positive impact on minority students by positively influencing their perception of STEM (Denson, Avery, & Schell, 2010).

Research also supports providing opportunities for underrepresented minority students to connect with STEM role models, supportive teachers, and counselors. Studies showed that connection with the aforementioned individuals has the potential to positively impact student success in STEM (Seymour & Hewitt, 1997). Lastly, underrepresented minority student success in STEM depends on their confidence in their ability to be successful in math and science. According to Holt (2006), underrepresented minority high school students' confidence to do well in math and science is a predictor of future success in STEM.

2.4 Developmental Assets Theory

In an attempt to determine specific values that could be used when isolating indicators that may have a positive impact on students, the 40 developmental assets have been developed as a result of the research studies conducted over the past couple of decades (Benson, 2006). The research on developmental assets was presented for the first time in the 1989 report *The Troubled Journey: A Portrait of 6th–12th Grade Youth* (Benson, 1993). In this study, 30 developmental assets had been developed and were used to study asset levels in youth in 460 cities across the country during a five-year span (1990–1995). The findings of the study conducted led to the improvement of the developmental assets framework and the addition of 10 additional assets. Benson went on to further conduct research studies in Minnesota and New Mexico using the newly configured 40 developmental assets framework and published results in 1996 (Benson, 1996).

The Search Institute's Insights & Evidence Report provided longitudinal evidence in support of the claim that an asset-based approach to student development had the potential to positively contribute to academic achievement. Essentially, the report revealed that a higher level of development assets led to student achievement even after controlling for variables such as gender, socioeconomic status, and race/ethnicity. Thus, the findings suggest that "building development assets is likely a critical component of boosting student achievement" (Scales & Roehlkepartain, 2003, p. 9).

The 40 developmental assets are categorized into two main groups: internal assets and external assets. Each main group includes four subcategories as shown in Table 2.1.

Table 2.1 Developmental Assets: Internal Assets vs. External Assets

Internal Assets	External Assets
Commitment to learning	Support
Positive values	Empowerment
Social competencies	Boundaries and expectations
Positive identity	Constructive use of time

2.4.1 Internal Assets

As shown in Table 2.2, internal assets focus on the intrinsic factors related to decision making and motivation (Benson, 2006; Coomey & Wilczenski, 2007).

Table 2.2 Developmental Assets Framework and Definitions: Internal Assets

Asset Type	Asset Name and Definition
Commitment to learning	1. Achievement motivation—Young person is motivated to do well in school.
	2. School engagement—Young person is actively engaged in learning.
	3. Homework—Young person reports doing at least one hour of homework every school day.
	4. Bonding to school—Young person cares about her or his school.
	5. Reading for pleasure—Young person reads for pleasure three or more hours per week.

Table 2.2 – Continued

Positive values	6. Caring—Young person places high value on helping other people.
	7. Equality and social justice—Young person places high value on promoting equality and reducing hunger and poverty.
	8. Integrity—Young person acts on convictions and stands up for her or his beliefs.
	9. Honesty—Young person "tells the truth even when it is not easy."
	10. Responsibility—Young person accepts and takes personal responsibility.
	11. Restraint—Young person believes it is important not to be sexually active or use alcohol or other drugs.
Social competencies	12. Planning and decision making—Young person knows how to plan ahead and make choices.
	13. Interpersonal competence—Young person has empathy, sensitivity, and friendship skills.
	14. Cultural competence—Young person has knowledge of and comfort with people of different cultural, racial, and ethnic backgrounds.
	15. Resistance skills—Young person can resist negative peer pressure and dangerous situations.
	16. Peaceful conflict resolution—Young person seeks to resolve conflict nonviolently.

Table 2.2 – Continued

Positive identity	
	17. Personal power—Young person feels he or she has control over "things that happen to me."
	18. Self-Esteem—Young person reports having high self-esteem.
	19. Sense of Purpose—Young person reports that "my life has a purpose."
	20. Positive View of Personal Future—Young person is optimistic about her or his personal future.

Note. Adapted from *All Kids Are Our Kids*, by P. L. Benson, 2006, p. 33. Copyright 2006 by John Wiley & Sons.

2.4.2 External Assets

As shown in Table 2.3, external assets focus on experiences in the community. Specifically, these experiences include interactions at schools, with families, and in the community in reference to the positive development of students (Benson, 2006; Coomey & Wilczenski, 2007).

Table 2.3 Developmental Assets Framework and Definitions: External Assets

Asset Type	Asset Name and Definition
Support	1. Family support—Family life provides high levels of love and support.
	2. Positive family communication—Young person and her or his parent(s) communicate positively, and young person is willing to seek advice and counsel from parent(s).
	3. Other adult relationships—Young person receives support from three or more nonparent adults.

Table 2.3 – Continued

	4. Caring neighborhood—Young person experiences caring neighbors. 5. Caring school climate—School provides a caring, encouraging environment. 6. Parent involvement in schooling—Parent(s) are actively involved in helping young person succeed in school.
Empowerment	7. Community values youth—Young person perceives that adults in the community value youth. 8. Youth as resources—Young people are given useful roles in the community. 9. Service to others—Young person serves in the community one hour or more per week. 10. Safety—Young person feels safe at home, at school, and in the neighborhood.
Boundaries and Expectations	11. Family boundaries—Family has clear rules and consequences and monitors the young person's whereabouts. 12. School boundaries—School provides clear rules and consequences. 13. Neighborhood boundaries—Neighbors take responsibility for monitoring young people's behavior. 14. Adult role models—Parent(s) and other adults model positive, responsible behavior.

Table 2.3 – Continued

	15. Positive peer influence—Young person's best friends model responsible behavior.
	16. High expectations—Both parent(s) and teachers encourage the young person to do well.
Constructive use of time	17. Creative activities—Young person spends three or more hours per week in lessons or practice in music, theater, or other arts.
	18. Youth programs—Young person spends three or more hours per week in sports, clubs, or organizations at school or in the community.
	19. Religious community—Young person spends one or more hours per week in activities in a religious institution.
	20. Time at home—Young person is out with friends "with nothing special to do" two or fewer nights per week.

Note. Adapted from *All Kids Are Our Kids*, by P. L. Benson, 2006, p. 32. Copyright 2006 by John Wiley & Sons.

2.4.3 Developmental Assets and Academic Achievement

Developmental assets research frequently correlates the level of assets with academic achievement. Studies by school districts in California, Michigan, Minnesota, and Texas have produced results that allow an analysis of the relationship between academic achievement and developmental assets (Scales, Benson, Roehlkepartain, Sesma, & van Dulman, 2006). According to Benson (2006), study results related to developmental assets and student academic achievement results indicated:

- When asset levels were linked to school records, the students with more assets had higher grade-point averages.

- When the same students were studied over a three-year period, the more assets students had at time one the higher their grade-point average at time two. Additionally, students whose assets decreased across these three years were twice as likely to go down in grade point average as were students whose assets remained stable or increased.
- In studies in Michigan and California, assets were positively related to scores on standardized tests.
- Asset levels are a strong predictor of achievement across and within each racial ethnic group. High versus low assets increase the chances of school success 4.2 times for Latino and Latina youth, 4.7 times for Native Americans, 7.9 times for Asian Americans, and 8.0 times for multiracial youth.
- Low-income students appear to particularly benefit from increases in developmental assets, in comparison with other students. (p. 89)

Prior research studies on developmental assets and academic achievement have produced similar results when studying teenage students and elementary school students (Scales & Leffert, 2004; Scales, Sesma, & Bolstrom, 2004). One study included approximately 300,000 6^{th}–12^{th} -grade students from over 500 communities throughout the United States. The results of the study showed that the more assets students reported having, the better their attendance and grades (Benson, Scales, Leffert, & Roehlkepartain, 1999). The study results were also consistent when studying low-income, urban school students (Scales et al., 2005).

2.5 Summary

Overall, several research studies have identified positive and negative factors as they relate to underrepresented minority students and academic achievement in STEM. However, the fact remains that underrepresented minority students continue to lag behind their white counterparts at all levels of the STEM circuit. In the future, it will be critical to continue to focus on contributing factors that will lead to improvement in overall underrepresented minority students' performance and academic achievement in science, technology, engineering, and math.

Improving underrepresented minority academic achievement in K–16 education is a critical component in America's race to promote continued quest for innovation. Additionally, the rapid demographic changes will require math and science achievement for all students if the society within the country expects to maintain a lead in the highly competitive future global economy (Business–Higher Education Forum, 2005). Therefore, research must continue to identify factors that will lead to closing the science, technology, engineering, and math gap for underrepresented minority students. Additionally, policymakers must work to create policy with specific and measurable indicators in order to track program effectiveness and underrepresented minority success. Billions of federal dollars have been allocated and spent to improve outcomes, but the lack of achievement for URMs in STEM continues to persist at all levels of the K–16 and career pipeline (Federal Coordination in STEM Education Task Force, 2012).

The current number of research studies providing details regarding the cause of URM underachievement is plentiful. On the contrary, research studies and best practices to improve URM performance are limited. Fortunately, the developmental assets theory research has shown that asset building is important for improving academic achievement across all ethnic groups, socioeconomic status, and gender. Consequently, the impact of assets and asset building on URM students in STEM should be explored to determine what successful schools are doing to promote URM success in STEM (Scales & Roehlkepartain, 2003).

CHAPTER 3

METHOD OF PROCEDURE

As a quantitative study, the research reported examines the relationship between internal and external developmental assets, and academic achievement among urban underrepresented minority students in a specialized high school STEM program setting and in traditional comprehensive high school settings. The population for the study included 11th-grade underrepresented minority students enrolled in high schools located in a school district located in a southwestern metroplex.

3.1 Hypotheses

After covarying out the effects of previous knowledge (measured by the Iowa Test of basic Skills), each of the eight subscales of the Developmental Assets Profile (DAP) served as a dependent variable with the following interaction effects and main effects being assessed:

Interaction effect hypothesis*:* There is no significant interaction between gender and School setting (traditional or STEM specialized) on mean DAP scores.

Main effect hypothesis 1 (gender): There is no significant mean difference on the DAP instrument between male and female students.

Main effect hypothesis 2 (student setting): There is no significant mean difference on the DAP instrument between students attending traditional and STEM specialized institutions.

3.2 Research Design

In carrying out the research design, a series of eight 2 × 2 between-subjects analysis of covariance was performed. Independent variables consisted of school setting including specialized science, technology, engineering, and math school setting and traditional comprehensive school setting (STEM and non-STEM). The covariate is the scores from the nationally normed Iowa Test of Basic Skills administered to study participants during their 8th

grade school year (2007–2008). The dependent variables consisted of external and internal developmental assets subcategories which include support, empowerment, boundaries and expectations, and constructive use of time (external assets); and commitment to learning, positive values, social competencies, and positive identity (internal assets).

