8-2-2013

THE JOURNEY OF A SCIENCE TEACHER: PREPARING FEMALE STUDENTS IN THE TRAINING FUTURE SCIENTISTS AFTER SCHOOL PROGRAM

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19THE JOURNEY OF A SCIENCE TEACHER:

PREPARING FEMALE STUDENTS IN THE

TRAINING FUTURE SCIENTISTS AFTER SCHOOL PROGRAM

By

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A DISSERTATION PROPOSAL

Submitted to the Graduate School at the

UNIVERSITY OF MISSOURI-ST. LOUIS
In partial fulfillment of the Requirements for the Degree

DOCTOR OF PHILOSOPHY OF EDUCATION IN TEACHING AND LEARNING
WITH AN EMPHASIS

In

SCIENCE EDUCATION

August 2013

<u>Advisory Committee</u>

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Abstract

What affect does female participation in the Training Future Scientist (TFS) program based on Vygotsky's sociocultural theory and Maslow's Hierarchies of Needs have on female adolescents' achievement levels in science and their attitude toward science and interest in science-based careers? The theoretical framework for this study was developed through a constructivist perspective, using dialogic engagement, coinciding with Lev Vygotsky's sociocultural learning theory. This action research project used mixed methods research design, targeted urban adolescent females who were members of Boys & Girls Club of Greater St. Louis (BGCGSTL) after-school program. The data collection measures were three qualitative instruments (semi-structured interviews, reflective journal entries and attitudinal survey open-ended responses) and two quantitative instruments (pre-test and posttests over the content from the Buckle-down Curriculum and attitudinal survey scaled responses). The goal was to describe the impact the Training Future Scientist (TFS) after-school program has on the girls' scientific content knowledge, attitude toward choosing a science career, and self-perception in science. Through the TFS after-school program participants had access to a secondary science teacher-researcher, peer leaders that were in the 9^{th} - 12^{th} grade, and Science, Technology, Engineering and Math (STEM) role models from Washington University Medical School Young Scientist Program (YSP) graduate and medical students and fellows as volunteers. The program utilized the Buckle-down Curriculum as guided, peer-led cooperative learning groups, hands-on labs and demonstrations facilitated by the researcher, trained peer leaders and/or role models that used constructivist science pedagogy to improve test-taking strategies. The outcomes for the TFS study were an increase in science content

knowledge, a positive trend in attitude change, and a negative trend in choosing a science career.

Keywords: informal science programs, urban girls, self-efficacy, cooperative learning, peer learning, female adolescents, and after-school urban education

This dissertation study was funded by two grants, the 2013 spring dissertation grant from the University of Missouri St. Louis and a philanthropic grant from Dr. Courtney Crim.

Dedications

This dissertation is dedicated to God, who is the head of my life, my mother, my children, Marttise & Meaghan, my Godparents, my God children, my cloud of witnesses, especially (Cora Mae, Sioni, Lois, and my dad), my family, especially (Maryan, Aunt Lucy, Aunt Inez, Aunt Marion, Uncle Charles, Evelyn & Lucy), my friends, especially (Mattie, Jackie, Courtney, Delores, Emily, Monica, Glynis, Juanita, Mae Emma, Christy, Terry, Sharon, RaShele, Jettie, Audrey, Rita, Emma, Pat, and Ellen), my pastor (Norman E. Owens, Jr.) and the entire Rhema Church family, my teachers, my past, present and future students, especially (Leigh, Mary, Khalidah, Mya, Kyra, Chacity, India, Rachel, Akilah, LeCreshia, Doneisha, Ametra, Myra, Akila, Rita, Kenisha, Amber, and Victoria) and my thesis prayer warriors.

Acknowledgments

"I can do all things through Christ that strengthens me" Phil 4: 13 "For I know the plans I have for you" declares the Lord "plans to prosper you and not to harm you." Jer. 29:11

There is a host of people that God has allowed to sow into my life as a member of my village that allowed me to complete this momentous journey. It was God from conception to now who has been on my side ordering my steps in Him. Thanks to my mom who introduced me to Him and always told me, "Rona, you can do anything you put your mind to."

It was through my relationship with Jennifer and the Young Scientist Program (YSP) that I heard about the science education doctoral program sponsored by the Center for Inquiry in Science Teaching & Learning (CISTL) funded by a grant facilitated by Dr. William Tate. Thanks to the YSP faculty advisor, Dr. Thomas Woolsey, who made an inquiry, which led to my acceptance into graduate school with a scholarship. This journey led me to solicit my advisor, Dr. Charles Granger and dissertation committee, co- chairs, Dr. Charles Granger and Dr. Gayle Wilkinson, committee members, Dr. Matthew Davis and Dr. Thomas Woolsey. Words cannot express how much your leadership and direction has kept me focused and driven to complete this project. Special thanks to Dr. Judith Cochran for her support at the beginning of this journey and Dr. Matthew Davis for broadening my scope to see how critical race theory has to be included in educating African-American children. Sincere gratitude is extended to the Graduate School, especially Diane Goodwin, Celeste Hazley, Janice Drewel, The Ward E. Barnes Library staff, especially Helen Shaw; The Teaching & Learning Center, especially Dr. Hoagland, Michael Butler and Amber; and the workers in the South campus cafeteria, especially

(Amanda and Alicia) for all of the individualize attention you have provided me on numerous occasions when I needed your support.

Special gratitude to my exit course teacher Dr. Navarro and her recommendation to have a writing partner once her course was over. It was in this class that I met my writing partner, editor, and now friend, Jason Spray. God definitely ordained this relationship because his patience is beyond what a normal person could provide, so it had to be the anointing of the Lord using him. I cannot wait until it is my turn to give back to him when he completes this journey. To all the other professors in the education department at UMSL, I want to thank you for preparing and supporting me through this journey, too.

I also want to thank Dr. William Kyle, the executive director for the National Association for Research in Science Teaching (NARST), for exposing me to all the research opportunities and researchers that are members of NARST. Thank you for introducing me to Dr. Atwater and a host of other African-American science educators from around the world that believe that urban education needs to be reformed to meet the specific needs of our urban and suburban students.

Thank you to Dr. Flint Fowler, director of Boys & Girls Club of Greater St. Louis and facility employees, Liz Johnson and Jason, for all of your phone calls and flexibility in your scheduling to make the Training Future Scientist (TFS) program possible. You will never be forgotten. The challenges we endured during the implementation of the TFS program really did make me strong, so do not feel bad about the rough days.

Finally, I want to thank my children, family, and the McKinley Classical Leadership Academy family. Thanks for the meals you cooked and adjusting the schedule so I could take sabbatical leave to finish and still return to McKinley. Lastly, my prayer warriors for your prayers that allowed me this time to fulfill my dream of receiving my doctorate. My prayer warriors were: (Rita, Debra, Benard, Ben, Valencia, LaTasha, Pat, Jean, Monica, Robert, Vivian, Takesha, Tiffeny, Dani, Desirae, Eddie, Jeffrey, Sharon, Damon, RaShele, Rochelle, Mishon, Delores, Edward, Michael, Alfred, Francis, Beverly, LaTeva, Jason, Michelle, Lisa, Marlene, Trudy, Dean, Silversteen, Charlene, Juanita, Delphine, Emiway, Cherron, James, Jennifer, Rashad, Leigh, Barbara, Connie, Lewis, Thomasina, Danielle, Veronica, Audrey, Amber, Claude, Meaghan, Marttise, Teresa, Jettie, Carl, Cathy, Mattie, Antionette, Maryan, Juanita and Robin). Thanks to all of you for your consistent petitions for favor and grace that are the two attributes from the Father that have given me the strength to finish this journey.

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Chapter 1

Why have I been the only African-American female working in research in this bustling research corridor in the Midwest for more than 20 years? This question has influenced my decision to enter science education and work with students in one of the largest urban school districts in Missouri. I have spent more than fifteen years, training over 1200 urban students, and 55 % of them African-American, 45 % non African-American, ~60 % female and ~40 % male. According to Brick house, N., Lowery, P., & Schultz, K. (2000) females lag behind males in science; however, it has been my experience that females have outperformed males in high school science courses. Gaudin (2013) during a Google+ “Fireside Hangout” talked with President Obama who stated, “We need to have more girls interested in math, science and engineering. We have half the population way underrepresented in those fields. That means we have all talent downstream that is not being encouraged” (Gaudin, 2013, p. 1).

Brickhouse et al. (2000) reported females only take the required science courses and rarely choose non-required courses. This influences how female students view themselves with respect to persons that engage in science. Having a female scientist as a secondary science teacher, I believe, had a huge impact on the outcomes of the female students I taught. How does an identifiable role model factor into this impact? My response would be first by being a role model, then by using the strategies and activities that are effective when working with females. I want to know why there are so few African-American females in science research, even as late as 2013 and how my research and educational journey helps fill this gap.

The research question is, “How might an after-school, informal science learning environment, using peer-led cooperative-learning and role-models, transform the minds and attitudes of urban adolescent females toward high performance on content state assessments and influence their desire to choose a science career?" Some insight into this question began to immerge after taking several graduate courses on critical race theory. My exposure to diverse scholarship on race introduced me to some scholars who had delved into the archives of St. Louis, an urban border city to explain why this geographical area remains mono-cultural. According to Lang (2009), Homer G. Phillips Hospital was the only entity employing black science-related professionals in significant numbers. At the beginning of the 1960s, one in every three African-Americans was either in unskilled work or household service (Lang, 2009, pp. 131-132). In 1948, Mary Stiritz and Carolyn Toft (1948) published an article in the Washington University *St. Louis Star*. The article reported, Homer G. Phillips was one of the country's most prominent hospitals that opened in 1937, to serve the large African-American citizens in this Midwest area. Homer G. Phillips was the only fully equipped hospital that trained African-American doctors, nurses and technicians (Stiritz, M. & Toft, C., 1948).

Unfortunately, Homer G. Phillips closed in 1979, the year this researcher graduated from high school. When I first entered college, my initial major was pre-medicine, with the hopes of becoming a pediatrician. After four years of struggling in science courses that I was not prepared to take, because of the inferior preparation I received in urban education, I finished my undergraduate program, majoring in biology. Since Homer G. Phillips was closed when I finished college in 1983, I applied to work at Washington University in clinical chemistry. This position was not long-lived because of racial inequalities among the workers in the laboratory. I transferred into research science because this job was just like the labs in college, minus the tests. At that time, Washington University and St. Louis University Medical Schools were both mono-cultural labs that only hired unskilled African-Americans as housekeepers, glassware preparers or phlebotomists. In both of these labs, I was the first African-American female research scientist hired with a four-year degree in 1983 and St. Louis University in 1989 and 2010. Since I was always the only African-American female researcher in every lab I worked in, for approximately eighteen years, I felt that I was the right female to lead more African-American females toward a profession that would be in high demand in the future.

Anne Cooper (1998) in her revised chapter says, “The only sane education for urban students is one that trains their mind, body and spirit” (Cooper, 1998, p. 250). Ratteray (1994) reported the problem with the education for African-American students is the lack of access to educational opportunities and the quality of accessible schools. Even now, urban education has these same concerns. If the schools’ urban African-American students do not meet the science educational requirements to produce future scientists, we need informal settings as another route for students to experience and open for their families to choose. Ferreira (2002) cited the publication *A Nation at Risk* (1983) and *Science for All American Project 2061* as two landmark publications that stress equity in science education as their core. Allen (1998) states in an excerpt from a more recent report, *A Nation “Still” at Risk*: An Education Manifesto:

> A dual system, separate and unequal, is being created, almost 50 years after it was declared unconstitutional. Equal educational opportunity is the next great civil rights issue. This means true equality comes from providing every child with a first-rate elementary and secondary education and the development of human potential that comes from meeting intellectual, social and spiritual challenges. (p. 6)

Recently I read *Black Teachers on Teaching* (Foster, 1997). This book was composed of interviews from three different types of teachers: elders, veterans and novices. The elders had taught for more than 40 years, the veterans from 15 to 25 years, and the novice teachers had less than five years experience in the classroom. As a veteran teacher, I related to the interview of a Mrs. Mabel Bettie Moss, a teacher from Philadelphia, who said,

> Most teachers do not appreciate black children and their strengths. Black kids are creative, inquisitive, and bright. That is the best word to describe them…in, so many instances school is just so boring and unrelated to their everyday lives. Occasionally when I have gone into other teachers' rooms, and seen what is going on, I have realized how awful it would be to have to be a student in that classroom. Too many teachers make learning boring. (Foster, 1997, p. xlv)

These words from Mrs. Moss gave me inkling as to why most of the females under my leadership had been so successful; my classes were not boring and my classroom was full of love, emotional, physical and spiritual support. Every year, I tell my students, "My goal is to meet individual student needs". Most of the students were shocked by my response and required a more detailed explanation. I continue by telling them how I had a substitute teacher when I was in the eighth grade science that flirted with the males the whole year, but taught us no science. Secondly, I did not have a real science class with a knowledgeable teacher until I was in the tenth grade, which made me ill prepared when I entered college. These experiences have been the key catalysts for making sure I design an eighth grade science curriculum that my students never forget. The skills and processes I teach them can be a springboard for their future, no matter their career path.