Analysis of covariance is the appropriate statistical procedure to use due to the fact that independent variables are assessed after dependent variable scores are adjusted for differences associated with the covariate. The intention of the study is to determine the answer to the question: Are mean differences among groups likely to have occurred by chance (Tabachnick & Fidell, 2007)?

3.3 Procedure

The data used for this study were 2012 DAP survey results from 142 underrepresented minority students in the 11th grade. The DAP survey results were collected by the school district during spring 2012. The survey consists of 58 items, 26 of which assess external assets and the remaining 32 assess internal assets. The DAP survey uses a four-step response scale for the 58-item questionnaire. Survey participants were asked the respond to questions by indicating whether an item is true by using the following responses:

1. Not At All or Rarely
2. Somewhat or Sometimes
3. Very or Often
4. Extremely or Almost Always

Responses were coded 0-1-2-3, respectively. The DAP survey also has a set of instructions at the beginning of the form that states:

> Below is a list of positive things that you might have in yourself, your family, friends, neighborhood, school, and community. For each item that describes you now or within the past three months, check if the item is true: Not At All or Rarely, Somewhat or Sometimes, Very or Often, or Extremely or Almost Always. If you do not want to answer

an item, leave it blank. But please try to answer all items as best you can. (Search Institute, 2004).

In addition to the instructions at the beginning of the survey, instructions are also located at the bottom of the first page in order to alert survey participants of the second page of questions, and at the bottom of the second page to thank participants for completing the entire survey. Instructions at the bottom of the first page state: “Please turn over and complete the back,” and at the bottom of the second page, “Thank you for completing this form.” (Search Institute, 2004).

The developmental assets categories are divided into four ranges including: Excellent, Good, Fair, and Low. Table 3.1 provides a summary of interpretive ranges for developmental assets categories, external and internal asset scales.

Table 3.1 Developmental Assets Survey Score Analysis

Label	Range of Scores	Typical Item Responses	Interpretive Guidelines
Excellent	26–30	2s and 3s with mostly 3s	Abundant assets. Most assets are experienced strongly and/or frequently.
Good	21–25	2s and 3s with mostly 2s	Moderate assets. Most assets are experienced often, but there is room for improvement.

Table 3.1 – Continued

Fair	15–20	1s and 2s with mostly 2s	Borderline assets. Some assets are experienced, but many are weak and/or infrequent. There is considerable room for strengthening assets in many areas.
Low	0–14	Mixture of 0s, 1s, and 2s	Depleted levels of assets. Few if any assets are strong or frequent. Most assets are experienced infrequently. Tremendous opportunities for strengthening assets in most areas.

Note. Adapted from Developmental Assets User Manual, p. 58, Copyright 2005 by the Search Institute.

Permission to use the data was granted by the district's Research Review Board in April 2012. The University of Texas at Arlington Institutional Review Board granted approval to proceed with the study on January 17, 2013. (See Appendix B)

3.4 Data Collection

Data used for the study was made available through the school district. The district provided a spreadsheet containing all of the data necessary to complete the study. The contents of the spreadsheet included:

1. A de-identified list of students assigned to separate case identification numbers
2. School location
3. Ethnicity
4. Gender
5. Language English Proficiency (LEP) code
6. Language English Proficiency (LEP) labels
7. Home language survey results
8. Lunch code
9. Economically Disadvantaged status
10. Total assets for each of the eight developmental assets subcategories
11. Total developmental assets external assets
12. Total developmental assets internal assets
13. Total developmental assets

3.5 Treatment of the Data

The Statistical Package for the Social Sciences (SPSS) version 21.0 was used for all statistical analyses.

Upon receipt from the district, the data was prepared for entry into SPSS. The variables were coded in the SPSS system for each ANCOVA as follows: Gender (Male = 1 and Female = 2), School Setting (STEM = 1 and non-STEM = 2). The homogeneity of variance was also evaluated for each of the eight ANCOVA's. SPSS was used to run descriptive statistics of the covariate and dependent variables used in the study. Additionally, frequency tables including school name, school setting, race/ethnicity, gender, lunch eligibility, and economically disadvantaged status were included. The exploratory study results were analyzed for statistical significance using a criterion alpha level of 0.05.

3.6 Summary of Methods

The research study analyzes the relationship between the developmental assets and academic achievement of urban underrepresented minority male and female students in a specialized science, technology, engineering, and math program in comparison to developmental assets and academic achievement of urban underrepresented minority male and female students in traditional comprehensive high school programs. The study uses existing data provided by the school district.

CHAPTER 4

PRESENTATION AND ANALYSIS OF DATA

The purpose of the research study is to examine the relationship between internal and external developmental assets, and academic achievement among urban underrepresented male and female minorities in a specialized high school STEM program setting and in traditional comprehensive high school settings. An interaction effect and two main effect hypotheses for each of the eight dependent variables were examined. In total, 24 hypotheses were tested. In testing the hypotheses, the goal was to determine whether specific assets would be identified as having an impact on underrepresented minorities in the specialized STEM and traditional high school settings. The study was conducted in an urban school district located in a southwestern metroplex.

According to Tabachnick and Fidell (2001), the following issues must be addressed for an analysis of covariance statistical technique to be effective: sample size, outliers, normality, homogeneity of variance, linearity, homogeneity of regression, and reliability of covariates. Tests and procedures used to analyze these assumptions are included below.

In order to determine whether a positive correlation existed between the covariate and the dependent variables, a bivariate correlation regression analysis was completed. The results reveal that the covariate and the developmental assets total mean scores had a significant positive correlation $p = 0.042$ ($p < 0.05$) as shown in Table 4.1.

Table 4.1 Regression Analysis of the Covariate and the Dependent Variable Developmental Assets Total

Model	Unstandardized Coefficients		Standardized Coefficients	*T*	Sig.
	ß	Std. Error	Beta		
(Constant)	7.305	6.031	.177	1.211	.228
Iowa Test of Basic Skills	.072	.035		2.054	.042

Note. Dependent Variable: Developmental Assets Total (α = 0.05 (values equal to $p < 0.05$—indicated inside of box).

Overall, the bivariate correlation regression results for each of the eight individual developmental asset subscales reveal that there were no negative effects, and the correlation was always positive. Specifically, the analysis reveals that the covariate (Iowa Test of Basic Skills) has the strongest effect on Commitment to Learn, Empowerment, Positive Values, and Social Competencies. On the other hand, the Support, Boundaries and Expectations, Positive Values, and Commitment to Learn asset categories had positive correlations with the covariate, but the effect was not as strong in relation to the total DAP mean scores and the aforementioned assets analyzed separately to have the strongest effect.

General linear models were run using SPSS software version 21.0 to test homogeneity of regression (slopes) assumptions for the eight subscales and no violations were detected.

The assumption of homogeneity variance is supported by Levene's test for equality of variances as shown in Table 4.2 (Levene, 1960; Tabachnick & Fidell, 2001).

Table 4.2 Levene's Test of Equality of Error Variances

Variable	*F*	*df*1	*df*2	Sig.
Support subscale–DAP	1.050	3	126	0.373
Empowerment subscale–DAP	2.496	3	127	0.063
Boundaries and expectations subscale–DAP	0.393	3	127	0.758
Constructive use of time subscale–DAP	0.811	3	129	0.490
Commitment subscale–DAP	1.283	3	127	0.283
Positive values subscale–DAP	4.097	3	128	0.008
Social competencies subscale–DAP	1.748	3	125	0.161
Positive identity subscale–DAP	4.097	3	128	0.008

Note. Tests the null hypothesis that the error variance of the dependent variables are equal across groups (Design: Intercept + Iowa + Gender + Setting + Gender * Setting).

The sample used in the study included a total of 71 11th-grade URM (54 male and 17 female) students in an urban specialized STEM high school setting and a sample size of 71 11th-grade URM (47 male and 24 female) students in a traditional high school setting. For this study, participants were selected based on the criteria listed below. Students eligible to be included in the study must have met the following criteria:

1. The student must have been enrolled in grade 11 during the 2011–2012 school year.
2. The student must have completed the developmental assets profile survey administered by the district, spring 2012.
3. The student must have taken and scored a combination score of 160 points on the reading and math portion of the Iowa Test of Basic Skills test during his or her eighth grade (2008–2009) school year with neither score in the combination less than 65 in reading or math.

4. The student must be registered in the Public Education Information Management System (PEIMS) database as an underrepresented minority.

Due to the requirement listed in criteria number three above, results from nine of the students enrolled at the specialized STEM school were excluded from the results of the statistical analysis. Lastly, post hoc comparisons were not necessary due to the fact that the analysis does not include three or more categories (Tabachnick & Fidell, 2007).

4.1 Data Characteristics

The targeted population includes 142 underrepresented minority students enrolled in high schools located in a southwestern metroplex. To achieve the research objective, a sample of 71 underrepresented minority students enrolled in 11^{th} grade at a specialized science, technology, engineering, and math school and a sample size of 71 underrepresented minority students enrolled in 11^{th} grade at a traditional comprehensive school were included in the study. A total of 142 students completed the Developmental Assets Profile survey for a response rate of 100%. The surveys were completed in the students' classrooms during the spring semester 2012 and SPSS version 21.0 was used to analyze the data.

4.1.1 Descriptive Statistics

Table 4.3 shows the descriptive statistics for the group of student participants (n = 142). The covariate Iowa Test of Basic Skills (n = 133) and the mean scores for each subscale of the eight dependent variables are shown.

Table 4.3 Descriptive Statistics of the Covariate and Dependent Variables Used in the Study

Variable	*N*	Minimum	Maximum	Mean	Std. Deviation
Iowa Test of Basic Skills	133	136	198	171.89	12.318
Support subscale–DAP	142	0	30	19.34	6.889
Empowerment subscale–DAP	142	3	30	19.67	5.771

Table 4.3 – Continued

Boundaries and expectations subscale –DAP	142	0	30	20.03	5.969
Constructive use of time subscale–DAP	142	0	30	15.63	6.415
Commitment subscale–DAP	142	1	30	20.32	5.885
Positive values subscale–DAP	142	2	30	19.94	5.095
Social competencies subscale–DAP	142	3	30	21.01	5.180
Positive identity subscale–DAP	142	0	30	19.75	6.432
Valid *N* (listwise)	133				

Note. DAP represents Developmental Assets Profile

Table 4.4 provides the number of students from each campus. Overall, the student results were analyzed using data from 11 traditional high schools and one specialized science, technology, engineering, and math high school.

Table 4.4 Descriptive Statistics of the Total Number of Students from STEM and Non-STEM Campuses

School Type	Frequency	Percent	Valid Percent	Cumulative Percent
NON-STEM 01	2	1.4	1.4	1.4
NON-STEM 02	5	3.5	3.5	4.9
NON-STEM 03	4	2.8	2.8	7.7
NON-STEM 04	3	2.1	2.1	9.9
NON-STEM 05	5	3.5	3.5	13.4
NON-STEM 06	8	5.6	5.6	19.0
NON-STEM 07	1	0.7	0.7	19.7
NON-STEM 08	2	1.4	1.4	21.1

Table 4.4 – Continued

NON-STEM 09	12	8.5	8.5	29.6
STEM	71	50.0	50.0	79.6
NON-STEM 10	7	4.9	4.9	84.5
NON-STEM 11	22	15.5	15.5	100.0
Total	142	100.0	100.0	

As shown in Table 4.5, the majority of study participants (*n* = 102, 71.8%) are Hispanic, with (*n* = 29, 20.4%) indicating his or her ethnicity as African American, (*n* = 9, 6.3%) Asian and (*n* = 2, 1.4%) American Indian or Alaska Native. Furthermore, demographic information for Non-Stem and STEM study participants can be found in Table 4.6 and 4.7.

Table 4.5 Descriptive Statistics of Student Ethnicity for Study Participants

Race/Ethnicity	Frequency	Percent	Valid Percent	Cumulative Percent
Asian	9	6.3	6.3	6.3
Black or African American	29	20.4	20.4	26.8
Hispanic/Latino	102	71.8	71.8	98.6
American Indian or Alaska Native	2	1.4	1.4	100.0
Total	142	100.0	100.0	

Table 4.6 Descriptive Statistics of Student Demographics for Non – STEM Study Participants

Race/Ethnicity/Gender	Frequency	Percent
Asian	3	4.2
Black or African American	8	11.3
Hispanic/Latino	60	84.5

Table 4.6 – Continued

American Indian or Alaska Native	0	0.0
Total	71	100.0
Male	47	66.0
Female	24	34.0
Total	71	100.0

Table 4.7 Descriptive Statistics of Student Demographics for STEM Study Participants

Race/Ethnicity/Gender	Frequency	Percent
Asian	6	8.5
Black or African American	21	29.6
Hispanic/Latino	42	59.1
American Indian or Alaska Native	2	2.8
Total	71	100.0
Male	54	76
Female	17	24
Total	71	100.0

Table 4.8 displays the female to male ratio of participants with 41 (28.9%) female and the remaining 101 (71.1%) male. Additionally, Table 4.9 shows that the overall, combined group of study participants consists of 94 (71%) male and 39 (29%) female.

Table 4.8 Descriptive Statistics of Gender for Study Participants

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	101	71.1	71.1	71.1
Female	41	28.9	28.9	100.0
Total	142	100.0	100.0	

Table 4.9 Descriptive Statistics of Gender and School Setting for Study Participants

	Between-Subjects Factors	Value Label	N
Gender	1	Male	94
	2	Female	39
School Setting	1	STEM	62
	2	non-STEM	71

4.2 Analysis of Results

Twenty-four 2 × 2 analyses of covariance were performed using the SPSS version 21.0. The independent variables consisted of school setting (STEM and non-STEM) and gender (male and female). The covariate was the Iowa Test of Basic Skills score and the dependent variables were the eight developmental assets subscales. Specifically, Commitment to Learning, Positive Values, Social Competencies, and Positive Identity were used to measure internal assets. Furthermore, Support, Empowerment, Boundaries and Expectations, and Constructive Use of Time were used to measure external assets.

Interaction effect hypothesis: There is no significant interaction between gender (males versus females) and school setting (traditional versus STEM-specialized), as measured by differences among mean scores for each subscale on the Developmental Assets Profile Survey (DAP).

Main effect hypothesis 1 (gender): There is no significant mean difference between male and female students, as measured by the mean scores for each subscale on the Developmental Assets Profile survey (DAP).

Main effect hypothesis 2 (student setting): There is no significant mean difference between STEM and traditional high school students, as measured by mean scores for each subscale on the Developmental Assets Profile survey (DAP).

The results for each 2 (Gender: Males versus Female) × 2 (Setting: STEM-specialized versus traditional high school) ANCOVA for all dependent variables (DAP-subscales) are analyzed below.

4.2.1 Variable 1—External Asset–Support

For the dependent variable Support, a significant interaction between gender, school setting, and DAP subscale mean scores was not found to be statistically significant, F (1, 125) = 2.229, p = 0.138, partial eta squared = 0.018. The null hypothesis of no significant interaction between gender and school setting on mean DAP Support subscale scores is not rejected.

A significant mean difference was not found to be statistically significant between males and females and DAP Support subscale mean scores, F (1, 125) = 0.706, p = 0.403, partial eta squared = 0.006. Therefore, the null hypothesis of no significant mean difference on the DAP Support subscale scores between male and female students is not rejected.

Additionally, a significant mean difference was not found to be statistically significant between school setting and DAP support subscale mean scores, F (1, 125) = 1.993, p = 0.161, partial eta squared = 0.016. As a result, the null hypothesis of no significant mean difference on the DAP Support subscale scores between students attending a traditional high school and a specialized STEM school is not rejected. Overall, as shown in Tables 4.10 and 4.11, the results of the analysis of covariance for the external asset Support subscales scores provide no evidence of statistically significant differences for the Support subscale.

Table 4.10 Analysis of Between-Subjects Effects for Dependent Variable: Support Subscale–DAP

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	164.646[a]	4	41.161	0.988	0.417	0.031
Intercept	103.522	1	103.522	2.485	0.117	0.019
IOWA	35.724	1	35.724	0.858	0.356	0.007

Table 4.10 –
Continued

SETTING	83.015	1	83.015	1.993	0.161	0.016
GENDER	29.394	1	29.394	0.706	0.403	0.006
SETTING * GENDER	92.846	1	92.846	2.229	0.138	0.018
Error	5207.423	125	41.659			
Total	55745.000	130				
Corrected Total	5372.069	129				

Note. a. *R* Squared = 0.031 (Adjusted *R* Squared = 0.000)

Table 4.11 Analysis of Gender * School Setting Dependent Variable: Support Subscale–DAP

School Setting	Gender	Mean	Std. Deviation	*N*
STEM	Male	19.56	5.976	45
	Female	22.27	6.352	15
	Total	20.23	6.132	60
non-STEM	Male	19.52	6.606	46
	Female	18.63	7.051	24
	Total	19.21	6.724	70
Total	Male	19.54	6.267	91
	Female	20.03	6.941	39
	Total	19.68	6.453	130

4.2.2 Variable 2—External Asset–Empowerment

The analysis for the dependent variable Empowerment determined an interaction between gender, school setting, and DAP subscale mean scores was not found to be statistically significant, F (1, 126) = 1.635, p = 0.203, partial eta squared = 0.013. The null hypothesis of no significant interaction between gender and school setting on mean DAP Empowerment subscale scores is not rejected.

Additionally, the analysis for the dependent variable Empowerment determined a significant mean difference does not exist when analyzing the results of the DAP instrument subscale scores between male and female students. In fact, a mean difference was not found to be statistically significant between males and females and DAP Empowerment subscale mean scores, as follows F (1, 126) = 3.468, p = 0.065, partial eta squared = 0.027. In sum, the Empowerment subscale results indicate that the mean difference is not significant at $p < 0.05$ level. Thus, the null hypothesis of no significant mean difference on the DAP Empowerment subscale scores between male and female students is not rejected.

In addition, significant mean difference was not found to be statistically significant between school setting and DAP Empowerment subscale mean scores, F (1, 126) = 0.083, p = 0.774, partial eta squared = 0.001. As a result, the null hypothesis of no significant mean difference on the DAP Empowerment subscale scores between students attending a traditional high school and a specialized STEM school is not rejected. Overall, the results of the analysis of covariance for the dependent variable Empowerment are presented in Tables 4.12 and 4.13.

Table 4.12 Analysis of Between-Subjects Effects for Dependent Variable: Empowerment Subscale–DAP

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	216.517[a]	4	54.129	1.842	0.125	0.055
Intercept	33.490	1	33.490	1.140	0.288	0.009
IOWA	113.085	1	113.085	3.849	0.052	0.030
SETTING	2.438	1	2.438	0.083	0.774	0.001
GENDER	101.908	1	101.908	3.468	0.065	0.027
SETTING * GENDER	48.035	1	48.035	1.635	0.203	0.013

Table 4.12 –
Continued

Error	3702.322	126	29.384
Total	55284.000	131	
Corrected Total	3918.840	130	

Note. a. *R* Squared = 0.055 (Adjusted *R* Squared = .025)

Table 4.13 Analysis of Gender * School Setting Dependent Variable: Empowerment Subscale–DAP

School Setting	Gender	Mean	Std. Deviation	*N*
STEM	Male	18.93	4.587	46
	Female	21.87	6.675	15
	Total	19.66	5.272	61
non-STEM	Male	19.76	6.001	46
	Female	20.25	5.211	24
	Total	19.93	5.709	70
Total	Male	19.35	5.328	92
	Female	20.87	5.786	39
	Total	19.80	5.490	131

4.2.3 Variable 3—External Asset–Boundaries and Expectations

The analysis for the dependent variable Boundaries and Expectations determined that an interaction between gender, school setting, and DAP subscale mean scores was not found to be statistically significant, *F* (1, 126) = 1.433, *p* = 0.233, partial eta squared = 0.011. The null hypothesis of no significant interaction between gender and school setting on mean DAP subscale scores is not rejected.

Additionally, a significant mean difference was not found to be statistically significant between males and females and DAP Boundaries and Expectations subscale mean scores, *F* (1, 126) = 0.814, p = 0.369, partial eta squared = 0.006. As a result, the null hypothesis of no significant mean difference on the DAP Boundaries and Expectations subscale scores between males and females is not rejected.