Lastly, I have always told all my students how much I care and believe in them, which aligns with Maslow's Hierarchy of Needs philosophy (Maslow, 1971). Catering to the affective domain of urban African-American students along with teaching in the student's zone of proximal development, espoused by Lev Vygotsky in his sociocultural theory (1978) has been a positive instructional match, especially since adolescence learning is essentially social. As I began my research, I learned about Lev Vygotsky's sociocultural learning theory, cooperative-learning and peer-led instruction were some of the practices outlined under the constructivist-teaching model. Johnson, Johnson and Holubec (2008), Ferreira (2002), and many others support the methodology because constructivist-based learning influences student learning in science. In fact, Johnson, Johnson and Roseth (2010) published numerous longitudinal studies on cooperative-learning which indicates that the most important peer-learning program is cooperative learning.

This information prompted me to draft a brief survey for some of my past students from 1997 – 2011. I contacted some of these students via Internet, Face book and in person by visiting their area high schools. There were four main objectives: whether the instructional strategies I taught them transferred to other subjects; secondly, how they have used the skills and practices that were taught to them after they left my leadership; third, what are their career choices; and finally what did they plan to major in college. The responses from these former science students were overwhelming. The evaluation of their responses is included in chapter 4. Below I offer a glimpse into the minds and hearts of a few of my female students, illustrating the impact my methodology had on their lives. The first young woman was my student from my second year of teaching, over ten years ago, I called her Leslie (pseudonym):

> Growing up, I had, unfortunately, concluded that math and science were always areas that were off limits to African Americans and females… Not only was my

> teacher incredibly smart, she was a woman, and she was African American… I went from thinking science was off limits to being selected to participate in Saint Louis University's Math and Science Upward Bound High School Summer Academy. I was chosen also to participate in a high school pharmacy program with the Saint Louis College of Pharmacy and Walgreens. While in college, I interned with the Washington D.C. Police Department Crime Scene Investigation Unit and helped to process forensic evidence for rape cases and homicides. I was a student in Mrs. Hill's classroom in 1999, and now it is 2012; I have one high school diploma, two Bachelor degrees, a Masters degree, and a PhD later; and I am still seeking out her leadership and guidance. (AL, 2012)

Another student from ten years ago, Mary, (pseudonym) reported:

> She was very educated in the field of science, and I have forever embedded in my mind "the double helix" because of her. I can honestly say I have always been a math and English kind of girl, never taking to science as a passion. Because I have had Ms. Hill as a science educator in my life, my high school years were less stressful in that field. She built the foundation for the knowledge of science, which let me to a 26 or 21 (forgive my memory) score in the science section on my American College Test, or ACT…(TM, 2012)

The following is from a young woman that was my student less than six years ago, named Alice (pseudonym). She said:

> You definitely showed me, that as a female and minority, I was able to succeed choosing the major that I am in, furthermore, at a predominantly white institution… I am double majoring in Civil Engineering and Human Right Studies at the University of Dayton in Ohio! (HA, 2012)

Testimonies such as these are what keeps me in the classroom and motivates me to share my passion for science with my students. My approach appears to be making a difference in the decision of female students regarding the choice of Science, Technology, Engineering and Math (STEM) career pathways.

Johnson *et al*. (2010) indicates that cooperation promotes greater efforts to achieve, more positive relationships, and greater psychological health than do competitive or individualistic efforts. In middle school, the quality of peer relationships accounts for 33 % to 40 % of the variance in achievement of these students (Johnson et al., 2010). Rennie and Parker (1997) discuss the pedagogic approaches that are more "gender inclusive" which are cooperative learning groups, hands-on and minds-on activities, access to role models and mentors. In 2011, I duplicated Gafney and Varma-Nelson's (2007) model using peer-led team learning (PLTL) to support my struggling students. I created a similar program that utilized gender-specific 8th grade peer leaders, working in peer-led cooperative-learning groups that mentored struggling 8th grade male and female students. This program allowed the struggling students to ask questions, define and change misconceptions and incorporate some new learning practices. Lev Vygotsky's sociocultural theory model was used to emphasize that learning is essentially social. It also revealed there is a gap between learning outcomes produced in isolation and those produced with careful guidance targeting individuals' zone of proximal development.

Theoretical Frame

The theoretical framework is constructivism and problem-based learning. This framework was chosen because the theory indicates what "knowing" is and how students come to construct new knowledge. Bambach (2000) stated many constructivists believe that the learner creates their own knowledge by combining the new knowledge with the prior knowledge he or she brings to the learning environment. With so many students coming into the classroom today with a variety of skill sets and prior knowledge, I thought why not allow similar age peers that are successful in science help break down these students learning barriers. According to Park and Oliver (2009), knowledge is not discovered but constructed within individual minds through social interactions. Having confidence in cooperative learning, I used this approach as a strategy to implement using peer leaders with this age group in this new program.

Since standardized testing is required as middle-school students' transition to high school, I decided to design an after-school enrichment program for females called Training Future Scientist (TFS) with a science standardized test preparation focus. The quantitative and qualitative research questions to guide this study were: 1) What effect does female participation in the TFS after-school program with a peer leader working in cooperative-learning groups has on learning science content? 2) What effect does female participation in the TFS after-school program with a peer leader working in cooperative-learning groups have on their affective domain, namely attitude toward science and self-perception? 3) What effect does female participation in the TFS after-school program with a peer leader working in cooperative-learning groups have on her career choice?

The hypotheses for this study were: H_1: The female students that participate in the TFS after-school program with a peer leader working in cooperative-learning groups did have an increase in their science content knowledge. H_2: The female students that participate in the TFS after-school program with a peer leader working in cooperative-learning groups did have a change in attitude toward science. H_3: The female students that participate in the TFS after-school program with a peer leader working in cooperative-learning groups did consider science careers.

The TFS program allowed these students to interact with role models and peer leaders as well as to participate in hands-on, minds-on activities. The instruction was guided by the Buckle-down Curriculum, a variety of cooperative-learning strategies and grade level expectations (GLEs) set forth by the state department of education. The students hopefully recognized the passion and love my research support staff and I had for science and why it was so important for us to share our passion with all of them.

Significance of this Study

The United States economy is dependent on citizenry that is scientifically informed and trained with the technical skills within the field of science, technology, engineering and math (STEM) in order for economic growth. In order to obtain a scientific literate citizenry, females need access and exposure to authentic opportunities to meet young scientists of their likeness working in the STEM career pipeline. Since I have had such a huge success with the females in my regular urban classroom, I decided to package what I do in the classroom and present the model in an urban community, after-school program.

The TFS program was established in St. Louis, Missouri, a large, urban border state that ran for five weeks. There was one peer-leader for every 3-4 female students. The peer leaders were past 8th grade students who are currently high school freshmen, sophomores and one senior attending public and private schools. The researcher chose these students as peer leaders because they were already experienced in this role from participating in a similar program in the 8th grade at an urban gifted middle school. The role models and mentors were volunteers from Washington University Medical School. They typically facilitated hands-on labs and science inquiry activities in urban and suburban schools and community venues during the regular school day and after-school programs.

Delimitations

The scope of this study was limited to one after-school program that served female adolescents ranging in age from 11 to 15. All of the female students volunteered to participate in this enrichment program offered at Boys & Girls Club of Great St. Louis (BGCGSTL) because they wanted the extra support for their spring standardized science assessments. The peer leaders were experienced in this role because they participated in a similar after-school program during 8^{th} grade. Lastly, the program was implemented at an after-school facility instead of a regular school setting after-school program.

Limitations

The female students that participated in the TFS program were only a sample representation of the female students that are members of BGCGSTL. The period for the TFS program was five weeks, instead of a full school semester. Attrition was another limitation of the participants, especially since this program was not mandatory, and was the only academic enrichment program at the facility from 5-7 p.m. The difference between the TFS program and the other after-school programs these peer leaders served in during their 8^{th} grade year was the peer leaders were mentoring their peers, and now the peer leaders mentored females they might not know.

Assumptions

The participants in this study answered all of the survey questions, pre and posttests, and semi-structured interview questions openly and honestly. The participants also attended and participated in the activities and treated the peer leaders and role models with respect. The participants were distracted by the competition to participate in non-academic programs.

Definition of terms:

Peer leaders: These students consistently earned 85 % or higher on summative and formative assessments; they interacted and answered questions from their peers about current content they had mastered and facilitated instruction in small cooperative-learning groups.

Grade Level Expectations (GLEs): These are the curriculum requirements that each student should know or be able to do by the end of each grade from K-12 in math, English, science and social studies.

Constructivist Learning Theory: A theory to explain how knowledge is constructed in the human being when information comes into contact with existing knowledge that had been developed by experiences.

Jigsaw group: A cooperative-learning strategy that allows each student to learn a specific aspect of a lesson with 4-5 students, called an expert group. Once these students were comfortable teaching the content assigned, students created a poster or notes to share with another group of 4-5 students, where each student shared the different information they learned in their expert group with the new jigsaw group.

Abbreviations

TFS: Training Future Scientist Program

BGCGSTL: Boys & Girls Club of Greater St. Louis

GS: Graduate students

P: Participants PL: Peer leaders PI: Principle investigator

STEM: Science, Technology, Engineering & Mathematics

Organization of the Remaining Chapters

The remainder of this study is organized into five additional chapters, references and appendices. Chapter 2 is a review of the literature that discusses the changes future educators need to make in order to reach the urban students of today; and, the benefits of struggling students participating in an after-school program working with peer-leaders in cooperative-learning groups. Chapter 3 explains the details of the research design and methodology. This chapter includes the instruments used to collect and analyze the data, the procedures followed and the participant selection process in this study. Chapter 4, titled, "At Home with Mrs. Hill" reveals my "secrets to success" with a peek into the life of my science classroom. This chapter reflects on what my students and I experience during a typical school year when I was a middle-school science instructor; in addition, the analyzed results from my past students' survey answers. The analysis of the data is presented in chapter 5. Chapter 6 contains s discussion of the findings from the current study, a summary of the entire study, implications for practice and recommendations for future studies.

Conclusion

According to the research, Ferreira (2002) and many others references after-school programs can help close the achievement gap and are an essential component in supporting the efforts of the school system in teaching and motivating females to pursue the science career track. Females need opportunities to work with peer-leaders and role models, using hands-on, minds-on activities in cooperative-learning groups and opportunities to ask questions in environments that are "gender inclusive." These rich settings have the potential to produce positive results for most females. I wanted to know the affect the TFS after-school enrichment program had on a female adolescent's outcome in science, regardless of her exposure or lack of exposure in her regular science classroom.

Chapter Two: Review of Related Literature

Constructivism in After-school programs

Constructivism has been extensively studied yet a clear concise definition of the term has not yet reached consensus by researchers. Hyslop-Margison and Strobel (2008), as well as Simpson (2002) feel that constructivism should not be labeled a theory but an epistemology or philosophical explanation about the nature of learning. Their argument is based on the definition of a theory, which states that a theory is a scientifically valid explanation for learning that allows hypotheses to be generated and tested. Seimears, C. M., Graves, E., Schroyer, M. G., and Staver, J. (2012) and Berlin (2012) have assembled an edited collection of previous studies using the philosophy of constructivism to improve adolescent achievement in an informal setting. Constructivism was the theoretical framework for this study. This study investigated a female only after-school program, using peer-led cooperative-learning groups and role models to increase the adolescents' science content knowledge, attitudes about science and possibly influence them to choose a science career.

Constructivism: Introduction

The education of African-Americans has been profoundly shaped throughout history by two major conditions: access to educational opportunities and accessible teaching methods. In 1996, The National Research Council (NCR) reported that current US science education reform needed to move to more constructivist practices instead of passive ones. Wheatley (1991) defined constructivism as a learning theory that promotes active learning that is constructed versus passive instruction. Passive instruction views the student as a receptacle and the teacher as a pitcher with all the information to fill this receptacle. Even though there is a plethora of models related to constructivism, the basic tenet of constructivism views the teacher as a facilitator. The students, on the other hand, are actively constructing their own understanding based on how they connect the new information to their prior knowledge and how "peers, do it". This phenomenon not only produces students that are motivated to achieve and learn, but students that can see themselves in science careers because of the successes they have had in the classroom or after-school programs.

Constructivism Characteristics

Seimears et al. (2012) reported that constructivism has many names, such as constructivist epistemology or simply constructivism. Both versions contend that the learner actively constructs his or her own knowledge. The benefit of constructing this knowledge is a lifelong process that can be done anytime, within any discipline. The construction of knowledge always makes sense to the individuals because it helps them interpret and predict events in their learning environment (Seimears, C.M., Graves, E., Schroyer, M.G., Staver, J., and Savasci, F., 2012).

Phillips (2000) stated that constructivism is a theory of "knowing" which has strong roots in anthropology, education and philosophy. Cobb and Bowers (1999) also reported that learners do not just view knowledge as the truth because constructivists compare the new knowledge to hypotheses already established in their prior knowledge reservoir. Bruning et al. (2004), Moshman (1982) and Phillips (1995) all agree that constructivism is not a single viewpoint, but rather three different constructivism perspectives: exogenous, endogenous and dialectical.

According to these researchers, exogenous constructivism refers to the construction of new knowledge from the information in the external world. The external forces that influence this construction are the student's experiences with teaching and models. Bruning et al. (2004) explained that endogenous constructivism uses mental structures from earlier structures, not necessarily from the environment. The last perspective, dialectical constructivism, is knowledge constructed from the interactions between peers and/or teachers and the environment. This perspective removes the boundaries of relying only on the resources from the environment and information from the teacher. Dialectical constructivism provides students the opportunity to reflect on the mental contradictions or misconceptions they may have because now they have access to the resources of their peers to integrate with their prior knowledge. This perspective is also compatible to Bandura's (1986) social cognitive theory and many motivation theories.