On the contrary, the analysis for the dependent variable Boundaries and Expectations determined a significant mean difference exists when analyzing the results of the DAP instrument subscale scores between students attending traditional high school and the specialized STEM school. In effect, a mean difference was found to be statistically significant between students attending the traditional high school and specialized STEM high school and the DAP Boundaries and Expectations subscale mean scores, as follows F (1, 126) = 4.526, p = 0.035, $p < 0.05$, partial eta squared = 0.035. The result of the analysis indicates that $p = 0.035$ ($p < 0.05$) satisfies the criterion alpha level of 0.05 and essentially specifies that the differences between the two groups have only a 5% probability of occurring by chance alone. In sum, the Boundaries and Expectations subscale results indicate that the mean difference is significant at $p < 0.05$ level and a statistically significant difference is explained by gender with an effect size of approximately 3%. Thus, the null hypothesis of no significant mean difference on the DAP Boundaries and Expectations subscale scores between students attending the traditional high school and the STEM specialized high school is rejected.

The overall results of the analysis of covariance for the dependent variable Boundaries and Expectations are presented in Tables 4.14 and 4.15.

Table 4.14 Analysis of Between Subjects Effects for Dependent Variable: Boundaries and Expectations Subscale–DAP

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	190.798[a]	4	47.699	1.489	0.209	0.045
Intercept	119.356	1	119.356	3.725	0.056	0.029
IOWA	32.157	1	32.157	1.004	0.318	0.008

Table 4.14 –
Continued

SETTING	145.004	1	145.004	4.526	0.035	0.035
GENDER	26.075	1	26.075	0.814	0.369	0.006
SETTING * GENDER	45.924	1	45.924	1.433	0.233	0.011
Error	4036.805	126	32.038			
Total	57592.000	131				
Corrected Total	4227.603	130				

Note. a. R Squared = 0.045 (Adjusted R Squared = 0.015). b. Computed using alpha = 0.05 (values equal to $p < 0.05$—indicated in box)

Table 4.15 Analysis of Gender * School Setting Dependent Variable: Boundaries and Expectations Subscale–DAP

School Setting	Gender	Mean	Std. Deviation	*N*
STEM	Male	20.63	5.507	46
	Female	22.73	5.934	15
	Total	21.15	5.639	61
non-STEM	Male	19.48	5.932	46
	Female	19.08	5.225	24
	Total	19.34	5.664	70
Total	Male	20.05	5.721	92
	Female	20.49	5.721	39
	Total	20.18	5.703	131

4.2.4 Variable 4—External Asset–Constructive Use of Time

For the dependent variable Constructive Use of Time, a significant interaction between gender, school setting, and DAP subscale mean scores was not found to be statistically significant, F (1, 128) = 1.580, p = 0.211, partial eta squared = 0.012. The null hypothesis of no significant interaction between gender and school setting on mean DAP *Constructive* Use of Time subscale scores is not rejected.

A significant mean difference was not found to be statistically significant between males and females and DAP Constructive Use of Time subscale mean scores, F (1, 128) = 3.404, p = 0.067, partial eta squared = 0.026. Although, significance was not found, close trends (p= 0.067) warrant further investigation. Nevertheless, the null hypothesis of no significant mean difference on the DAP Constructive Use of Time subscale scores between male and female students is not rejected.

Additionally, a significant mean difference was not found to be statistically significant between school setting and DAP Constructive Use of Time subscale mean scores, F (1, 128) = 0.001, p = 0.976, partial eta squared = 0.000. As a result, the null hypothesis of no significant mean difference on the DAP Constructive Use of Time subscale scores between students attending a traditional high school and a specialized STEM school is not rejected. Overall, as shown in Tables 4.16 and 4.17, the results of the analysis of covariance for the external asset Constructive Use of Time subscales scores provide no evidence of statistically significant differences for the Constructive Use of Time subscale.

Table 4.16 Analysis of Between Subjects Effects for Dependent Variable: Constructive Use of Time Subscale–DAP

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	271.124[a]	4	67.781	1.679	0.159	0.050
Intercept	5.048	1	5.048	0.125	0.724	0.001
IOWA	116.704	1	116.704	2.892	0.091	0.022
SETTING	.036	1	0.036	0.001	0.976	0.000
GENDER	137.400	1	137.400	3.404	0.067	0.026

Table 4.16 –
Continued

SETTING * GENDER	63.746	1	63.746	1.580	0.211	0.012
Error	5165.898	128	40.359			
Total	37561.000	133				
Corrected Total	5437.023	132				

Note. a. *R* Squared = 0.050 (Adjusted *R* Squared = 0.020)

Table 4.17 Analysis of Gender * School Setting Dependent Variable: Constructive Use of Time Subscale–DAP

School Setting	Gender	Mean	Std. Deviation	N
STEM	Male	14.36	6.343	47
	Female	17.80	5.784	15
	Total	15.19	6.342	62
non-STEM	Male	15.64	6.169	47
	Female	16.25	7.261	24
	Total	15.85	6.513	71
Total	Male	15.00	6.256	94
	Female	16.85	6.695	39
	Total	15.54	6.418	133

4.2.5 Variable 5—Internal Asset–Commitment to Learning

For the dependent variable Commitment to Learning, a significant interaction between gender, school setting, and DAP subscale mean scores was not found to be statistically significant, F (1, 126) = 0.473, p = 0.493, partial eta squared =0 .004. The null hypothesis of no significant interaction between gender and school setting on mean DAP Commitment to Learning subscale scores is not rejected.

A significant mean difference was not found to be statistically significant between males and females and DAP Commitment to Learning subscale mean scores, F (1, 126) = 0.367, p = 0.546, partial eta squared = 0.003. Therefore, the null hypothesis of no significant mean difference on the DAP Commitment to Learning subscale scores between male and female students is not rejected.

Additionally, a significant mean difference was not found to be statistically significant between school setting and DAP Commitment to Learning subscale mean scores, F (1, 126) = 0.367, p = 0.546, partial eta squared = 0.003. As a result, the null hypothesis of no significant mean difference on the DAP Commitment to Learning subscale scores between students attending a traditional high school and a specialized STEM school is not rejected. Overall, as shown in Tables 4.18 and 4.19, the results of the analysis of covariance for the external asset Commitment to Learning subscale scores provide no evidence of statistically significant differences for the Commitment to Learning subscale.

Table 4.18 Analysis of Between-Subjects Effects for Dependent Variable: Commitment Subscale–DAP

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	316.392[a]	4	79.098	2.636	0.037	0.077
Intercept	0.209	1	0.209	0.007	0.934	0.000
IOWA	298.603	1	298.603	9.951	0.002	0.073
SETTING	11.004	1	11.004	0.367	0.546	0.003
GENDER	8.670	1	8.670	0.289	0.592	0.002
SETTING * GENDER	14.208	1	14.208	0.473	0.493	0.004
Error	3780.967	126	30.008			

Table 4.18 –
Continued

Total	59705.000	131
Corrected Total	4097.359	130

Note. a. *R* Squared = 0.077 (Adjusted *R* Squared = 0.048)

Table 4.19 Analysis of Gender * School Setting for Dependent Variable: Commitment Subscale–DAP

School Setting	Gender	Mean	Std. Deviation	N
STEM	Male	20.74	5.355	47
	Female	21.40	7.385	15
	Total	20.90	5.850	62
non-STEM	Male	20.47	5.133	45
	Female	20.08	6.036	24
	Total	20.33	5.422	69
Total	Male	20.61	5.220	92
	Female	20.59	6.524	39
	Total	20.60	5.614	131

4.2.6 Variable 6—Internal Asset–Positive Values

For the dependent variable Positive Values, a significant interaction between gender, school setting, and DAP subscale mean scores was not found to be statistically significant, *F* (1, 127) = 1.816, *p* =.180, partial eta squared = 0.014. The null hypothesis of no significant interaction between gender and school setting on mean DAP Positive Values subscale scores is not rejected.

A significant mean difference was not found to be statistically significant between males and females and DAP Positive Values subscale mean scores, *F* (1, 127) = 2.468, *p* = 0.119, partial eta squared = 0.019. Therefore, the null hypothesis of no significant mean difference on the DAP Positive Values subscale scores between male and female students is not rejected.

Additionally, a significant mean difference was not found to be statistically significant between school setting and DAP Positive values subscale mean scores, F (1, 127) = 0.685, p = 0.410, partial eta squared = 0.005. As a result, the null hypothesis of no significant mean difference on the DAP Positive Values subscale scores between students attending a traditional high school and a specialized STEM school is not rejected. Overall, as shown in Tables 4.20 and 4.21, the results of the analysis of covariance for the external asset Positive Values subscale scores provide no evidence of statistically significant differences for the Positive Values subscale.

Table 4.20 Analysis of Between-Subject Effects for Dependent Variable: Positive Values Subscale–DAP

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	238.623[a]	4	59.656	2.546	0.043	0.074
Intercept	10.825	1	10.825	0.462	0.498	0.004
IOWA	177.412	1	177.412	7.572	0.007	0.056
SETTING	16.037	1	16.037	0.685	0.410	0.005
GENDER	57.830	1	57.830	2.468	0.119	0.019
SETTING * GENDER	42.539	1	42.539	1.816	0.180	0.014
Error	2975.437	127	23.429			
Total	56656.000	132				
Corrected Total	3214.061	131				

Note. a. R Squared = 0.074 (Adjusted R Squared = 0.045)

Table 4.21 Analysis of Gender * School Setting for Dependent Variable: Positive Values Subscale–DAP

School Setting	Gender	Mean	Std. Deviation	*N*
STEM	Male	19.74	4.104	47
	Female	22.00	5.305	15
	Total	20.29	4.485	62
non-STEM	Male	19.96	5.308	46
	Female	20.00	5.579	24
	Total	19.97	5.362	70
Total	Male	19.85	4.713	93
	Female	20.77	5.494	39
	Total	20.12	4.953	132

4.2.7 Variable 7—Internal Asset–Social Competencies

For the dependent variable Social Competencies, a significant interaction between gender, school setting, and DAP subscale mean scores were not found to be statistically significant, F (1, 124) = 0.907, p =0.343, partial eta squared = 0.007. The null hypothesis of no significant interaction between gender and school setting on mean DAP Social Competencies subscale scores is not rejected.

A significant mean difference was not found to be statistically significant between males and females and DAP Social Competencies subscale mean scores, F (1, 124) = 0.341, p = 0.561, partial eta squared = 0.003. Therefore, the null hypothesis of no significant mean difference on the DAP Social Competencies subscale scores between male and female students is not rejected.

Additionally, a significant mean difference was not found to be statistically significant between school setting and DAP Social Competencies subscale mean scores, F (1, 124) = 0.022, p = 0.881, partial eta squared = 0.000. As a result, the null hypothesis of no significant mean difference on the DAP Social Competencies subscale scores between students attending a traditional high school and a specialized STEM school is not rejected. Overall, as shown in Tables 4.22 and 4.23, the results of the analysis of covariance for the external asset Social Competencies subscale scores provide no evidence of statistically significant differences for the Social Competencies subscale.

Table 4.22 Analysis of Between-Subjects Effects for Dependent Variable: Social Competencies Subscale–DAP

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	104.942[a]	4	26.236	1.178	0.324	0.037
Intercept	69.271	1	69.271	3.109	0.080	0.024
IOWA	82.307	1	82.307	3.694	0.057	0.029
SETTING	0.500	1	0.500	0.022	0.881	0.000
GENDER	7.586	1	7.586	0.341	0.561	0.003
SETTING * GENDER	20.203	1	20.203	0.907	0.343	0.007
Error	2762.655	124	22.279			
Total	61705.000	129				
Corrected Total	2867.597	128				

Note. a. *R* Squared = 0.037 (Adjusted *R* Squared = 0.006)

Table 4.23 Analysis of Gender * School Setting Estimates for Dependent Variable: Social Competencies Subscale–DAP

	Gender	Mean	Std. Deviation	N
STEM	Male	20.87	4.037	46
	Female	22.00	5.818	14
	Total	21.13	4.485	60

Table 4.23 –
Continued

	Male	21.71	4.906	45
non-STEM	Female	21.25	5.160	24
	Total	21.55	4.963	69
	Male	21.29	4.483	91
Total	Female	21.53	5.346	38
	Total	21.36	4.733	129

4.2.8 Variable 8—Internal Asset–Positive Identity

For the dependent variable Positive Identity, a significant interaction between gender, school setting, and DAP subscale mean scores were not found to be statistically significant, *F* (1, 123) = 1.310, *p* = 0.255, partial eta squared = 0.011. The null hypothesis of no significant interaction between gender and school setting on mean DAP Positive Identity subscale scores is not rejected.

A significant mean difference was not found to be statistically significant between males and females and DAP Positive Identity subscale mean scores, *F* (1, 123) = 0.403, *p* = 0.527, partial eta squared = 0.003. Therefore, the null hypothesis of no significant mean difference on the DAP Positive Identity subscale scores between male and female students is not rejected.

Additionally, a significant mean difference was not found to be statistically significant between school setting and DAP Positive Identity subscale mean scores, *F* (1, 123) = 0.544, *p* = 0.462, partial eta squared = 0.004. As a result, the null hypothesis of no significant mean difference on the DAP Positive Identity subscale scores between students attending a traditional high school and a specialized STEM school is not rejected. Overall, as shown in Tables 4.24 and 4.25, the results of the analysis of covariance for the external asset Positive Identity subscale scores provide no evidence of statistically significant differences for the Positive Identity subscale.

Table 4.24 Analysis of Between-Subjects Effects for Dependent Variable: Positive Identity Subscale–DAP

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	93.560[a]	4	23.390	0.711	0.586	0.023
Intercept	92.875	1	92.875	2.825	0.095	0.022
IOWA	48.233	1	48.233	1.467	0.228	0.012
SETTING	17.887	1	17.887	0.544	0.462	0.004
GENDER	13.260	1	13.260	0.403	0.527	0.003
SETTING * GENDER	43.081	1	43.081	1.310	0.255	0.011
Error	4044.409	123	32.881			
Total	58012.000	128				
Corrected Total	4137.969	127				

Note. a. *R* Squared = 0.023 (Adjusted *R* Squared = −0.009)

Table 4.25 Analysis of Gender * School Setting for Dependent Variable: Positive Identity Subscale–DAP

School Setting	Gender	Mean	Std. Deviation	*N*
STEM	Male	20.27	4.929	44
	Female	22.07	6.330	14
	Total	20.71	5.298	58
non-STEM	Male	20.59	5.991	46
	Female	19.92	6.296	24
	Total	20.36	6.060	70

Table 4.25 –
Continued

	Male	20.43	5.469	90
Total	Female	20.71	6.311	38
	Total	20.52	5.708	128

4.3 Summary of Subscale Mean Values

The research suggests that growth in assets parallels growth in thriving (Benson 2006, Scales et al., 2006). Internal assets focus on the inner life of students commitments, passions, and competencies needed to guide an individual's choices and actions. In addition, external assets refer to positive developmental experiences and opportunities that need to be offered by families, schools, neighborhoods, community organizations, religious institutions, and other organizations (Benson, 2006). In sum, the means are displayed in Table 4.26, and the results of the analysis and the mean values for each of the eight subscales are further discussed.

4.3.1 External Asset–Support

The Support assets appear to be instrumental in a number of developmental outcomes including internalization of boundaries and values, taking action to help others, and development of empathy and self-esteem. The results of the study show that overall, the mean scores indicated that both male (M = 19.56) and female (M = 22.27) students enrolled in the specialized STEM program reported higher levels of the Support assets when compared to male (M = 19.52) and female (M = 18.63) students enrolled in the comprehensive school setting. However, the results of the analysis of covariance for each of the three hypotheses and the dependent variable Support subscale indicate that a mean difference was not found to be statistically significant.

4.3.2 External Asset–Empowerment

The Empowerment asset is a key asset that contributes to students feeling good about themselves and their skills. Overall, the mean scores indicate that female students (M = 21.87) enrolled in the specialized STEM program reported higher levels of the Empowerment assets when compared to female students (M = 20.25) enrolled in the comprehensive school setting. On the other hand, male students (M = 19.76) enrolled in the comprehensive school settings reported higher levels of Empowerment assets when compared to males (M = 18.93) in the STEM program. Nevertheless, the analysis of covariance results show that for each of the three hypotheses and the dependent variable Empowerment subscale a mean difference was not found to be statistically significant.

4.3.3 External Asset–Boundaries and Expectations

Boundaries are established by clearly communicating what is approved and celebrated, combined with establishing high expectations for students' ability to succeed. This asset category is most strongly and consistently related to high academic achievement.

Overall, the mean scores indicated that both male (M = 20.63) and female (M = 22.73) students enrolled in the specialized STEM program reported higher levels of the Boundaries and Expectations assets when compared to male (M = 19.48) and female (M = 19.08) students enrolled in the comprehensive school setting. The results of the analysis of covariance indicate that a statistically significant mean difference explained by setting was found between students attending the traditional high school and specialized STEM high school setting. The result of the analysis indicates p = 0.035; therefore, the null hypothesis (Main Effect Hypothesis #2) of no significant mean difference on the DAP Boundaries and Expectations subscale scores, students attending the traditional high school and the STEM specialized high school, is rejected.

4.3.4 External Asset–Constructive Use of Time

This asset focuses on the connections students make with principled, caring adults who nurture skill and capacity through relationship building and supervision. Overall, the mean scores indicate that female students (*M* = 17.80) enrolled in the specialized STEM program reported higher levels of the Constructive Use of Time assets when compared to female students (*M* = 16.25) enrolled in the comprehensive school setting. On the other hand, male students (*M* = 15.64) enrolled in the comprehensive school settings reported higher levels of Constructive Use of Time assets when compared to males (*M* = 14.36) in the STEM program.

Nevertheless, the analysis of covariance results indicate that for each of the three hypotheses and the dependent variable Constructive Use of Time subscale a mean difference was not found to be statistically significant.

4.3.5 Internal Asset–Commitment to Learning

The Commitment to Learning assets are important for success and engaged citizenship. High levels of these assets help establish a connection between learning and future career.

Overall, the mean scores indicate that both male (*M* = 20.74) and female (*M* = 21.40) students enrolled in the specialized STEM program reported higher levels of the Commitment to Learning assets when compared to male (*M* = 20.47) and female (*M* = 20.08) students enrolled in the comprehensive school setting.

However, the results of the analysis of covariance for each of the three hypotheses and the dependent variable Commitment to Learning subscale indicate that a mean difference was not found to be statistically significant.

4.3.6 Internal Asset–Positive Values

The development of the Positive Values assets stem from modeling and experiences of being with people who exhibit care and compassion.

Overall, the mean scores indicate that female students (*M* = 22.00) enrolled in the specialized STEM program reported higher levels of the Positive Values assets when compared to female students (*M* = 21.25) enrolled in the comprehensive school setting. On the other hand, male students (*M* = 21.71) enrolled in the comprehensive school settings reported higher levels of Positive Values assets when compared to males (*M* = 20.87) in the STEM program.

However, the results of the analysis of covariance for each of the three hypotheses and the dependent variable Positive Values subscale indicate that a mean difference was not found to be statistically significant.

4.3.7 Internal Asset–Social Competencies

The Social Competencies assets inhibit substance use, reduce violence, and are important components for preventing high-risk behaviors.

Overall, the mean scores indicate that female students (*M* = 22.00) enrolled in the specialized STEM program reported higher levels of the Social Competencies assets when compared to female students (*M* = 20.00) enrolled in the comprehensive school setting. On the other hand, male students (*M* = 19.85) enrolled in the comprehensive school settings reported higher levels of Social Competencies assets when compared to males (*M* = 19.74) in the STEM program.

However, the results of the analysis of covariance for each of the three hypotheses and the dependent variable Social Competencies subscale indicate that a mean difference was not found to be statistically significant.

4.3.8 Internal Asset–Positive Identity

The positive identity asset focuses on students' views of themselves. Students develop self-esteem, sense of purpose, and a positive outlook of the future. According to the research, without these assets, students can lose initiative, direction, or purpose.

Overall, the mean scores indicate that female students (*M* = 22.07) enrolled in the specialized STEM program reported higher levels of the Positive Identity assets when compared to female students (*M* = 19.92) enrolled in the comprehensive school setting. On the other hand, male students (*M* = 20.59) enrolled in the comprehensive school settings reported higher levels of Positive Identity assets when compared to males (*M* = 20.27) in the STEM program.

However, the results of the analysis of covariance for each of the three hypotheses and the dependent variable Positive Identity subscale indicate that a mean difference was not found to be statistically significant.