Bandura (1977) stated that an effective way for learners to learn is to allow them to observe the behavior first as they participate in the environment. Additional attributes that assist learners from the environment is access to models or role models that are similar to them in appearance, positive internal and external reinforcement and a variety of examples of persons in the environment benefitting from the resources available in this environment (McLeod, 2011). Bandura (1977) identified three core concepts in social learning. He believed that a person could learn from observations because he or she is able to observe a live model, a verbal instructional model or symbolic model. Each model provides a person specific instructions and/or explanations of what the person is suppose to duplicate or replicate. The second core concept in social learning is the individual's mental state when learning is being implemented. Both types of reinforcements are necessary for true learning to occur. Bandura (1977) believed that internal reinforcement such as pride, satisfaction and a sense of accomplishment, could make a greater difference than just providing an individual external reinforcement. The key to effective external reinforcement has to be something the individual can use or benefit from in order to influence learning. Focusing the reinforcement on internal factors helps the learner connect the information they already know, which is also discussed in the Naturalist Educational Theory (NET) established by Granger (1998). The third core concept in social learning is to realize that learning does not necessarily lead to a change in behavior. In order for the modeling process to be complete a person must pay attention, experience retention, perform a task or act that allows them to reproduce what they learned based on information retained and finally the motivation to imitate the behavior that was just modeled (Bandura, 1997).

The Naturalist Education Theory (NET) substantiates teaching inner city or urban students because it allows learners to scaffold the prior knowledge they learn in the home and/or community where they live. NET explained how the total mental construct is fueled by the intellectual energy our prior knowledge and new experiences create to form an interconnectedness between this information. These connections are engineered by design, not stumbled upon by trial and error. This statement reminded me of how I learn a new person’s name. I conscientiously connect the name to someone I know with the same name in order for me to remember this new information. If I do not mentally complete the entire process, I do not remember the new person’s name, not even five minutes later. This is an example of a NET construct I can teach my students to use when they are trying to remember some new and sophisticated science concepts. These interactions then create different NET formations for each individual person based on their prior knowledge and experiences. Granger (1998) posits that the more experiences a person has and the more prior knowledge available will make it easier for new information to be integrated into their working knowledge.

Granger (1998) reported the importance of combining the new information properly with the original information. If the original information is not laid down correctly then, when a person attempts to add the new information, misconceptions can occur. This reminded me about how I teach using analogies in order to help students identify a frame of reference for new information.

Granger (1998) stated, “Science is a natural behavior, essential for survival and the engine for other constructs” (p. 7). I definitely agree with this statement because the mathematical skills I teach my students in science are skills they can also use in math. The writing skills I teach my students can support the writing expectations in language arts and other writing courses. We both agree that science is the essence of our cognitive structure, both knowledge and process (Granger, 1998).

Finally, Granger (1998) believes the responsibility of providing each individual, in society, with the basics for development of a complete basic mental framework during the critical, early formative years is on the shoulders of society and the educational system. I feel the family should take on some of this responsibility, too, because these infants have genes that influence the learning process as well. Granger discusses what happens in the brains of these infants that educators need to consider and share with the family and community. He said,

> The total construct continued to become complex if intellectual energy expended to form interconnections between existing mental constructs and new experiences. The outermost bytes of the cognitive structure are liable to erosion to the highest degree, because there are fewer interconnections or stabilizing factors associated

> with them. The innermost bytes form the cognitive core of the spiral lattice that is saturated with interconnecting ideas and process and therefore the most stable. The older the concept in the mental construct, therefore the more interconnections and the more stable the byte, in general the last information goes off first. The more frequent and current the reinforcement the more resistant the decay. This erosion can be initiated by lack of maintenance, electro-physical factors, aging, the incorporation of misconceptions, or a combination of these factors. Misconceptions are a problem in building the lattice, because they partially fit and interconnect with their existing cognitive structures. Misconceptions reduce efficiency and effectiveness of the overall learning process and speeds up the cognitive decay process. The NET model respects the brain's rules for meaningful and lasting learning and demands that organizing the processes of pedagogy should be based on these rules. (Granger, 1998, p. 9-10)

Constructivism Summary

To summarize, constructivism in after-school programs and/or in the regular classroom fosters deeper understanding in adolescents. Science education programs need to be equitable for all students and teachers, regardless of where they live in the U.S. Using the constructivist model, which is aligned with Lev Vygotsky's (1978) notions of dialogic, allows learners to connect new information presented with their prior knowledge, which individuals bring to the learning environment. This idea coincides with Granger's NET. The three perspectives of constructivism, exogenous, endogenous, and dialectical, ensure that all students, regardless of their limited environmental access, can still learn through interactions with their peers and teachers. This model investigated many of the attributes of Bandura's Social Learning Theory by observing how attention, retention, reproduction and motivation influenced the participants overall performance.

Vygotsky's Sociocultural Theory

Introduction

Vygotsky's sociocultural theory of human learning describes learning as a social process and the origination of human intelligence in society or culture. Freire (1970), an educator for critical consciousness, stated in his book the *Pedagogy of the Oppressed* that,

> Education is suffering from narration sickness. Students are not just empty containers waiting for teachers to come and fill them. Knowledge emerges only through invention and re-invention, through the restless, impatient, continuing, hopeful inquiry human beings pursue in the world, with the world and with one another. (p.100)

Characteristics of Vygotsky's Sociocultural Theory

Vygotsky's theoretical framework is that social interaction plays a fundamental role in the development of cognition. He believes that all learning is perceived on two levels. The first level is interaction with others, which leads to the integration into the individual's mental structure. The second level, which includes the "zone of proximal development," determines a person's cognitive development. In order for a person to reach his or her fullest potential, help and social interaction with a teacher or knowledgeable and experienced peer is necessary. The scaffolding to support the learners' understanding gradually develops their knowledge domain. The development of more complex skills is facilitated during peer-to-peer interactions and during cooperative-learning activities (Vygotsky, 1978).

Rohrkemper (1989) indicated that Vygotsky places a strong emphasis on the learner having access to rich social environments to increase their development and skill set. Lev Vygotsky contends since humans are unlike animals, that can only react to their environment, they have the capability to alter their environment for their own purposes. This social mediation attribute, which is only common in humans, makes it possible for humans to learn while observing the role consciousness plays for humans that are in collaboration with teachers and experienced peers (Rohrkemper, 1989).

Trudge and Scrims (2003) cited in recent years that Vygotsky's influence has increased in the disciplines of education, psychology and linguistics. Vygotsky's theory stresses the three main factors that influence human development. The three influences are: a) interpersonal or social, b) cultural-historical and c) individual. The learner must interact with experienced individuals in a rich environment in order for the interpersonal factor to emerge. This interaction reorganizes the learner's mental structures. Without this interaction, transformation will not occur in one's own knowledge. The cultural-historical influence states that learning and development cannot be disassociated from their context. In order to increase this factor, learners' cultural-historical exposure needs to be rich and active to increase the learners' prior knowledge context. The individual's influence is based on the inherited factors that learners receive from their parents. Vygotsky believed these learning trajectories are different for each learner because it is dependent on the mental and physical capabilities of the learner's genetics. Of the three influences, the interpersonal factor is the one that received the most attention amongst Western researchers (Tudge & Scrimsher, 2003).

Interpersonal or social activity is a phenomenon that explains the changes that occur in the conscious and then establishes a psychological theory that connects the behavior with the mind (Kozulin, 1986; Wertsch, 1985). The social environment influences cognition because of the tools or cultural objects, language and social institutions to which a learner has access. The social interactions help coordinate the three influences on development by causing cognitive changes due to internalizing and mentally transforming these interactions (Bruning, et al., 2004). This philosophy of

Vygotsky (1962) coincides with dialectical (cognitive) constructivism, which emphasizes the interaction between learners using social or private speech or their environment.

Zone of Proximal Development

Vygotsky (1978) identified the zone of proximal development as the key concept in understanding the theory.

> He defines the zone as the distance between the actual developmental level as determined by independent problem solving and the level of potential development through problem solving under adult guidance or in collaboration with more capable peers (p. 86).

Another group of researchers called this zone the level of potential a learner has when provided access to proper instruction either from a teacher or an experienced peer (Puntambekar and Hubscher, 2005). Bredo (1997) identified this region as a learner's developmental readiness in a specific domain. Bruner (1984) stated a learner's zone of proximal development allows the learner to work on a difficult task as long as the teacher and/or experienced peer works with them. Therefore, the learner gleans knowledge and skills from the individual with more knowledge to accomplish the task.

Summary of Vygotsky's Sociocultural Theory

Vygotsky believed that a learner's interaction with a teacher, experienced peer and a rich environment assists learning by providing these learners with opportunities, which can greatly broaden their zone of proximal development and influenced the outcomes of these learners and other learners. This leads to the third topic of discussion, using peer-leaders in cooperative learning groups to develop Vygotsky's sociocultural theory.

Peer led, Cooperative Learning

Peer led, Cooperative Learning: Introduction

Smith (2009) said,

> Our society cannot continue providing inner-city students with an inferior education. We have a responsibility to provide every child with an equal, quality education, regardless of whether the child is a white boy or a black girl, regardless to whether the child lives in a rundown home in the inner city or a pristine mansion in the suburbs. With a quality education, every child can have the same chance of pursuing happiness and realizing the American dream. Not only did this make for more successful individuals, but it also resulted in a stronger country. Hopefully, the Midwest can once again be home to a landmark moment in the struggle for racial equality, this time by providing all students with a quality education. (p. 1169)

One model that has been very effective with middle school students is using peer-led cooperative learning groups in regular classrooms and/or after-school programs to improve the educational experiences to which these students are exposed.

Characteristics of Peer led, Cooperative Learning

Peer learning involves activities in which students work together with peer leaders to increase their knowledge or successfully complete assignments. Peer-leaders serve as role models and score well on the assessments, and they demonstrate fluent communication and leadership skills. Middle school is an ideal academic level to promote and implement peer learning. Keill (1969) reported that this theory could be applied in collaborative learning, peer tutoring, cross-age tutoring, learning communities, peer-assisted learning, and team-based learning. Each one of these strategies illustrates effective methods to improve academic achievement. In a literature review, Parker and Asher (1987) concluded that the quality of students' relationships with peers is linked to academic performance. Wentzel (1996) reported students who behave cooperatively with others tend to excel academically and gain acceptance from their peers more so than those students who do not participate in the process.

Numerous longitudinal studies by the Johnson research team (2010) indicate that the most effective peer-learning program is cooperative learning. Their research indicates that cooperation promotes greater efforts to achieve, positive relationships, and greater psychological health than do competitive or individualistic efforts. For middle school students, the quality of peer relationships explains 33 – 40 percent of the variance in achievement of these students (Johnson et al., 2010). Gafney and Varma-Nelson (2007) used peer-led team learning (PLTL) with undergraduates in Chemistry and discussed the long-term effects of peer-led team learning. Their study linked the use of trained peer-leaders with small group work and integrated these strategies into the structure of the course (Gafney & Varma-Nelson, 2007).

Fuchs et al. (1997), defined peer tutoring as another strategy that provides struggling students an opportunity to ask questions that they would avoid asking during whole class instruction. There is significant evidence that peer tutoring produces achievement gains when compared to traditional learning environments (Fuchs, Fuchs, Mathes, & Simmons, 1997). Gijlers and de Jong (2005) performed a study with adolescents age 15-16 and reported a relationship between a student's prior knowledge and ability to participate in collaborative discovery learning processes. These researchers reported, in their qualitative analysis, results pertaining to how important it is for the high-achieving student to sufficiently scaffold the lower-achieving student and make sure they are working in the student's zone of proximal development (Gijlers & de Jong, 2005). Mualem and Eylon (2007) also examined how using qualitative strategies successfully led junior high-school physics students to problem solve with mastery. These researchers felt the three main factors to breaking the learning barrier for these students were the learning materials, the teacher's physics knowledge, and the need to separate and control the variables in the learning environment (Mualem & Eylon, 2007).

In order for this model to work successfully, teachers have to train the peer tutors to ensure they have the prerequisites and patience to work with a specific age group of students in an after-school setting. In this study, they defined supplemental instruction (SI) as a student academic assistance program that increases academic performance and retention through its structured use of collaborative learning strategies (Martin, Blanc & Arendale, 1977). The Martin, et al., (1977) research group discussed how supplemental instruction could support the classroom experience.

The peer-assistance model has been used to improve teacher practice. Ferlazzo (2013) reports teachers need to be exposed to situations to promote a philosophy of being a life-long learner. He thought who would be the best candidates to teach teachers, but other experienced, expert teachers. This model is the basis for the peer assistance and review (PAR) program implemented by the American Federation of Teachers, which has shown to be very successful in fostering ongoing professional improvement and growth for teachers. Some of the attributes of the PAR program are: 1) it helps new teachers escape the "sink-or-swim" approach which improves retention in the teaching profession; 2) it provides guidance and support from expert colleagues for struggling and/or inexperienced teachers as they attempt to master a very complex endeavor; 3) it identifies and provides an out for the teachers who are not suited for the profession early in the process; and 4) lastly it aides in retention of good teachers that might get driven out by frustration or isolation without the support of this program (Ferlazzo, 2013).

The second half of the program is the peer review focus, which yields a positive impact on the school culture and climate that produce teachers that demonstrate professionalism. Instead of teachers feeling isolated, they have a vehicle to improve their practice and support their colleagues all at the same time. This model is very effective because now they own the quality of their development, instead of being told what to do by professionals with limited to no classroom experience. This reduces resentment among the staff and builds highly collaborative relationships between the teachers and administrators. “The reality is that school systems have a responsibility to invest in high-quality teaching: they cannot afford not to address the educational and economic cost of rampant teacher turnover” (Ferlazzo, 2013).