Table 4.26 Analysis of Asset Mean Values for STEM and Non-STEM Study Participants

Dependent Variable	School Setting	Gender	Mean
Support	STEM	Male	19.56
		Female	22.27
	Non -STEM	Male	19.52
		Female	22.07
Empowerment	STEM	Male	18.93
		Female	21.87
	Non-STEM	Male	19.76
		Female	20.25
Boundaries and Expectations	STEM	Male	20.63
		Female	22.73
	Non-STEM	Male	19.48
		Female	19.08
Constructive Use of Time	STEM	Male	14.36
		Female	17.80
	Non-STEM	Male	15.64
		Female	16.25

Table 4.26 – Continued

Commitment to Learning	STEM	Male	20.74
		Female	21.40
	Non-STEM	Male	20.47
		Female	20.08
Positive Values	STEM	Male	20.87
		Female	22.00
	Non-STEM	Male	21.71
		Female	21.25
Social Competencies	STEM	Male	19.74
		Female	22.00
	Non-STEM	Male	19.85
		Female	20.00
Positive Identity	STEM	Male	20.27
		Female	22.07
	Non-STEM	Male	20.59
		Female	19.92

4.4 Chapter Summary

Chapter 4 presents results of the 24 2 × 2 analysis of covariance statistical analyses used to describe the study sample and answer the three hypotheses posed for the study. The three hypotheses were tested using statistical analyses, with all decisions on the statistical significance of the findings made using $p < 0.05$. The participants were 11^{th}-grade students enrolled in one specialized STEM high school and eleven traditional comprehensive high schools in an urban school district located in a southwestern metroplex. The majority of participants ($n = 102$, 71.8%) were Hispanic and most of the students ($n = 101$, 71.1%) were male, with 41 ($n = 41$, 28.8%) female.

CHAPTER 5

SUMMARY, DISCUSSION, FINDINGS, CONCLUSIONS, IMPLICATIONS FOR PRACTICE, AND RECOMMENDATIONS FOR FURTHER RESEARCH

5.1 Summary

In this exploratory study, 24 hypotheses were tested. All 24 hypotheses were tested using eight 2 × 2 analyses of covariance to compare the mean developmental assets profile scores for internal assets (Commitment to Learning, Positive Values, Social Competencies, and Positive Identity) and external assets (Support, Empowerment, Boundaries and Expectations, and Constructive Use of Time). All decisions related to significance of the findings were made using a criterion alpha level of $p < 0.05$. The project explores the relationships between internal and external developmental assets, and academic achievement among urban underrepresented minority students. Female and male students in a science, technology, engineering, and math (STEM) focused high school setting were compared to female and male students in traditional comprehensive high school settings.

5.2 Discussions

This study was designed to contribute to the theory, research, and practice in STEM education. The focus of the study is the relationship between developmental assets and academic achievement of urban underrepresented minority female and male students in a specialized science, technology, engineering, and math program and in a traditional comprehensive high school program.

The overall relationship between internal and external developmental assets and academic achievement among urban underrepresented minority students in a specialized high school STEM program setting and in traditional comprehensive high school settings was examined. The study used data provided by the school district including students' assets as measured by the Developmental Assets Profile (DAP) survey administered during the 2011–2012 school year, student standardized test scores—eligible students scored a combination of 160 points on the reading and math portion of the Iowa Test of Basic Skills test administered during their eighth-grade (2008–2009) school year, and student grade level, gender, ethnicity, and high school organization name and number.

5.2.1 Theory

The results indicate that the developmental assets profile survey instrument can be used to measure and determine significant mean differences between male and female students enrolled in a specialized science, technology, engineering, and math high school when compared to male and female students enrolled in traditional comprehensive high school programs. The results may have the potential to provide schools with information regarding the indicators that positively influence building developmental assets which may help impact student achievement for underrepresented minorities in the areas of science, technology, engineering, and math. Additionally, the project was designed to contribute to the understanding about the strength of development assets theory and the influence of the theory as it relates to underrepresented minority students' academic outcomes and the influencing factors internal and external to school.

5.2.2 Research

Although several researchers have explored the cause of this problem, the underrepresentation of URMs in STEM, it continues to persist. According to the National Center for Education Statistics, over 65% of the college students entering STEM majors do not complete a degree within six years of beginning their college career (Gonzales et al., 2008). Moreover, the Higher Education Research Initiative reports that the number of URMs matriculating through a STEM degree program is significantly less than expected. It is hoped that findings from this study will add to the research knowledge base and help move the K–16 research community toward a solution.

5.2.3 Practice

The findings of this study will help shape future policy and practice designed to help support and strengthen the STEM pipeline in the United States. By determining differences between underrepresented minorities in specialized STEM-focused settings and underrepresented minority students in traditional high school settings, the findings offer results that may potentially provide the foundational blueprint for future K–16 STEM-focused programs designed to increase minority student successful participation in STEM. As a result of this addition to the knowledge base, improved STEM outcomes for underrepresented minorities in K–16 could positively translate into an increased number of URMs being prepared for college, choosing STEM, and persisting in STEM fields in the future.

5.3 Findings

In this exploratory study, the following hypotheses were tested for each of the eight dependent variables for a total of 24 hypotheses tested.

Interaction effect hypothesis: There is no significant interaction between gender and school setting (traditional or STEM specialized) on mean DAP scores.

Main effect hypothesis 1 (gender): There is no significant mean difference on the DAP instrument between male and female students.

Main effect hypothesis 2 (student setting): There is no significant mean difference on the DAP instrument between students attending traditional and STEM-specialized institutions

Overall, the results of the study and the analysis of covariance for the eight subscales measuring developmental assets mean scores produced statistically significant findings in the area of Boundaries and Expectations. The 2 × 2 ANCOVA used to test the mean scores for Boundaries and Expectations subscale produced a statistically significant effect, indicating that the variability in the score can be explained by school setting. According to the research, the asset category Boundaries and Expectations is most strongly and consistently related to a variety of outcomes, but especially high academic achievement (Benson, 2006; Scales &

Roehlkepartain, 2003). The results show that both male and female participants enrolled in the specialized STEM school were more likely to have positive responses regarding Boundaries and Expectations when compared to male and female participants enrolled in traditional comprehensive high school programs as measured by the Developmental Assets Profile survey.

5.4 Conclusions

Rigorous curriculum, high expectations, and supportive environments have been identified in the literature as indicators that have the potential to positively impact underrepresented minorities in STEM. The developmental assets theory research has also shown that asset building is important for improving academic achievement across all ethnic groups, socioeconomic status, and gender. As a result of this study, it becomes evident that school setting, an environment of high expectations, and the encouragement and motivation required to enable underrepresented minority students to feel empowered to accomplish their goals, is important, especially for underrepresented minority females. Overall, the research related to underrepresented minorities in STEM has focused primarily on the cause for underachievement as opposed to best practices for improving academic achievement and performance. The Developmental Assets Profile results may potentially provide key leverage points and targeted indicators for building student asset levels in key areas.

5.5 Implications for Practice

The findings of this study will help shape future policy and practice designed to assist in supporting and strengthening the STEM pipeline in the United States. By determining differences between underrepresented minorities in specialized STEM-focused settings and underrepresented minority students in traditional high school settings, the findings offer results that may potentially provide the foundational blueprint for future K–16 STEM-focused programs designed to increase minority student successful participation in STEM. As a result of this addition to the knowledge base, improved STEM outcomes for underrepresented minorities in

K–16 could positively translate into an increased number of URMs being prepared for college, choosing STEM, and persisting in STEM fields in the future.

5.6 Recommendations for Further Study

Based on the study findings, it is recommended that further research be conducted in the following areas:

- Design a qualitative study in order to conduct interviews with students. Questions should be developed that will enable the researcher to determine the specific Developmental Asset Profile components participants believe impact them the most.
- Analyze the relationship between developmental assets and academic achievement across a variety of STEM Schools.
- Use a longitudinal research design in order to determine asset levels in students enrolled in the middle school program and track student persistence in STEM upon graduation from high school.
- Further research the connection between standardized test performance and student level of assets.
- Assess the long-term impact of asset building for females in STEM K–12.

In sum, the focus on improving outcomes for underrepresented minorities in STEM is essential. “Underrepresentation of females and persons of color in the United States STEM workforce is a statistical fact regardless of the denominator chosen” (Chubin, 2010, p. 8). Particularly, further studies should be conducted to target this issue and inform policymakers and educators in order to forge a clear path ahead and promote long-term sustained improvement.

> The first step to closing that gap is to believe, as I do, that high expectations are for all students. I believe intelligence is equally distributed throughout the world, but opportunity is not. And the same is true within our own country.
>
> President William J. Clinton
> *Remarks at the White House Strategy Session, June 15, 2000*

APPENDIX A

RESEARCH REVIEW BOARD LETTER OF APPROVAL (REFERENCE #11-031)

Alan King, C.P.A.
Interim Superintendent of Schools

Dallas Independent School District

April 10, 2012

Ms. Jovan Grant-Wells
528 Tuscan Drive
Irving, TX 75039

RE: Urban Underrepresented Minority Students in Science, Technology, Engineering and Math: An Analysis of the Relationship between External Assets, Internal Assets, and Academic Achievement

Dear Ms. Grant-Wells:

The Research Review Board (RRB) of the Dallas Independent School District (Dallas ISD) has reviewed and approved your proposal to conduct the above-referenced study. Based on the information provided, the committee concludes that the study serves a worthwhile purpose and will benefit the district.

It is our understanding that you have read and agreed to the terms described in the *Procedures and Policies for Conducting Extra-District Research in the Dallas Independent School District*. Please note that all school and district information, wherever applicable, should remain confidential within the limits of the law. In addition, any data collected from Dallas ISD may be used solely for the purposes of the approved study.

Approval by the RRB does not guarantee that any Dallas ISD department, school, or employee will comply with data requests for the study. If the study involves collection of primary data at a school or schools, the permission of the building principal(s) must be obtained separately from this approval.

Please provide the RRB with a copy of any data file constructed using Dallas ISD student or personnel information, and a copy of your final report, within 30 days following the completion of the study. In all future communications, please use the study's reference number (11-031).

On behalf of the committee, I wish you the best of luck with your study.

Sincerely,

Dorothea Weir

Dorothea Weir, Ph. D.
Chair, Research Review Board
Office of Applied Research
Department of Evaluation and Accountability
Dallas Independent School District

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APPENDIX B

INSTITUTIONAL REVIEW BOARD NOTIFICATION OF EXEMPTION
(PROTOCOL: 2013-0262)

Office of Research Administration
Regulatory Services
817-272-3723
regulatoryservices@uta.edu
http://www.uta.edu/ra/oric/

Institutional Review Board
Notification of Exemption

January 17, 2013

Jovan Carisa Wells
Dr. Adrienne Hyle
Educational Leadership & Policy Studies
Box 19575

Protocol Number: 2013-0262

Protocol Title: *URBAN UNDERREPRESENTED MINORITY STUDENTS IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATH: AN ANALYSIS OF THE RELATIONSHIP BETWEEN DEVELOPMENTAL ASSETS AND ACADEMIC ACHIEVEMENT*

Type of Review: **Exemption Determination**

The UT Arlington Institutional Review Board (IRB) Chair, or designee, has reviewed the above referenced study and found that it qualified for exemption under the federal guidelines for the protection of human subjects as referenced at Title 45CFR46.101(2)(b) category (4). You are therefore authorized to begin the research as of January 14, 2013.

Pursuant to Title 45 CFR 46.103(b)(4)(iii), investigators are required to, "promptly report to the IRB **any** proposed changes in the research activity, and to ensure that such changes in approved research, during the period for which IRB approval has already been given, are **not initiated without prior IRB review and approval** except when necessary to eliminate apparent immediate hazards to the subject." Please be advised that as the principal investigator, you are required to report local adverse (unanticipated) events to the Office of Research Administration; Regulatory Services within 24 hours of the occurrence or upon acknowledgement of the occurrence.

All investigators and key personnel identified in the protocol must have documented Human Subject Protection (HSP) Training on file with this office. Completion certificates are valid for 2 years from completion date.

The UT Arlington Office of Research Administration; Regulatory Services appreciates your continuing commitment to the protection of human subjects in research. Should you have questions, or need to report completion of study procedures, please contact Robin Dickey at 817-272-9329 or robind@uta.edu. You may also contact Regulatory Services at 817-272-3723 or regulatoryservices@uta.edu.

REFERENCES

Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college.* Washington, D.C.: U.S. Department of Education.

Anderson, E., & Kim, D. (2006). *Increasing the success of minority students in science and technology*. Washington, D.C.: American Council on Education.

Astin, A. W. (1993). What *matters in college? Four critical years revisited*. San Francisco: Jossey–Bass.

Astin, A. W., & Astin, H. S. (1992). *Undergraduate science education: The American freshman: Thirty-year trends*. Los Angeles, CA: University of California–Los Angeles, Higher Education Research Institute.

Axelrod, J. (2007). Rising above the gathering storm: Energizing and employing America for a brighter economic future. National Academies Press.

Augustine, N. R. (2005). Rising above the gathering storm: Energizing and employing America for a brighter economic future. *Retrieved August 20, 2012*. National Academies Press

Benson, P. L. (1993). The Troubled Journey: A Portrait of 6th–12th Grade Youth. Minneapolis, MN: Search Institute

Benson, P. L. (2006). *All kids are our kids: What communities must do to raise caring and responsible children and adolescents*. (2nd ed). San Francisco, CA: Jossey–Bass.

Benson, P. L., Scales, P. C., Leffert, N., & Roehlkepartain, E. C. (1999). *A Fragile foundation: The State of developmental assets among American youth*. Minneapolis, MN: Search Institute.

Benson, P. L., Scales, P. C., & Syvertsen, A. K. (2011). The contribution of the developmental assets framework to positive youth development theory and practice. In R. M. Lerner, J. V. Lerner, & J. B. Benson (Eds.), *Advances in child development and behavior* (pp. 197–230). London, England: Academic Press.doi:10.1016/B978-0-12-386492-5.00008-7

Berryman, S. E. (1983). *Who will do science?* New York: W. H. Freeman.

Boe, J. (2010). *Strategies for science, technology, engineering and math in technology education* (Doctoral Dissertation, North Dakota State University). Retrieved from ProQuest Dissertations database. (UMI No. 34200040)

Bonous-Hammarth, M. (2000). Pathways to success: Affirming opportunities for science, mathematics, and engineering majors. *Journal of Negro Education*, 92–111.

Bracey, G. (2009). The Bracey report on the condition of public education, 2009. *Boulder and Tempe: Education and the Public Interest Center & Education Policy Research Unit. Retrieved November*, *20*, 2012.

Business–Higher Education Forum (2005). A commitment to America's future: Responding to the crisis in mathematics and science education. Washington, D.C.

Bush, G. W. (2007). *Statement on signing the America COMPETES Act*, August 9, 2007. The American Presidency Project. Retrieved from http://www.presidency.ucsb.edu/ws/?pid=75650

Byars-Winston, A., Estrada, Y., Howard, C., Davis, D., & Zalapa, J. (2010). Influence of social cognitive and ethnic variables on academic goals of underrepresented students in science and engineering: A multiple-group analysis. *Journal of Counseling Psychology*, *57*(2), 205–218. doi: 10.1037/a0018608.

Cernkovich, S. A., & Giordano, P. C. (1992). School bonding, race, and delinquency. *Criminology*, *30*(2), 261–291.

Chaskin , R. J., & Hawley, T. (1994). *Youth and caring: Developing a field of inquiry and practice.* Chicago: Chapin Hall Center for Children, University of Chicago.

Chen, X., & Weko, T. (2009). *Students who study science, technology, engineering, and mathematics (STEM) in postsecondary education.* Washington: U.S. Department of Education, NCES, 2009-161. Retrieved from http://nces.ed.gov/pubs2009/2009161.pdf

Chow, C. (2011). *Learning from our global competitors: A comparative analysis of science, technology, engineering and mathematics (STEM) education pipelines in the United States, mainland China and Taiwan* (Doctoral Dissertation, University of Southern California). Retrieved from ProQuest Dissertations database. (UMI No. 3477870)

Chubin, D. E. (2009). Underrepresentation in the Real World. *Science & Engineering Ethics*, *15*(1), 7–10. doi:10.1007/s11948-009-9116-7.

Chubin, D. E., May, G. S., & Babco, E. L. (2005). Diversifying the Engineering Workforce. *Journal Of Engineering Education*, *94*(1), 73–86.

Coomey, S. M., & Wilczenski, F. L. (2007). *A practical guide to service learning: Strategies for positive development in schools.* New York, NY: Springer.

Collins, M. (1992). *Ordinary children, extraordinary teachers.* Charlottesville, VA: Hampton Roads.

Denson, C. D., Avery, Z. A., and Schell, J. D. (2010). Critical inquiry into urban African American students' perceptions of engineering*. Journal of African American Studies, 14*(1), 61–74.

Dowd, A. C., Malcolm, L. E., & Bensimon, E. M. (2009). *Benchmarking the success of Latino* *and Latina students in STEM to achieve national graduation goals.* Los Angeles, CA: University of Southern California.

Duncan, A. (2010, November/December). Back to school: Enhancing U.S. education and competiveness. *Foreign Affairs, 89*(6), 65–76.

Espinosa, L. (2009). *Pipelines and pathways: Women of color in STEM majors and the experiences that shape their persistence* (Doctoral dissertation, University of California, Los Angeles). Retrieved from ProQuest Dissertations database. (UMI No. 3394926)

Farro, S. (2009). *Achievements and challenges of undergraduates in science, technology, engineering,and mathematics fields in the Ronald E. McNair program* (Doctoral dissertation, Colorado State University). Retrieved from ProQuest Dissertations database. (UMI No. 3385152)

Federal Coordination in STEM Education Task Force, Committee on STEM Education, National Science and Technology Council. (2012). *Coordinating federal science, technology, engineering and mathematics (stem) education investments: Progress report*. Retrieved from U.S. Government http://www.whitehouse.gov/sites/default/files/microsites/ostp/nstc_federal_stem_education_coordination_report.pdf

Federal Inventory of STEM Education Fast-Track Action Committee, Committee on STEM Education, National Science and Technology Council. (2011). *The federal science, technology, engineering, and mathematics (stem) education portfolio*. Retrieved from U.S. Government http://www.whitehouse.gov/sites/default/files/microsites

Frehill, L. M. (2011). *2011 NACME data book: A comprehensive analysis of the "new" American dilemma*. White Plains, NY: National Action Council for Minorities and Engineering.

Gary, S. (2010). *Four portraits: The role of historically black colleges and universities in the development of black science, technology, engineering and mathematics Ph.D. students* (Doctoral dissertation, University of Pennsylvania). Retrieved from ProQuest Dissertations database. (UMI No.3410468)

Gereffi, G., Wadhwa, V., Rissing, B., & Ong, R. (2008). Getting the numbers right: International engineering education in the United States, China, and India. *Journal Of Engineering Education*, *97*(1), 13–25.

Gonzales, P., Williams, T., Jocelyn, L., Roey, S., Kastberg, D., & Brenwald, S. U.S. Department of Education, Institute of Education Sciences. (2008). *Highlights from TIMSS 2007: Mathematics and science achievement of U.S. fourth and eighth grade students in an international context (NCES 2009-001)*. Washington, D.C.: National Center for Education Statistics.

Grandy, J. (1998). Persistence in science of high-ability minority students. *Journal of Higher Education*, *69*(6), 589–620.

Harper, S. R. (Ed.). (2011). *Students of color in STEM: New directions for institutional research,* (No. 148). San Francisco, CA: Jossey–Bass.

Harper, S. R., & Newman, C. B. (2010). *Students of Color and STEM: Engineering a New Research Agenda*. San Francisco, CA: Jossey–Bass.

Holt, J. K. (2006). An evaluation of math and science educational and occupational persistence among minorities. Proceeding from the 2006 annual meeting of the Eastern Education Research Association, Hilton Head, SC.

Humes, K., Jones, N. A., & Ramirez, R. R. (2011). *Overview of Race and Hispanic Origin, 2010*. US Department of Commerce, Economics and Statistics Administration, US Census Bureau.

Hunter, L., & Elias, M. J. (2000). Interracial friendships, multicultural sensitivity, and social competence: How are they related? *Journal of Applied Developmental Psychology*, *20*, 551–573.

Hurtado, S., Eagan, K., & Chang, M. (2010). Degrees of success: Bachelor’s degree completion rates among Initial STEM majors. *Los Angeles, CA: Higher Education Research Institute*.

Legewie, J. & DiPrete, T. A. (2012), High school environments, stem orientations,and the gender gap in science and engineering degrees. Unpublished Working Paper. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2008733

Leggon, C. B., & Pearson Jr, W. (2009). Assessing programs to improve minority participation in STEM fields: What we know and what we need to know. *Doctoral education and the faculty of the future*, 160–171.

Levene, H. (1960). In I. Olkin et al. (Eds.), *Contributions to probability and statistics: Essays in honor of Harold Hotelling*, (pp. 278–292). Palo Alto, CA Stanford University Press.

Li, H. (2010). Higher education in China: Complement or competition to U.S. universities. In T. Clotfelter (Ed.), *American universities in a global market* (pp. 269–304). Chicago, IL: University of Chicago Press.

Mahoney, J. L. (2000). School extracurricular activity participation as a moderator in the development of antisocial patterns. *Child Development 71*(2), 502–516.

Mahoney, M. (2009). *Student attitude toward STEM: Development of an instrument for high school STEM-based programs* (Doctoral dissertation, Ohio State University). Retrieved from ProQuest Dissertations database. (UMI No. 3378124)

Mahoney, J. L., & Cairns, R. B. (1997). Do extracurricular activities protect against early school dropout?. *Developmental psychology*, *33*(2), 241.