Summary of Peer led, Cooperative Learning

Classrooms have many students with a variety of different skill levels, thus allowing peers to help would prove to be more successful for all involved. According to Park and Oliver (2009), “knowledge is not discovered, but constructed within an individual’s mind through social interactions.” (p. 333). They also reported that it can occur either in a typical classroom or in a structured after-school program. The pressures invoked on regular classroom teachers are increasing while the instructional time is decreasing and being interrupted. Some students must rely on after-school programs as a supplement to the academic instruction they receive in their traditional classrooms. Therefore, the benefits and attributes of after-school programs were discussed.

Role Models in Science

Introduction to Role Models in Science

Several researchers have decided to provide female students access to work with role models in STEM careers. Role models can have a positive impact on females and improve their attitude toward science, which is vital for influencing females to choose science careers in their future. Some researchers feel using role models is a recipe for success, especially when working with females, because this model can shape a girl's academic and career path.

Characteristics of Role Models

Kekelis et al. (2005) called their research program with role models as a "Recipe for Success" These researchers collected data from role models, students, and teachers and was able to develop the seven ingredients for a successful program using role models. The seven ingredients for success when using role models are: 1) Be personal and passionate about your career; 2) Introduce fun and interactive activities; 3) Do some public relations about why science matters; 4) Share your struggles and how you gained confidence; 5) Fill a gap with academic and career guidance; 6) Facilitate work site visits; and 7) Training and support are essential.

These researchers collected data from the over 700 participants in the Techbridge program in Northern California. The Techbridge program was hosted in 12 schools in this region and a co-educational program at the California School for the Blind. The sampling method was not very detailed, but the researchers did discover that the girls with a female science and/or technology family member had a higher chance of choosing a profession in science and/or technology. The students that did not have this internal access, (a female family member that chose science and/or technology career path), even though they loved the “hands-on” activities still did not chose science as a career (Kekelis et al., 2005).

Information from these researchers is important because they discuss how to successfully implement role models in a science and technology after-school program. These researchers outlined in detail the seven principles an effective program should have, so I feel sharing this article with my role models benefitted them and offered them some direction on what the girls in my program might need. The role models I used have had some very positive outcomes as my students from the past, but since this is a very experiential environment, I wanted to see what attributes this type of program needed to be successful.

Weber (2011) addressed how exposing females to in-formal STEM related activities, utilizing role models, could positively influence female interest in STEM. This research shared the same passion I have for the influence of role models in science on adolescent females. Weber’s program included a culminating event to bring closure to the experience. This program was short-term compared to the program that was intended to be implemented. The research question was: How would an opportunity to engage and inspire middle school girls to explore the world of STEM careers influence their interest in pursuing a career in an engineering-related field change? The program involved two “Girls’ Nights Out” at the California Middle School, allowing the girls to rotate through four hands-on activities, and a culminating event for students and parents. The theoretical or philosophical perspective was constructivism using cooperative-learning, hands-on activities allowing the facilitators to teach through inquiry.

The methods used to answer the research question were pre and post activity surveys. The pre survey was completed before the first "Girls Night Out" and the post survey was completed one week following the culminating activity. The participants in this program were 58 female middle-school students, several female college students from the Forensics Club, faculty and alumni. My program used role models from Washington University Medical School, not just engineers though, but scientists from a variety of disciplines. Each evening contained hands-on crime scene investigations and other science related activities that were developed by the California University Forensics Club. The goal was to connect what the students were learning in school to science, technology and engineering. At the culminating event, the parents were presented information about the outlook and need for diversity in the STEM workforce; how to continue to encourage their daughters to pursue interests in STEM areas; scholarship opportunities; and other STEM programs at the university. The researchers reported that the students' career goals and plans for enrolling in STEM-related course changed because of their participation in the project. They did not document any science content knowledge changes, but this was not the aim for their initial problem statement (Weber, 2011).

Summary of Role Models in Science

Some conceptual frameworks that emerged from these studies are the importance of providing underrepresented females access as well as opportunities to build their confidence to pursue STEM careers using role models. One effective strategy to ensure these females do not fall through the cracks is to provide these students informal as well as formal STEM-related learning opportunities. Both of these researchers provided some valuable information supporting the benefits of using STEM role models as well as peer leaders in after-school programs.

After-School Programs

Introduction to After-School Programs

Providing equitable opportunities for all students should be the goal for all schools and school districts. Even though nationally the focus is to increase the number of females in STEM career (Hill, C., Corbett, C. and Rose, A., 2010), The President's Council of Advisors on Science and Technology (2001)reported the lack of females in STEM careers is multifaceted. Ferreira (2002) and so many others believed that participation in after-school programs is a way to help close the achievement gap by ethnicity and gender. According to their research, these programs strive to produce structured educational programs that cater to the needs of females by providing them access to inquiry activities using cooperative-learning groups and peer leaders (Ferreira, 2002).

Characteristics of After-School Programs

Brickhouse et al. (2000) mentioned that girls are alienated from science in many traditional schools. Perhaps, since the traditional schools are failing to reach these female students in the traditional classroom, having after-school programs have to take up the mantle to expose our females to science. That extra time provides them access to authentic, structured and inquiry-based hands-on experiences. Previously mentioned in this dissertation, several studies have seen positive results using after-school programs. Some of the key components needed for the program to be effective are facilitation by experienced teachers and/or peer leaders;, interaction with role models that are scientists, technologists, engineers and mathematicians also known as STEM representatives, access to materials and strategies that promote inquiry and hands-on lab experiences to increase science content knowledge, and opportunities for reflection and evaluation to document attitudinal and career changes (Brickhouse et. al, 2000).

According to Jones, Mullis, Raizen, Weiss and Weston (1992), during the eighth grade 64 % of females liked science when compared to 72 % of males, and by senior year only 57 % of females liked science compared to 74 % of males (Jones et al, 1992). Bruschi and Anderson (1994) also saw a gender difference in attitude as the students got older, which eventually reflected in their academic achievement. Even though the gender differences were very small when the learners were age nine, by the time these learners were 13 to 17, males outperformed the females. In addition, the Caucasian learners were outperforming both the Hispanic and African-American learners at each age level (Bruschi and Anderson, 1994).

Several other researchers have found a strong correlation between learner's attitude about science and achievement in science. Weinburgh (1995) performed a meta-analysis on some research studies conducted in 1970 and 1991, which identified a high correlation between attitude and achievement for low performing African-American females. He concluded that if female students are exposed to positive experiences in science, then they would usually yield high academic achievement. Farenga and Joyce (1998) and Catsambia (1995) also reached the same conclusion and reported these experiences could influence these females' future career aspirations.

Ferreira (2002) designed an after-school program that utilized equitable teaching strategies that favored female success using role models that were engineers. She used a case study approach, as outlined by Merriam, (1998) to see if she could shift the learners' attitudes about science, technology, engineering and math. The program was implemented after-school in an urban middle school math classroom, for seven months, two times per week. The math teacher served as the liaison between the school and the program facilitators. Eighteen African-American female students in middle school and seven engineers participated in the study. The five of the seven engineers were African-American. These engineers served as mentors and role models for the female participants. The outcomes of the program were 78.5 % of the females that participated in the program decided, "Science is easy for me" compared to 58.8 % at the beginning of the program. Another huge gain was the response to the statement "I would like to be an engineer someday;" the pre-survey reported only 52.9 %, while the post survey reported 78.6 %, a gain of over 20 percent (Ferreira, 2002).

This program's curriculum, which was published by American Association for the Advancement of Science (1990), fostered the science reform initiatives from the National Science Education Standards and Science for All Americans (AAAS, 1990). The National Research Council (1996) reported that science is not done to a learner, but science is something that a learner participates in during "hands-on, minds-on" activities that are combined with their prior knowledge to construct new knowledge. These experiences produce an increase in problem-solving skills and self-confidence in science, math and language arts (Sitman, Bruce, May, McConaghy, & Nolt, 1997). Another group of researchers reported that exposing learners to these activities fostered positive attitudes toward science and promoted the choice of science careers (Bartsch, I., Snow, E., & Bell, S., 1998; Lee-Pearce, M. L., Plowman, T. S., & Touchstone, D., 1998; Tyler-Wood, Cass & Potter, 1997).

The Clearinghouse on Women's Issues (CWI's) (2013) speakers described several strategies to encourage girls and women in STEM. The first speaker, Dr. Janice Koch explained that men were still dominated the historically male fields of science, technology, engineering and math and it is in childhood that female receive the message that STEM is for boys. She concluded her message with what she deemed the million-dollar question, "What can we do to foster girls' engagement with these subjects?" Another speaker, April Osajima, reiterated the need to focus on the world outside the classroom. Her rationale was it often lacks the rigid time constraints of a school day and it allows girls to become truly immersed in a variety of concepts without the distractions of their male peers. She has worked with facilitators of Girls Inc. Osajima's recommendations to the facilitators were: 1) "Assume that girls are interested in STEM, and make STEM activities part of what everyone does; 2) We must let girls make big, interesting mistakes until they come to the solution on their own; and 3) We must get past "the yuk factor" (Koch, J., Jesse, J. and Osajima, A., 2013, p. 3). These speakers stressed in order to increase gender equity in STEM this required motivation and exposure to these disciplines in school and informal STEM settings (Koch et al., 2013).

Summary of After-School Programs

With all the challenges and expectations placed on traditional classroom teachers in urban education, providing urban students with access to after-school programs is a necessity. This school year, in Missouri, the eighth grade students are required to take a standardized assessment in science along with math and language arts assessments.

Since this is the first year Missouri included science testing at the secondary level for 8^{th} grader, I thought designing an after-school year program focused on females could ensure the females that participated in the TFS program did have science exposure. The goal of the TFS program was to provide these females with access to peer leaders, mentors, role models and hands-on lab opportunities using cooperative-learning strategies that enhanced their science content knowledge, change their attitudes about science and guide them to a career in science.

Chapter Three: Methodology

Introduction

Why are male adolescents still out performing female adolescents in science in the U.S.? This has not always been the situation with the adolescents I have worked with in urban education, for over fifteen years. My female students have consistently out-performed my male students in science, which led to this mixed methods, Action Research study in St. Louis, Missouri in an urban community center for males and females. The questions for this study the Training Future Scientist (TFS) are: 1) What effect does female participation in the TFS after-school program with a peer leader working in cooperative-learning groups has on learning science content? 2) What effect does female participation in the TFS after-school program with a peer leader working in cooperative-learning groups have on their affective domain, namely attitude toward science and self-perception? 3) What effect does female participation in the TFS after-school program with a peer leader working in cooperative-learning groups have on their career choice?

The three purposes of the TFS program were: 1) determine if the influence of working in cooperative-learning groups with peer leaders and mentors increased the science content knowledge of the participants as measured by pre and posttests; 2) probe the identity and future aspirations of all these females after working cooperatively using hands-on labs and activities with university role models in science; 3) document any attitudinal changes about science and choosing science pathways as female students engage in science learning informally.

Action Research

Action research is a form of applied research performed by researchers that are interested in practical solutions to problems that can yield social change (Bogdan & Biklen, 2007). O'Brien (1998) reported that Action Research is known by many different names including participatory research, collaborative inquiry, emancipatory research, action learning and contextual action research. Each type is a variation in the theme, but they all are "learning by doing" to solve a problem the research has identified. Action research is distinguished from common problem-solving activities, because it attempts to contribute to both the practical concerns of people while furthering some of the goals in social science research. This researcher makes sure the theoretical framework informed the intervention participants; by refine the methodological tools to suit the situations that arise in the program; and collect, analyze and present the data on a cyclical basis (O'Brien, 1998).

Another attribute of action research is that everyone involved becomes a researcher. The participants begin to discover how they learn best as well as which activities and strategies work best to produce the individual outcomes they desire. Action research also has a social dimension while exposing everyone to real-world experiences that can lead to solving real-world problems. Action research for the primary researcher reduces bias, because no matter what previous data reported, the new study's results can conflict the previous findings (O'Brien, 1998).

Winter (1989) identified six of the key principles of Action research. The six principles he discussed are: a) reflexive critique, b) dialectical critique, c) collaborative resource, d) risk, e) plural structure, and theory, and f) practice, and transformation. A reflexive critique takes the information from the notes and transcripts as authoritative, which give rise to theoretical considerations. A dialectical critique is the social realities between the language of the participants, especially the communication that conflict or opposition between individuals. A collaborative resource means all of the participants are co-researchers so every person's ideas are equally important which should reduce skewing the credibility, because multiple viewpoints were considered. Risks enter action research, because sometimes it might be hard to convince the participants to use a different approach, especially if the old way is easy and comfortable, but in the end the participants' realized they did learn using the new approach. Plural structure means there are many accounts with commentary from multiple views that act as an ongoing discussion rather than a conclusion of fact. For action researchers, theory informs practice, practice refines theory, in a continuous transformation. Theory and practice influence the transformation and it up to the primary researcher to identify the theoretical justifications, and question the basis of the justifications (Winter, 1989).

Mixed Methods

Creswell (2004) defined mixed methods investigations as a study that integrates qualitative and quantitative methods that logically answers a program of inquiry. Bazeley's (2008) said mixed methods are studies that have more than one methodological approach in combination with one another involving each of the qualitative and quantitative approaches. Hewson (2006) defined mixed methods as a combination of quantitative and qualitative methodologies within one study that addresses a single research question.

Greene (2007) explained the rationale for choosing the proper mixed method design for a study. She discussed the challenges of proper mixing at different stages of the inquiry process, within a single inquiry study, or across studies within an integrated program. Some of Green's interpretation and rationale is highly supported by theorists Tashakkori and Teddlie (1998). Green (2007) cited the evolutionary interpretation and distinction between the different types of mixed method studies. Green (2007) said the rationale for integration between the methodologies is necessary because neither method alone yielded sufficient results that clearly captured the trends or details of the research question(s).

Theorists Tashakkori and Teddlie (1998) reported different stages of mixing during the inquiry process. In their book, the goal was to end the paradigm wars with the adoption of the social inquiry design, with the primary focus on basic quantitative and qualitative inquiry traditions. Their work allowed for the differentiation of the overall design of mixing more specific techniques of data gathering and analysis (Tashakkori & Teddlie, 1998).

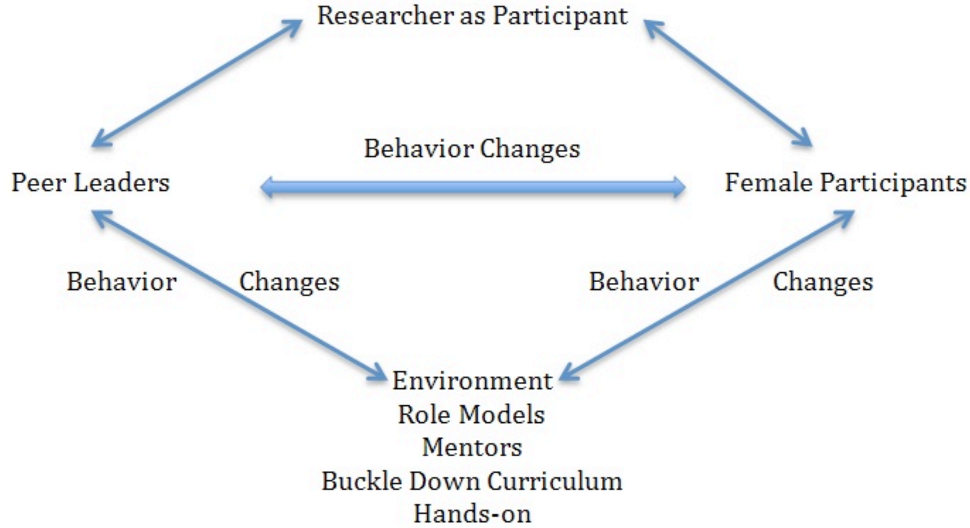
The latest update from Tashakkori and Teddlie (2006) now has four dimensions: the number of methodological approaches, number of strands or phases, type of implementation and the stage of integration. The number of methodological studies distinguishes between a mono-method and mixed method designs. The number of strands or phases in the inquiry design determines if the design has one strand or multiple strands to answer the inquiry. The types of implementation include three different processes: concurrent, sequential or conversion. The stage of integration is the main rationale for implementing a mixed method study, because it integrates the findings and draws inferences from both the qualitative and quantitative data (Tashakkori & Teddlie, 2006).

Morse (2003) discussed methodology integrity in mixed methods studies. She explained two theoretical drives that define these studies, inductive inferences or deductive inferences. Inductive inferences support the qualitative data as the primary influence on the findings and the quantitative data supplements the findings. Deductive inferences on the other hand are supported by the quantitative data as the primary focus and the qualitative data is a supplement. She reported that a study must infer one or the other, but not both. This philosophy is very different from what Greene (2007) and Tashakkori and Teddlie (1998) reported. Greene (2007) distinguished between the different types of mixed methods based on an integration between and across a study; and Tashakkori and Teddlie (1998) focused on the number of methodological approaches used (Morse, 2003).

TFS is a mixed method study that integrated all three of the research questions within one study using an inductive approach for the qualitative data and a deductive approach for the quantitative data. The quantitative results came from the participants' numerical responses on the attitudinal surveys and Buckle-down curriculum pre-tests and posttests. The qualitative data came from the responses from the short answers responses on the attitudinal surveys and semi-structured interviews with the researcher, select peer leaders, participants and role models. Berg (2004) stressed that the qualitative information should help the researcher understand the numerical data provided from the attitudinal surveys, pre-tests, and posttests. Bruner (1990) offered a bit of caution, although a person says they enjoy an experience does not always guarantee mastery scores for the quantitative instruments. For example, Bruner (1990) and Parsons (2008) maintained that with African-American students, it is not only the pedagogy of the science content that produces academic achievement but also the teacher's cultural ethos that gives meaning and purpose to student learning.

The TFS program used the theoretical framework of constructivism. The literature identified three tenets of constructivism: exogenous, endogenous and dialectical. Exogenous constructivism refers to the construction of new knowledge from the information in their external world (Bruning et al., 2004; Moshman, 1982; and Phillips, 1995). Bruning et al. (2004) explained that endogenous constructivism uses mental structures from earlier structures, not necessarily from the environment. Whereas, dialectical constructivism, is knowledge constructed from the interactions between peers and/or teachers and their environment. Dialectical constructivism provides students the opportunity to reflect on the mental contradictions or misconceptions they may have, because now they have access to the resources of their peers to integrate with their prior knowledge (Bruning *et al.,* 2004; Moshman, 1982; and Phillips, 1995). Figure 3.1 depicts the potential behavioral changes that occurred between all the different participant relationships that developed in the study.

Figure 1: Participant Relationships



The dialectical perspective guided this study because Vygotsky's sociocultural theory is an effective model when teaching science. Based on the research from Johnson *et al.* (2010) some of the outcomes of cooperative learning are greater efforts to achieve, to promote more positive relationships, and greater psychological health compared to competitive or individualistic efforts (Johnson *et al.,* 2010). This was a major influence on my decision to design collaborative dialectical environments for learning.

The cooperative learning strategy was integrated with: Vygotsky's sociocultural learning, Maslow's Hierarchy of Needs principles, Bandura's social cognitive theory and Granger's NET theories to create the TFS program. The students that participated in this science driven after-school program hopefully saw the engagement and rapport the peer leaders, graduate students, role models and the researcher tried to impart to them during every session. The survey responses from my past students, from 1998-2011 were compared to the responses from the current participants. Although my past students did not complete the same attitudinal surveys administered in this program I wanted to evaluate and compare their responses with my current students. I really wanted to know if a brief, immersive approach using effective science pedagogy with an African-American teacher who is a role model that provides the cultural ethos urban students need to succeed and produced similar results to those I have witnessed in my classroom and regular after-school clubs I have facilitated at my school for more than fifteen years.

Design of the Study

An Overview

This Action research, mixed method study was implemented for five weeks at the Boys and Girls Club of Greater St. Louis. This is an after-school science program, which is only one of multiple choices provided by this community-based non-profit organization. This educational and social service agency provides K-12 students and families, who resided in St. Louis City, with multiple options.

Table 1 outlines the data collection procedures for the TFS Action research project. The project included: a) semi-structured interviews from select participants; b) three teacher-made Attitudinal surveys; and c) pre and posttests for the science content from four units in the Buckle-down curriculum program. Data collection also included reflective journal responses from the selected students and the researcher and reflective survey responses from hands-on lab experiences and online survey.

Table 1 TFS Research Methods

	Qualitative data	**Qualitative data**	**Qualitative data**	**Quantitative data**	**Quantitative data**
Research participants	Semi-structured interviews	Reflective journal entries	Reflective Survey responses	Pre & Post Content tests	Attitudinal survey responses
Researcher as participant	X	X	X		
Female Peer leaders	X	X	X		
Female Participants	X	X	X	X	X
Role models	X		X		
Past Students			X		

Table 2 TFS Quantitative Research Methods

Paired Sample T-tests	**Survey Frequencies Responses**	**Survey Correlation Results**
Pre test & Post test Science content	All Surveys Questions: 1-10 Attitude changes	Surveys: I & II; II & III; and I & III Questions: 1-10 Attitude changes
Sum of Surveys 1 & 3 Questions 1-10 Attitude changes	All Surveys Questions: 11-15 Career choice	Surveys: I & II; II & III; and I & III Questions: 11-15 Career choice
	Trend Analysis for Attitude changes & Career choice	

The quantitative data was generated first, with the participants' completing Attitudinal Survey I (see Appendix A-C) and the science content pre-test and posttests published for each unit in the Buckle-down curriculum. The Buckle-down science curriculum is divided into five units that provide in-depth science review and MAP test preparation and practice. The first unit was The Nature of Science, which addresses: 1) the scientific investigations, 2) scientific method, and 3) science and technology. The second unit was Physical Science and it addresses: 1) physical properties of matter, 2) chemical properties of matter, 3) forms of energy, and 4) force and motion. The third unit was Life Science, which addresses: 1) structure and function of organisms, 2) reproduction and heredity, and 3) ecosystems. The fourth and final unit that the TFS program addressed was Earth and Space, which covered 1) weather and climate, 2) plate tectonics, 3) the changing earth, and 4) space science (Hamer, T. & Booth, J, 2007). .

The clear, logical content deepens most students' science skills and knowledge and improves their performance on the Missouri Achievement Program (MAP). In addition, most students discovered the wonders of science and developed concrete understanding of essential science concepts in the regular class, too. Finally, students saw positive results with kid-friendly instruction, lots of MAP test practice, and two separate MAP practice tests modeled after the actual exam (Hamer, *et al*., 2007). After each pre-test, the participants inserted all of the vocabulary words and definitions for each unit they did not know in an online study tool called Quizlet.com. Quizlet.com is an online easy-to-use learning tool for vocabulary in a variety of content areas.

Once the pre-test for each sub unit was completed, the students participated in cooperative learning activities to learn the vocabulary and specific content for the section assigned to their expert group. Examples of these activities are: creating webs of the words, graphic organizers and interactive diagrams to explain the objectives and vocabulary words. Each expert group combined their interactive posters to create a larger poster for each subunit. This large poster was posted on the walls of Boys and Girls Club of Greater St. Louis - Herbert Hoover for all the members in the club to use in order to further their knowledge. Once these activities are completed, the students were divided into jigsaw cooperative learning groups and worked in dyads, triads, and pair-share, report teams, to finish each sub-unit. A peer leader was assigned to each group to facilitate instruction. In these jigsaw groups each expert discussed the answers for the section they were assigned. After all of the content questions were completed in their Buckle-down manual, the students created laboratory groups to perform group investigations with three to four participants to complete the hands-on labs published at the end of each subunit. The peer leaders also facilitated the group investigations. The students took the posttest with the expectation of each participant earning a minimum of 80 %.

The participants continued these same procedures for every subunit in each unit. The role models and mentors from Washington University Medical School visited the TFS after-school program to facilitate additional hands-on labs and demonstrations for the Physical Science units. After the first visit with the role models, the participants completed the second Attitudinal Survey II (see Appendix B) online and answer the following open-ended online questions: 1) Explain in detail(s) if your attitude about science has changed. 2) What specifically caused your change in attitude about science? Based on the data from this survey, adjustments to the program were made when needed. The students' took the first practice, standardized assessment and evaluated their answers in peer-led, cooperative-learning groups during the following study session.

The participants completed the next two units, before the medical and graduate students from Washington University joineed us again. After the third unit, the role models visited again and focused on the Chemistry unit. Once the last unit was completed the participants had taken a second practice standardize assessment The students completed the third Attitudinal Survey III online (see Appendix C) and answered the following open-ended online questions: 1) Which activity(ies) did you enjoy the most in the after-school program? 2) What science content do you know for sure? 3) What science content do you still struggle with? 4) Explain in detail if your attitude about science changed? 5) What do you feel caused this attitudinal change? If your attitude changed about science, which part of the program do you feel caused your attitudinal change? Be specific. The culminating event included an awards program to acknowledge my appreciation of all the participants in the program with a Science Symposium featuring a diversity of Women in Science from the community where the audience posed questions.

Table 3 TFS Qualitative Research Methods

Focus group Semi-structured Interview	**Reflective responses**	**Reflective Journal Entries**
Transcription of interview	Attitudinal Surveys II & III	All TFS participants including the PI
Open, axial & selective coding (Strauss & Corbin, 1998b)	Compared participant responses	Compared participant responses

The qualitative data was generated from the reflective survey responses from the open-ended questions from Attitudinal Surveys II and III completed only by the participants in the after-school program; the semi-structured interview responses from select participants in the program in the focus group; reflective journal responses from focus group participants; and the reflective survey responses from my past students from 1998-2011. The individuals who were selected to participate in the semi-structured interview were the researcher as participant, two program participants that had high scores on Attitudinal Survey I and two program participants that had a median score on Attitudinal Survey I. In addition, two peer leaders who participated at least seventy-five percent of the time and two role models who participated during the university visit were also included in the interview. The questions for the semi-structured interview were: 1) What are some of the benefits of the program? Be specific and support your answer. 2) What strategies and/or activities were the most affective for you in the program? Be specific and support your answer. The survey questions for my past students were: 1) Did what I teach you transfer to other subjects and/or peers? 2) How have you used the skills and practices I taught you since you left my leadership? 3) What year were you in my 8^{th} grade class? 4) What is your career choice or perspective career choice? 5) If you are in college, what is your major; if not in college, what do you plan to choose as your major in college.

The semi-structured interviews were transcribed, inserted into a Microsoft Excel spreadsheet, and evaluated using line by line open coding analysis to yield the emergent themes, categories and subcategories of the responses. The quantitative data was compiled from the after-school participants' results from the Buckle-down curriculum pre and posttest and the attitudinal surveys. The mean value and standard deviation for each survey item was analyzed for each survey. Additionally, four students were selected based on their Attitudinal Survey I scores to participate in a focus group in order to understand the specific influence the TFS after-school program had on the three objectives of the program and to probe the interpretation of the data.