Malcolm, L. E., & Malcolm, S. M. (2011). The double bind: The next generation. *Harvard Educational Review*, *81*(2), 162–171.

Martin, M. O., Mullis, I. V., Foy, P., & Olson, J. F. (2008). TIMSS 2007 international mathematics report: Findings from Trends in International Mathematics and Science Study at the fourth and eighth grades. Chestnut Hill, MA: Boston College.

May, G. S., & Chubin, D. E. (2003). A retrospective on undergraduate engineering success for underrepresented minority students. *Journal of Engineering Education*, *92*(1), 27–39.

Medeiros, D. (2011). *The influence of female social models in corporate STEM initiatives on girls' math and science attitudes* (Doctoral dissertation, University of Pennsylvania). Retrieved from ProQuest Dissertations database. (UMI No. 3475819)

Melguizo, T., & Wolniak, G. C. (2011). The earnings benefits of majoring in stem fields among high achieving minority students. *Research in Higher Education*, *53*(4), 383–405. doi: 10.1007/s11162-011-9238-z

Metcalf, H. (2011). *Formation and representation: Critical analyses of identity, supply, and demand in science, technology, engineering, and mathematics* (Doctoral dissertation, The University of Arizona). Retrieved from ProQuest Dissertations database. (UMI No. 3450747)

Mitchell, A. (2011). *An investigation of faculty relationships as a source of motivation for STEM undergraduates at a historically-black university* (Doctoral dissertation, Howard University). Retrieved from ProQuest Dissertations database. (UMI No. 3460678)

Mitchell, S. (2011). *Factors that contribute to persistence and retention of underrepresented minority undergraduate students in science, technology, engineering, and mathematics (STEM)* (Doctoral dissertation, The University of Southern Mississippi). Retrieved from ProQuest Dissertation database. (UMI No. 3477173)

Museus, S. D., Palmer, R. T., Davis, R. J., & Maramba, D. C. (2011). Special issue: Racial and ethnic minority students' success in stem education. *ASHE Higher Education Report*, *36*(6), 27–52.

National Science Foundation, National Center for Science and Engineering Statistics. 2013. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2013*. Special Report NSF 13-304. Arlington, VA. Available at http://www.nsf.gov/statistics/wmpd/

National Science Board, National Science Foundation. 2010. *Preparing the next Generation of STEM Innovators: Identifying and Developing Our Nation's Human Capital.* Special Report NSB-1—33. Arlington, VA. Available at http://www.nsf.gov/nsb/publications/2010/nsb1033.pdf

National Science Foundation, Division of Science Resources Statistics. (2011). *Women, minorities, and persons with disabilities in science and engineering 2011.* Special Report NSF 11-309. Arlington, VA. Available at http://www.nsf.gov/statistics/wmpd/

National Research Council. (2011). *Expanding underrepresented minority participation: America's science and technology talent at the crossroads*. Washington, D.C.: TheNational Academies Press.

National Research Council. (2007). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. Washington, D.C.: The National Academies Press.

National Science Board. 2008. *Science and Engineering Indicators 2008.* Two volumes. Arlington, VA: National Science Foundation (volume 1, NSB 08-01; volume 2, NSB 08-01A).

National Science Board, National Science Foundation. 2010. *Preparing the next Generation of STEM Innovators: Identifying and Developing Our Nation's Human Capital.* Special Report NSB-1—33. Arlington, VA. Available at http://www.nsf.gov/nsb/publications/2010/nsb1033.pdf

No Child Left Behind Act of 2001, Pub. L. No. 107-110,115 Stat. 1425 (2002).

Oakes, J. (1990). *Lost* talent: *The under participation of women, minorities and disabled persons in science.* Santa Monica, CA: RAND Corporation.

Oakes, J. (1990). Opportunities, achievement, and choice: Women and minority students in science and mathematics. *Review of Research in Education*, *16*(2), 153–166.

Obama, B. H. (2009a). Remarks by the President at the National Academy of Sciences Annual Meeting, April 27, 2009.

Obama, B. H. (2009b). Remarks on the "educate to innovate" campaign. *Daily Compilation of Presidential Documents,*1-5. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=45545839&site=ehost-live

Patchen, M. (1982). *Black-white contact in schools: Its social and academic effects.* West Lafayette, IN: Purdue University Press.

PCAST. see President's Council of Advisors on Science and Technology.

Pollard, D. (1989). A profile of underclass achievers. *Journal of Negro Education, 58,* 297–308.

President's Council of Advisors on Science and Technology (U.S.) [PCAST]. (2010). *Prepare and Inspire: K–12 Education in Science, Technology, Engineering, and Math (STEM) for America's Future: Executive Report*. Executive Office of the President, President's Council of Advisors on Science and Technology.

President's Council of Advisors on Science and Technology [PCAST]. (2012). *Engage to excel: producing one million additional college graduates with degrees in science, technology, engineering, and mathematics*. Retrieved from United States Government website: http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_2-25-12.pdf

Reddick, R. J., Welton, A. D., Alsandor, D. J., Alsandor, D. J., & Alsandor, D. J. (2011). Stories of success: high minority, high poverty public school graduate narratives on accessing higher education. *Journal of Advanced Academics*, 22(4), 594–618. doi: 10.1177/1932202X11414133

Rendon, L. I., and Hope, R. (1996). An educational system in crisis. In L. Rendon and R. Hope (Eds.), *Educating a new majority* (pp. 1–33). San Francisco, CA: Jossey–Bass.

Russell, M. L., and Atwater, M. M. (205). Traveling the road to success: A disclosure on persistence throughout the science pipeline with African American students at a predominantly white institution. *Journal of Research in Science Teaching*, *42*(96), 691–715.

Sax, L. J. (1996). *The Impact of College on Post-College Commitment to Science Careers: Gender Differences in a Nine-Year Follow-Up of College Freshmen*.

Scales, P. C., Benson, P. L., Roehlkepartain, E. C., Sesma, A., & van Dulmen, M. (2006). The role of developmental assets in predicting academic achievement: A longitudinal study. *Journal of Adolescence, 29*(5), 691–708.

Scales, P. C., Foster, K. C., Mannes, M., Horst, M. A., Pinto, K. C. & Rutherford, A. (2005). School- business partnerships, developmental assets, and positive outcomes among urban high school students: A mixed-methods study. *Urban Education, 40*(2), 144–189.

Scales, P. C., & Roehlkepartain, E.C. (2003). Boosting student achievement: New research on the power of developmental assets. *Search Institute Insights & Evidence*, *1* (1), 1–10.

Scales, P. C., Sesma, A., Jr., & Bolstrom, B. (2004). Coming into their own: How developmental assets help promote positive growth in middle childhood. Minneapolis, MN: Search Institute.

Scales, P. C., & Leffert, N. (2004). Developmental assets: A synthesis of the scientific research on adolescent development (2nd ed). Minneapolis, MN: Search Institute.

Schachter, R. (2008). Remedial nation: As two and four year colleges face onslaught of unprepared students, they are turning to new strategies. *University Business*, 52–56

Search Institute (2005). *Developmental Assets Profile User Manual (2005). Search Institute, Minneapolis, MN.*

Search Institute (2011). *Developmental assets*. (2011, February 27). Retrieved from http://www.search-institute.org/developmental-assets

Sells, L. W. (1980). The invisible filter. *Engineering Education*, *70*(4), 437–473.

Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.

Search Institute. (2004). *Developmental assets profile survey*. Minneapolis, MN: Search Institute Press.

Simmons, R. G., & Blyth, D. A. (1987). *Moving into adolescence: The impact of pubertal change and school context.* New York, NY: Aldine de Gruyter.

Snyder, T. D., Dillow, S. A., & Hoffman, C. M. (2009). Digest of Education Statistics, 2008. NCES 2009-020. *National Center for Education Statistics*.

Stotts, J. (2011). *The STEM initiative---a multiple case study of mission-driven leadership in two schools implementing STEM in Texas: Successes, obstacles, and lessons learned* (Doctoral dissertation, The University of Texas at San Antonio). Retrieved from ProQuest Dissertation database. (UMI No. 3454109)

Subotnik, R. F., Edmiston, A. M., & Rayhack, K. M. (2007). Developing national policies in STEM talent development: Obstacles and opportunities. *NATO Security Through Science Series E Human and Societal Dynamics*, *16*, 28.

Subotnik, R. F., Tai, R. H., Rickhoff, R., & Almarode, J. (2008). Specialized public high schools of science, mathematics, and technology and the stem pipeline: What do we know now and what will we know in 5 years? *Roeper Review*, *32,* 7–16.

Summers, M. F. & Hrabowski III, F. A. (2006). Preparing minority scientists and engineers. *Science*, *311*, 1870–1871. Retrieved from http://sciencemag.org

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics*. (5th ed., pp. 1–980). Boston, MA: Pearson Education.

Thompson, G. L., Warren, S., and Carter, L. (2004). It’s not my fault: Predicting high school teachers who blame parents and students for students’ low achievement. *High School Journal*, *87*(3), 5–14.

Trask-Tate, A. J., & Cunningham, M. (2010). Planning ahead: The relationship among school support, parental involvement, and the future academic expectations in African American adolescents. *The Journal of Negro Education*, *79*(2), 137–150.

Ulsh, L. (2011). *Accelerated integrated science sequence: Interdisciplinary undergraduate science for the 21st century* (Doctoral dissertation, Claremont Graduate University). Retrieved from ProQuest dissertations database (UMI No: 3449925)

Wasonga, T. (2002). Gender effects on perceptions of external assets, development of resilience and academic achievement: Perpetuation theory approach. *Gender Issues*, *20*(4), 43–54.

Wells, A. S., & Crain, R. L. (1994). Perpetuation theory and the long-term effects of school desegregation. *Review of Educational Research*, *64*(4), 531–555.

BIOGRAPHICAL INFORMATION

Jovan Grant Wells is passionate about working to provide high quality science, technology, engineering, and math education for all students. Upon graduating from college with a bachelor's of science in biology, she began work as a research assistant at the University of Texas Southwestern Medical Center in the department of molecular cardiology. In 2001, she began to pursue a career as an educator. She started as a middle school science teacher in a suburban school district and soon began the path toward educational leadership. Since earning a master's in education in 2006, and Texas Superintendent's certification in 2007, she has served in a variety of leadership roles in both urban and suburban school district's including: department leader, middle school assistant principal, high school principal, and executive director.