Sampling Process

Most sampling is non-probabilistic, but in this study, the sampling process was a convenient, purposeful sample with some additional snowball sampling for recruitment. Merriam (1998) defined convenient sampling as “a selection of participants based on time, money, location, and availability of respondents” (p. 78). She further explained that the first participants who sign-up for the program encourage their friends and peers to consider participating in the program, too. This was the process used for contacting the participants, peer leaders, role models, mentors and my past students. I sent letters to the peer leaders to invite them to participate in this project. The peer leaders, select role models and mentors attended a meeting with me to determine the best days and times to implement this program and understand the focus and purpose of the study.

In order to recruit the students that are members of the community center prior to the implementation of the study, I, and the Boys and Girls Club of Greater St. Louis, created promotional and informational flyers to post around the community center and sent home a flyer as an insert in the community center’s monthly newsletter. I presented a brief Power Point presentation at the spring Open House at the community center to share the purpose and results from my previous students using the same curriculum program. The parents and students who were interested based on the names from the sign-up sheets posted in designated locations at the club, received invitations to attend a second informational meeting to entertain additional questions and discuss the expectations for all the participants involved in the study.

Two students that scored high and two students that scored in the middle range on the first attitudinal survey and their families were selected to participate in one to two interviews, which lasted less than sixty minutes. Parental consent forms for the participants were completed at the organizational meeting hosted by the Boys and Girls Club of Greater St. Louis – Herbert Hoover. I did not select any students that scored low on the first attitudinal survey because from my experience, these students have very high attrition and low motivation to participate in the program. The role models and mentors were selected based on their area of expertise and skill set they possess that enhanced the curriculum that I have selected to guide this program. The peer leaders were paired with 2-4 participants based on the number of students that volunteer to participate. Records of all communications, attendance and participation in the TFS program were recorded in an Excel spreadsheet and Microsoft Word files on a password-protected computer and locked file cabinet for a minimum of five years.

Target Population

The participants were divided into four different groups and the researcher was the fifth person that was evaluated in the TFS program. The first group was the twelve to thirty, 11 – 15 year old females who were members of Boys and Girls Club of Greater St. Louis. These female students represented a small percentage of the over 9,000 students this community program serves in four locations. The majority of all the female participants were African-American. The second group were the peer leaders, who were my past eighth grade students that are currently in the 9^{th} – 11^{th} grade in high school; they served in this capacity to assist their struggling peers to restore their academic integrity before transitioning to high school. These students participated in a professional development retreat before the program began with the researcher to get the hands-on lab materials organized and to finalize the expectations of their role in the program. The third group were role models and mentors, who are medical and graduate students pursuing graduate work at Washington University. The fourth group was my past students from 1998 – 2011, who provided archival data. These students are either in high school and/or post secondary school now. I used several measures to contact these students, from face to face contact, telephone calls and email messages sent via Face Book and Hotmail. Locating and receiving responses from these students was very challenging, so the results are only representative of less than 20 % of my female students that responded to my communications. The ethnicity and cultural backgrounds of the peer leaders, role models, mentors and past students are diverse, ranging from African-American, Caucasian-American, Asian-American and Hispanic-American. The majority of the members in each group, including the researcher, have an affiliation with a large urban school district as a student, peer leader, role model and/or mentor.

Program Setting

The TFS after-school program was housed in one of the Boys and Girls Club of Greater St. Louis, four community centers, of this multiple facility organization. This facility is opened 48 weeks a year, five days a week and has some 78,000 square feet. The majority of the youth this location serves is African-American, from single-parent homes identified as low-income. These young people face major challenges in their communities such as lack of income for basic needs, family instability, inadequate housing and exposure to violence and drug abuse. This facility with the support of its 36 board members, 95 full and part-time employees and 750 volunteers is a place where these youth can come and feel safe and get support in a variety of capacities. In addition to the nurturing the program provides these youth have access to vision and dental clinics, reading and science rooms, technology center, game room, tennis courts, football field, gymnasium, art room, teen center, performing arts and dance studio, multi-purpose room, cafeteria, kitchen, fitness center and a music studio.

For the present study, the main goal was to increase the 11-15 year old female participants' interest in science content knowledge, influence a shift in their attitude about science and self-perception, and possibly motivate them to choose a science career and/or science path in high school and college. This program ran for 25 contact hours. Since this is an after-school program with so many other amenities, I was depending on parental involvement to encourage their daughters to participate in this program. The rationale for the female only focus was to reverse the statistics in the U.S. regarding females lagging behind their male counterparts in science achievement starting at age thirteen and in choosing science careers (Brickhouse et. al, 2000; Hill et al., 2010).

For the past three years, I have implemented a similar program in my regular classroom during the school day and the results have been astounding. Even though the district and state scores on the science assessments declined, the students in my program had over 81 % of the students earning Advanced and/or Proficient on the science state assessments two years in a row and over 91 % of the students earned Advanced and/or Proficient in the third year. After several discussions with my advisor and exit course professor, we decided to see if I could package my approach in an after-school program.

Because the TFS after-school program was in an experiential setting, the attendance averaged of eight females depended on the interest level of the participants. Sessions included interactions with trained peer leaders, access to mentors and role models from an area medical center to demonstrate and facilitate hands-on labs and/or activities, and a panel of female guest speakers from a variety of STEM careers to answer questions regarding their career and educational pathway. My expectation was that some females showed up for all of the sessions while others attended sparingly. The goal in my marketing message was to stress the importance of consistent attendance, that I tracked and reported, and active participation yielded the results my students in the past three years acquired. Unfortunately, no monetary rewards were offered in this program at this time, but the academic gains the TFS program provided for this age group hopefully increased the participants' self-confidence and science content knowledge. In the past the science assessment awarded bonus points to the school when the students' earned Advanced and/or Proficient, but now the assessment is required.

Instrumentation

According to Merriam (1998), I was the primary interpretive instrument for the qualitative data, because I performed, interpreted and analyzed the interviews; collected, sorted, coded and analyzed the data; and lastly designed, implemented and facilitated the implementation of the program. I brought personal expertise to this study because this was the fourth year I have used this curriculum to prepare 8th grade students for the spring science standardized assessments. The program I implemented in the past was alongside the regular science curriculum I taught in the classroom. The curriculum was an enhancement to my regular curriculum because it provided a structured overview for each of the possible objectives that would be evaluated on the standardized state assessments. Since the TFS program was situated in an experiential setting of an after-school program instead of a regular urban school classroom, this program used an intensive approach. The definition of intensive for this study is two ninety-minute sessions per week for six to eight weeks.

During each session the students' identified and recorded the key objectives for each unit of study, took a pre and posttest, answeredd constructed response questions, and designed and completed a hands-on lab exploring the objectives. Every other week role models and mentors from Washington University visited the program to provide the participants with additional hands-on experiences that lead to deeper science content understanding, critical-thinking and problem-solving skills. These visits exposed the participants to possible examples of science careers, too. The final event was a culminating activity to celebrate the achievement of the participants, appreciation of the volunteers and the community center and one more opportunity to meet some area female scientists that serve in the St. Louis area.

Because of my expansive and extensive career as a science researcher in this city, many of these female scientists are women who I have developed relationships with since I entered the field over twenty years ago. As a veteran teacher for this age group, I readily acknowledged the need for and value of this type of exposure to enhance and reinforce student development, motivation and learning. I found that females are able to grow and explore new venues when the teacher or coach genuinely cares about them. Obviously, this intervention was not as easy as a comprehensive program in a regular classroom, plus after-school time. Hopefully the testimonial support of my peer leaders, the evidence of my credentials, my success using this curriculum in the past, and my passion for science motivated the participants to give the program a chance to be honest during interviews and when completing surveys, and to cooperate during program activities. All of the data was stored in a locked cabinet and all names of participants were kept confidential.

Data Collection Procedures

Interviews

This study employed semi-structured interviews, which are effective in qualitative research to support the participants' responses to the survey questions, pre and posttests and responses in the reflective journals. Interviews are the verbal data that can substantiate the numerical data collected from other instruments in the study. The answers from the open-ended responses from Attitudinal Survey III revealed the amount of science content knowledge the students gained and the results from the affective domain question for my study after participating in the program. The results from Attitudinal surveys II and III answered the final question regarding the participant's career choice and college path. Ideally, I wanted to conduct interviews with two representatives from each of the four groups of participants, then have one of the mentors interview me. Merriam (1998) suggests that the interview should employ open-end questions allowed the participants an opportunity to hopefully explain their responses on the survey. The validity of the study was substantiated by stressing that all of their responses, positive and/or negative are welcomed and were used in the analysis. The responses from the interviewees are just representative of the participants in the study.

Surveys

The survey for this study was modified into three separate versions that the participants took at different times 1) using an online survey service on the first day of the program; 2) after Washington University role model visit, three weeks into the program; and 3) on the last day of the program. All three of the Attitudinal surveys have the same fifteen questions in part I which evaluated a change in the participants' science identity, attitude about science and science career choice and additional open-ended questions on surveys II and III. (See Appendix J-L) The survey questions were divided into three categories: 1) science identity, 2) attitude about science and 3) choosing a career in science. The first survey was field tested by fifteen adolescent females from an urban middle school in this Midwestern city. The consensus from the discussion with these students and the researcher increased the validity and reliability of the survey questions.

Pre-tests and Post tests

The pre-tests and posttests were included as an evaluation of the teaching pages for each unit of the selected curriculum. This was the only test the participants completed. The pre-test was administered at the beginning of the unit before the unit was discussed. The posttest was administered after all of the teaching assignments and activities have been implemented to evaluate the science content knowledge retention and growth. A summative assessment was given during the fifth week in the program to all the participants, once all of the units have been presented. This summative assessment allowed students to identify their strengths and weaknesses for the state assessments in the spring. In addition, it also allowed the participants to evaluate what they knew for sure and where additional instruction was needed.

Journal Entries

The students' reflective journald consisted of: 1) Buckle-down curriculum pretests results from each subunit; 2) participant's communications and interactions with their families, teachers and peers outside the program; and 3) reflective journal recordings from the participants. This information provided insight into what the participants had learned from participating in the program, and how they had shared what they know with their family, friends and teachers. This journal provided the participants with a vehicle to record any responses after their interactions with their family, friends and teachers outside the program. My reflective journal contained: 1) weekly observations and notes from the bi-weekly program sessions; 2) documentation of weekly reflections about the experiences in the program and dialectical excerpts; 3) any notes that needed to be included in the evaluations and findings section of the this project; and 4) finally, reflexive discourse for any changes that needed to be made to future sessions.

Data Analysis Procedures

The first set of data was the results generated from the responses from Attitudinal Survey I. The two students who scored high on Survey I and the two students who scored in the median range on Survey I and who had a parent(s) that consented to participate in an interview were included. The participants compared their results from Attitudinal Survey II and III to their responses on Attitudinal Survey I. The initial results from all participant data were inserted and stored in a Microsoft Excel spreadsheet, then exported into SPSS to run several statistical functions. Averages, standard deviations, p scores, t-tests and an ANOVA were calculated to compare the responses from Survey I to the responses from Surveys II and III. The purpose was to reveal any attitudinal changes about science and/or possibly choosing a career in science.

The second set of critical data was extrapolated from the transcripts of the interviews. Incomplete and run-on sentences were transcribed as the participants spoke the information. I used the same voice recorder, word processor, and computer to format all interview transcripts uniformly. The interview protocol was in bold print to distinguish the questions from the conversation between the researcher and interviewee. Each interview received a code name, a brief introduction, key facts about the participant and any relevant characteristics to distinguish between the four female participants. Line numbers were added to all transcripts for ease of coding, discussion and retrieval. Digital and computer-generated copies of all transcripts were stored on an external hard drive that was password protected. The questions were recited orally to the interviewee by the researcher and listed on a handout the researcher referenced during each interview. To reduce transcription errors the researcher recited the interview questions, probed answers from the interviewees and then allowed the participant to review the transcript after transcription. Any errors and/or misquotes were edited by the researcher. A fellow graduate student coded some of the transcripts using my codebook to establish inter-rater reliability for most of the interviews to ensure reliability of the transcriptions. The inter-rater reliability was 95 %. I performed the interview in a quiet location free of distractions, such as telephone calls and doorbells.

The data collection coding method followed the process outlined by Strauss and Corbin (1998b). The data from all interviews were categorized and coded using open coding, then examined to identify the emerging themes using axial coding and selective coding from their experiences in the program. The coding schema included dominant categories and subcategories (axial coding) to ensure reliability of the analysis of the data. Once all the data was categorized and sorted by category and sub category, quotes were selected from each category to illustrate the participants' comments, which represented each category. A similar process was used to analyze the reflective journal responses as well and representative quotes were included in the analysis to support the participants' interpretation of the benefits of this form of data collection.

The last data collection evaluated any changes in science content knowledge based on the pre and posttest results for each curriculum unit covered. The researcher compared the focus group participants' results to the overall average results for all of the participants in the program. The initial results were stored in a Microsoft Excel file then exported into SPSS to perform statistical analysis and a simple t-test comparing the pre and posttest results.

Threats to Internal Validity

Instrumentation

Instrumentation may be a threat only if a pre-test and posttest are used. Instrumentation only becomes a threat to internal validity if the posttest is changed and the scoring procedures have changed. To control for this threat, instrumentation was standardized so that the same scales were used on both the pretest and posttest (Creswell, 2008).

Threats to External Validity

Experimenter Effect

Experimenter effect may be a threat to external validity. The behaviors of the participants could be unintentionally influenced by certain characteristics or behaviors of the person implementing the treatment. Examples of these characteristics or behaviors might be: a) encouragement, b) verbal reinforcement, c) mannerisms, d) sex, e) age, and

f) race, to name a few. This makes it difficult for the researcher to make generalizations from the outcomes to other populations (Bracht & Glass, 1968).

Ethics Involved

Upon university IRB consent, which was required of this institution of higher learning, I made every effort to be conscientious and respectful of my participants' time, efforts and decision to participate in this study. I consistently treated everyone involved in this study with respect and honesty and did not make any false promises regarding the expected outcomes from participation in this study. Equity versus equality was always my guide to ensure meeting the individual needs of each participant in the study.

The most significant component for success with this age group is the students' attachment, which is influenced deeply by their teachers. Hallinan (2008) reports the kinds of experiences that teachers create for students may exert a powerful influence on students. Since this is an after-school facility that had a plethora of activities that the participants could choose from, it was important for the researcher to show, not tell, her passion and enthusiasm on the first day, so that the participants wanted to return for the rest of the program. Based on the reflections from my past students, the care, encouragement and support I gave my students were the vital elements and key motivations for them to achieve in my presence and in my absence.

Limitations to the Study Design

The framework for this study was based on previous work with several after-school science programs I implemented in my regular secondary school. I would hope that my success in the TFS programs would not be interfered and biased by the observations of this new program. Lack of control over whom and how many females chose to participate in the study was a huge limitation, but the facility after-school coordinators assured me there were a sufficient number of females to participate, but attrition was a problem. One suggestion to remedy the attrition problem was to run the program for a minimum of six weeks instead of eight weeks. The trust I had built with my past students was developed over years of cultivation and consistent communication, but the time I spent with these students was limited to less than thirty hours, which was a greater limitation than attrition.

Chapter 4: "At Home with Mrs. Hill: My Secrets to Success…"

First Day of School

Summer vacation is finally over and it is the first day of school. Over 100 students saw their 7^{th} grade advisories to receive their new 8^{th} grade class schedules to see who their 8^{th} grade advisor is. This is the moment most of these students have been waiting for because now they are the oldest students in the middle school and they are able to work with the 8^{th} grade team of teachers. Many of these students have worked with some of us in the past, either as a participant in our school's Black History Month program, a member of one of our sports teams or in one of our after-school programs. On the other hand, some of these students only speak to us in the halls, but they know we appear to be nice and care about adolescents because that is the message some of their older siblings have conveyed to them.

The bell rings and the students leave their old 7^{th} grade advisors and start to file into their new 8^{th} grade advisories. Only a few of the students are assigned to my homeroom but everyone is assigned to be a student in my science class. This was not always the case. In the past, parents would write letters or call the principal asking if their child could be placed on my team or in my homeroom. Now, due to several budget cuts in St. Louis Public Schools, I am the only eighth grade science teacher, so even though their child was not assigned to my advisory, at least I am their science teacher.

The majority of the 8^{th} grade students and parents are excited because the impact I had on their older children is still evident. Some of these students still use my strategies to succeed in high school and college. Therefore, the parents want to know if I can do the same thing for another child in their family. This chapter reveals some of my secrets to success, e.g., my passion for science, my teaching philosophy, my best practices and key philosophers that I follow. Most of all, I want to relay to my students how I am motivated in my calling to train our future citizens. My best attribute that keeps me challenging my students, especially my female students year after year, is the fact that I treat them as if they are my very own children. Secondly, I target the students' affective domain, using individual and group strategies to evaluate what each student really knows. Finally, in order to succeed I focus my teaching toward their individual cognitive domains and individual needs. These natural attributes I possess were affirmed by Palmer (2005) as key components for an affective learning environment. Palmer (2005) stated that the emotional component that is created by the teacher when he or she creates a supportive and pleasant class atmosphere includes smiles, empathetic listening, voice regulation, use of the student's name and general attention. I also believe that students have a responsibility to be actively involved in the class. So, on the first day school my students notice the genuine respect, concern and interest I have for them and my passion for science, an equitable and rich classroom environment with a teacher that believes all children can learn and who is determined to implement effective curriculum and instruction for all adolescents.

Genuine Love & Passion

Accepting the Call to Teach

As long as I can remember, I have had a genuine love for children of all ages. My decision to teach adolescents was motivated by my lack of a science teacher when I was in the 8^{th} grade. In 1994, I worked in a research laboratory at St. Louis University, (as a senior research assistant) in pulmonary medicine. In this position, I maintained my own research projects, as well as trained all the new people that joined our lab. One day while working, I heard a small voice say, “I need you to train my people.” The voice was familiar, so immediately I responded to the call and returned to school part-time to obtain my teaching certification while working forty hours a week as a non-traditional employee. In addition, I managed a family with a husband and two minor children serving as their first teacher, role model and primary breadwinner.

I finished my course work and student teaching assignment in three years and was invited to the St. Louis Public Schools Principal interviews in the spring of 1997. The principal of the only gifted middle school in the state of Missouri hired me. This was the beginning of my journey as a teacher with the assignment to train and motivate urban students to become future scientists. Armed with fifteen years of research experience and several years of religious teaching experience, my new job was to teach 8th graders the 9th grade science curriculum, I thought. After several days, during the first week, I realized teachers needed to be equipped with multiple hats to be successful in an urban setting. My students first wanted to know that I cared about them before I shared with them everything I knew about science.

First Years

My first year of teaching was probably the hardest year because normally new teachers are assigned a mentor inside their school to help with the transition from corporate America to the teaching profession. Unfortunately, my mentor was so overwhelmed with my credentials that she would not mentor me. Therefore, I began developing curriculum and instructional strategies based on what I had learned during my course work in the philosophy of education. Eventually, I began participating in a variety of teacher professional development programs offered by the school science community.

These opportunities helped to mold me into the gifted teacher my students needed. My ultimate goal was to expose my students to the plethora of science experiences in St. Louis that I had been robbed of as a child. I wanted my students to be able to work in research laboratories or follow STEM careers if they so choose.

It was during my second year of teaching I realized that educating the youth of America was not my only job. As a teacher I was molding, counseling, as well as nurturing my gifted adolescents. My students were eager to learn science but they were also able to participate in whatever tasks I asked them to perform. In our district we have endured budget cuts in the teaching staff, support staff and custodial staff, so on select occasions my students would assist me in cleaning my classroom to prepare for Parent-Teacher conferences as well as volunteer to set-up and pack-up my classroom. My students helped organize graded papers and set-up a student database to store student information, science vocabulary words and other study tools. Providing my students with these opportunities increased their self-esteem and self-confidence in their role in society. Their parents expressed amazement because now these adolescents were volunteering to help at home and in their communities.

Each year several of these students served as peer leaders in the classroom and in after-school programs I developed and facilitated to help my struggling students. Now, as I reflect over the last fifteen years of teaching, the impact I had on my students in the classroom was a huge influence on the design of my dissertation project focused on an experiential after-school program.

The passion and love for my students I have was a common thread shared by the teachers interviewed by Michelle Foster in her book *Black Teachers on Teaching.* Lucy Laney Croft stated,

> "… the educated Negro woman must teach the "Black babies." These dull teachers fail to know their pupils – to find out their real needs, and hence had no cause to study methods of better and best development of the boys and girls under their care." (Foster, 1997, XLIV)

Just like Foster, I want this project to be an example of what it takes to be a successful teacher working with diverse urban students in a time when the voice of the African-American teacher is being marginalized and in some instances silenced completely.

Philosophy of Teaching

It is my belief that all students can learn. Therefore, as their teacher, it is my responsibility to educate, motivate, and inspire them to reach their fullest potential regardless of their circumstances. I believe each student has specific needs and learning styles that need to be addressed in order for the transfer from potential to maximum kinetic. Students experienced equitable treatment and their prior knowledge and experiences were a springboard to connect the new knowledge. The learning environment embodied the attributes that motivated the students to learn and mature into responsible citizenry. Some of these attributes are love, safety, curiosity fostering, and access to resources, nutrition, nourishment and compassion. Similar to Maslow's Theory of Human Motivation, this "home away from home" setting inspires risk-taking and a desire to share what they know with others to increase one another's knowledge. After many of my students leave, my classroom they realize that society is just a larger family that demands the same commitment and dedication fostered in my classroom.

My physical attributes, an African-American female, along with the sincere love I have for each student, have motivated my students to learn beyond their own expectations. Using teaching strategies that provide “hands-on, minds-on” experiences daily help my students realize science is attainable. My students’ self-efficacy and attitudes about science have changed because now when you ask my students, “How many of them chose math or science as a career path?” over 50 % of them raise their hands and say, “I am”. This change comes from exposure to learning how to work in cooperative-learning groups to solve problems, implement, and analyze lab investigations. My students participate in short and long-term research projects and read and write about a variety of topics in science, math, technology and engineering which helps to broadens their scope. The authentic experiences I engage my students in are what makes a difference and is evident on their formative and summative assessments. They realize assessments are just one method to “show what they know,” especially in a society that evaluates the teaching and learning in the classroom by the students’ scores on a test.

My goal to inspire my students is similar to an equilibrium chemical reaction. I say this because my students inspire me to be the best teacher just as much as I inspire them to be the best students. The relationships my students and I have developed serve as a “beacon of light” for others that observe how we interact. Even though I give to my students, my school and my community all, my giving is not in vain, because my students give as much as they get. The passion and love my students receive from me is passed on by serving as peer leaders and mentors in the classroom, school, their family and community.

I believe to teach is to serve. Every opportunity I receive to teach fuels my passion to educate, motivate and inspire others to be the best they can be. I serve as a role model of a life-long learner and a prime example showing that it does not matter how or when you start the race but how you finish. I remind my students always to take advantage of every opportunity they encounter along life's journey, good or bad, and use these experiences to the best of their ability. I believe it is the culmination of these combined experiences that propelled them into everything they set their hearts out to become.

Effective Curriculum & Instruction

I realized when I began this research journey that my philosophy was in alignment with the information Ferreira (2002) cited in the publication *A Nation at Risk* (1983) and *Science for All Americans: Project 2061* which are two landmark publications that strive for equity in science education. I also agree with what Allen (1998) stated in an excerpt from a more recent report, *A Nation "Still" at Risk: An Education Manifesto* that:

> "A dual system, separate and unequal, is being created, almost 50 years after it was declared unconstitutional. Equal educational opportunity is the next great civil rights issue. By this is meant the true equality that comes from providing every child with a first-rate elementary and secondary education, and to the development of human potential that comes from meeting intellectual, social and spiritual challenges." (Allen, 1998)

Meeting My Students Needs

Maslow (1971) stated, "If basic needs are not met, then there is a tendency to ignore higher needs. (p. 2)." I was confronted with this dilemma every year with at least 15% of my students on a daily basis. To ensure the higher needs of learning science content, I had to make sure I maintained a generous supply of healthy snacks to distribute to my students when one student acknowledged he or she was hungry. I discovered after taking a poll by asking, "Is anyone else hungry?" at least 75-80 % of my students raised their hands and said they were hungry. This brief delay did not stop instruction because the students immediately began the "daily opener" activity while I prepared and distributed a small snack to all the students. According to Maslow, if the physiological needs of an individual are not met, some people can die, but the people that live have a hard time moving to the next levels, which are security, social, ego (self-esteem), and self-actualization. Self-actualization is the level that is rarely met, but the other three levels are very important for an individual to maintain because these are the attributes that propel them to reaching their potential. Even though distributing healthy was a small gesture, it motivates my students to complete the objectives for the day and recognize that I care about their physical health as well as their academic achievements. This is an example of a difference in teacher behavior that a suburban teacher might not be confronted with but this is a very common experience most urban teachers see, regardless if the school is labeled Title I (schools where more than 25% of the students receive free and reduced lunch) or not. My school is not a Title I school, but my students still have needs that many of their families cannot meet. I feel it is my responsibility to meet these needs if I want my students to learn and continue to move through Maslow's Hierarchy of Needs.

Teaching and Instruction

One method that can transform instruction in any classroom is the adoption of a differentiated classroom. Tomlinson (1999) described a differentiated classroom teacher as a teacher that allows the students to dictate where he or she starts in the curriculum.

Their goal is to meet individual student has needs and engage all students, except the severely handicapped. They believe all students can learn and holds each child to the highest standards. They work diligently to make students work harder than they plan to and the low, middle and high students all achieve and learn more than they plan to accomplish. They do not force-fit a learning style on a student. Their goal is to design a learning environment that prescribes the best learning environment for students. Some examples of how to differentiate your classroom are centers, entry points using Howard Gardner's Multiple Intelligences, tiered activities, learning contracts, compacting, problem-based learning, group investigations, independent study, choice boards, 4MAT and portfolios (Tomlinson, 1999).

In order to serve all students, specific changes have to be made in teaching strategies and techniques, teacher behavior and the curriculum developed for economically-disadvantage, inner city students and economically-advantaged suburban students. This contention is supported by three major learning theorists, which are Maslow's Hierarchy of Needs Theory, Constructivism, and Lev Vygotsky's Social Learning Theory. The Naturalistic Education Theory is another theory that supports this hypothesis as well. Each theory has a critical functioning role in student learning in urban public schools at every grade level but especially during the emotional adolescent years of middle school.

The second learning theory I use is constructivism. In 1996, The National Research Council (NCR) reported that current US science education reform needed to move to more constructivism practices instead of passive ones. Wheatley (1991) defined constructivism as a learning theory that promotes active learning that is constructed versus passive instruction. Passive instruction views the student as a receptacle and the teacher as a pitcher with all the information to fill this receptacle (Wheatley, 1991). Many teachers do not use the constructivism model because of their approach as the sage on the stage. Now teachers become the guide on the side.

The construction of knowledge always makes sense to the individual because it helps them interpret and predict events in their learning environment (Seimears, C.M., Graves, E., Schroyer, M.G., Staver, J., & Savasci, F., 2012). Phillips (2000) stated that constructivism is a theory of "knowing" which has strong roots in philosophy, education and anthropology. Cobb and Bowers (1999) also reported that learners do not just view knowledge as the truth because constructivist compare the new knowledge to hypotheses already established in their prior knowledge reservoir. This perspective is also compatible to Bandura's (1986) social cognitive theory and many motivation theories (Bruning et al, 2004). Teachers that use constructivism in their classrooms witnessed a significant change in everyone's behavior, including their own. The students are more engaged and actively learning and the teaching strategies and techniques used to implement the curriculum are more coherent and flexible to address current content, misconceptions and remediation.

The third theorist that supports my curriculum and instructional practices in urban public schools is Lev Vygotsky's Social Learning Theory. Vygotsky's (1978) theoretical framework is that social interaction plays a fundamental role in the development of cognition. He believes that all learning is perceived on two levels. The first level is interaction with others, which leads to the integration into the individual's mental structure. The second level, which includes the "zone of proximal development," determines a person's cognitive development. In order for a person to reach his or her fullest potential, help and social interaction with a teacher or knowledgeable and experienced peer is necessary. The scaffolding to support the learners' understanding gradually develops their knowledge domain. The development of more complex skills is facilitated during peer-to-peer interaction and during cooperative-learning activities (Vygotsky, 1978).

Teachers that choose to adopt Vygotsky's Social Learning Theory in their classrooms first witnessed a significant change in their struggling students. Providing these struggling students opportunities to socialize and interact with mastery student leaders in pair-share teams and/or cooperative-learning groups provided these students another resource besides the teacher. Using this approach fosters leadership opportunities for all students, especially disadvantaged students. Teachers can tailor their lessons around the prior knowledge and experiences of these students and allow their personal experiences to become the springboard into understanding the curriculum content. This methodology gave these teachers a glimpse into the lives of their students because regardless of your families' socio-economic status, everyone has something valuable to contribute to the learning environment in public education.

Student Testimonials

After reading the research, I decided to contact some of my past students to see if what I taught them was still effective in their lives. I wanted to know if time had made a difference because, in my mind, I was still teaching and loving all my students just the same from my first year of teaching but only the students' testimonials would reveal if this were true. Therefore, I designed a brief questionnaire with five questions that I distributed by hand delivery to the two high schools in the area that most of my students attend and as an attachment on Face book and/or Hotmail. The five questions I asked these students were: 1) Was what I taught transferable to other subjects and/or peers? 2) How have you used the skills and practices I taught you since you left my leadership? 3) What year were you in my 8th grade class at McKinley? 4) What is your career choice or prospective career choice? 5) What is your major if you are in college? If you are not in college yet, what do you plan to choose as your major? The answers to these questions supported my hypothesis that what I gave my students had transpired for over fifteen years and what I gave them was something they could use in their futures and they could share with others.

The first question: *Was what I taught transferable to other subjects and/or peers? The responses from each student using pseudonym names were as follows:*

- "…laying my eyes on an African American female scientist for the first time that class day was amazing, it did not resonate then that I too would become a junior African American scientist in training while in Mrs. Hill's classroom. We participated in labs. We learned great study techniques. We were exposed to real world instances of the science we were studying in the textbook. We went on field trips that stretched our minds even further and brought the concepts we were studying close to home. But most importantly, we were nurtured. We laughed. We were cared about. We learned about struggles. We were encouraged. In Mrs. Hill, we had a role model both inside and outside of the classroom. Although I would end up pursuing a career in policy, my time in Mrs. Hill's class has had an everlasting impact on my life." (Leslie, 1998 Lines 12-21)

- "When Mrs. Hill introduced chemistry this is when I realized how much further I wanted to take my science education." (Kia, 2000 Lines 7-9)

- "I remember being able to use a lot of the things I learned in Mrs. Hill's class in other classes. I remember learning skills that I used and continue to use in my daily life outside of school as well." (Tia, 2002 Lines 5-7)

- "I think the skills that have been transferrable for me are organization and the ability to work well in groups. I knew that Ms. Hill always expected a lot from everyone. She never tried to be our friend but I always looked up to her because she challenged me to do my best always. Ms. Hill had very high expectations for all students, class was fast paced, and there was always a lot of work in class to do. Even with that, I gained a really deep appreciation for the sciences and was able to develop the ability to work well in challenging, fast-paced settings. These skills have really helped me out in my college coursework." (Sha, 2002 Lines 2-8)

- "You encouraged a lot of collaboration with others in and outside of the classroom so I remember learning from you, teaching it to my peers the way I interpreted it, and then learning from the way they interpreted it. Generally, this really made sure we listened, but even understood it." (Alice, 2005 Lines 6-9)

- "She built the foundation for the knowledge of science, which led me to a 26 or 21 (forgive my memory) score in the science section on my American College Test, or ACT." (Mary, ~ 2000 Lines 14-16)

- "From Ms. Hill I learned how important it is to stay focus and study in order to make the grade. She also taught me the importance of being an African American woman in a science related field. I did not realize how important it was to excel and do well in science courses until I met Ms. Hill. She was always looking for different ways to adapt to every one of her students different learning styles and was constantly trying something new. It is because of this that I can adapt to different professors, no matter how they teach I am able to get the most out of the class." (Kila, 2007 Lines 5-12)

- "…what I have learned in your class was infallible. It was actually instrumental to my decision to become a teacher. I try to take some Mrs. Hill's teaching techniques and apply it to my tutoring." (Chac, 2008 lines 5-7)

- "The work was applicable to math & science classes, but the life lessons were applicable o everything." (Siv, 2010 Lines 4-5)

- "Yes, I learned a lot during my middle school years. Everything that I was taught helped me help my friends with their HW and assignments. Having Ms. Hill has made me smarter and has more knowledge then most others. I was ahead of my class." (Dia, 2011 Lines 5-6 & 7-8)

- "Yes, the knowledge I acquired from your teaching allowed me to progress in my current Chemistry 350 course at Metro. Taking your physical science class introduced me to identifying periodic trends. I have tutored fellow peers with Biology and Chemistry and I believe that your teaching has given me a strong foundation for science." (Tac, 2011, Lines 4-7)

- "I was able to apply precision and accuracy to chemistry as well as determining the number of significant digits in a number and putting it into scientific notation." (Dorf, 2011 Lines 4-5)

- "I was able to apply precision and accuracy to chemistry as well as determining the number of significant digits in a number and putting it into scientific notation." (Morf, 2011 Lines 4-5)

- "I am 14 years old. Mrs. Robinson-Hill was a very valuable teacher and mother figure towards me. She taught me many skills. These skills include organization, teamwork and study skills. These are three important skills that I still use today. I use not only in all my classes at school, but at home as well. I am able to help my peers with certain things. Things that were taught to me by Mrs. Robinson-Hill. Before I was under Mrs. Robinson-Hill's leadership, I was interested in politics and criminal justice I am glad that I was given an opportunity to gain knowledge from Mrs. Robinson-Hill. Even though she is no longer my teacher, she has definitely left a life changing mark!" (Diah, 2012 Lines 4-11)

- "I do think that what you taught me was transferable because it is something that is easy to explain to others to help them with their science classes." (Tia, 2012 Lines 5-6)

Based on these sample testimonials, the strategies I imparted to my students can be transferred to other core subjects and their peers. Some students saw me as a role model and a few even thought of me as a mother figure, but even in all my different roles, all the students recognized my primary objective which was to teach science and motivate them to one day become future scientists.

The second question stated: *How have you used the skills and practices I taught you since you left my leadership?* The responses to this question were:

- "…..would you believe that I still have my science notebook from 8th grade Biology? Well, it is true, in fact, I used the same method of organization in preparing my study notebooks just recently for my Doctoral Candidacy Exams, which I passed with a unanimous decision from my committee. Perhaps, the best way to convey how I have used the skills and practices that were taught to me during my time with Mrs. Hill is to highlight the fact that I am writing about my experiences. I was a student in Mrs. Hill's classroom in 1999, it is 2012. One high school diploma, two Bachelor degrees, a Masters degree, and a PhD later, I am still seeking out her leadership and guidance. After all that I learned and the analytical and educational support I received at such a young age, which would later come to influence various aspects of my life, I would be remiss if I did not continue to seek out her leadership." (Leslie, Lines 38-48)

- "….while a student I consistently tutored college chemistry, and currently I work as a classroom teacher, hoping to transform minds into future scientists as Mrs. Hill did for us. I strive for all of those I teach to have a thorough level of comprehension so that they too can feel confident to teach as I did when I transitioned from Mrs. Hill's 8th grade class." (Kia, Lines 11-16)

- "…..I served as an AmeriCorps member where I tutored 3rd graders in the SLPS district in reading and I used many of Mrs. Hill's teaching skills to help my students learn the essentials of reading and phonics." (Tia, Lines 11-13)

- "The one thing that sticks out to me is the focus on organization. Ms. Hill made sure that we had very organized binders and folders and I have truly kept that with me throughout my time in high school and college. I just found my binder a few weeks ago and was amazed at how organized I was in 8th grade. This was truly due to Ms. Hill's leadership and has been a huge component of my life ever since." (Sha, Lines 11-14)

- "…school years that I begin to see science as actually interesting rather than just another required course. You definitely showed me that as a female and minority I was able to succeed and even excel amongst my peers. That has definitely helped me build confidence choosing the major that I'm in furthermore at a predominantly white institution." (Alice, Lines 14-19)

- "She was very educated in the field of science and I have forever have embedded in my mind [the double helix] because of her." (Mary, Lines 10-11)

- "Ms. Hill taught us a lot of different note taking and study skills that I definitely used in high school and I am now using in college." (Kila, Lines 4-5)

- "Yes, I recall the scientific method during my Physics labs for the last two years." (Chac, Line 9)

- "I still use Cornell Notes and your specialized headings in my notebooks because it is an effective note-taking system. I also tab sections of my binders and notebooks for organizational purposes. Like physical science journals PSJs, I never forget to bring my binder to school." (Tac, Lines 10-12)

- "I am way more organized now and it helps me keep up with all my work and assignments. I have used the skills such as Cornell-notes that help us organize our notes." (Dorf, Line 7)

Of course, each year I always told my students I was not only preparing them for high school, but in reality, I was preparing them for life. As you can see from most of my students' testimonials, they have used the skills I taught them in school as well as in their personal lives. What surprised me the most in their comments was how many of them still use Cornell notes and their science notebook. This surprised me, because when I taught these skills in 8th grade many of these girls wanted to know why we had to use these skills, because it took so long to set-up. It is refreshing to know that many of them realized these skills were some effective strategies that taught them organizational skills and allowed them to be successful in school and life.

The last two questions focused on the career choices my girls chose beyond high school since one of my initial goals for becoming a teacher was to motivate my students to become future scientists. The two questions are *What is your career choice or prospective career choice?* and What *is your major if you are in college?* Out of the fifteen girls that sent me responses, eleven of them have or plan to pursue a degree in a science field. Some of the fields of study were chemistry & pharmaceutical, anthropology, public health, civil engineering, human right studies, pre-veterinary & a doctorate in veterinary medicine, marine biology, psychology, anesthesiology, environmental studies, pediatrician and forensic science. One hundred percent of the high school graduates have earned a college degree or attending a four-year college now. Sha (pseudonym) has earned her Masters in Public Health and Kia has begun her graduate work in pharmaceuticals. Leslie (pseudonym) has also earned her Masters in Criminal Justice and is currently pursuing her doctorate in Criminal Justice, which was funded by full scholarship for both degrees from Homeland Security.

Words cannot express how proud I am of my girls and the direction they have chosen for their future. Each year my goal is to be the best teacher my students can have and to make sure my students understand science so that science was a field of study that they were motivated to choose. Fortunately, for me, teaching science in a regular classroom can be accomplished, in addition to motivating my students to choose science careers. Now in this project I want to know if what I give my students in the regular classroom can be transferred to some girls in an after-school program that transformed them into future scientists.

Chapter 5: Findings

Introduction

The main focus of Training Future Scientist (TFS) program's was to see if participants working with peer leaders in cooperative-learning groups in an after-school program would increase the participant's science content knowledge, impact the participants' attitude and self-perception in science and possibly motivate them to choose a science career. I was also interested in observing if my "At home" approach to teaching could be modeled in an after-school program even though I was not the participants primary science and/or classroom teacher. I also wanted to know if my physical attributes of being an African-American female scientist would motivate the participants to internalize the science instruction and actually learn science in this female friendly environment that my peer leaders and I developed.

The findings and analysis are presented one research question and hypothesis at a time using tables, charts and graphs to support and explain the results. Once the last research question and hypothesis support has been presented, a summary of the key findings are presented that led to the final summary, conclusion and recommendations for future work.

Testing Instruments

The pre-test was a total of twenty-one selected response questions and four constructed response questions from the Nature of Science, Physical Science and Life Science units in the Buckle-down workbook. For the posttest, each participant completed the twenty-five selected response questions recorded in the Practice test booklet. My rationale for only requiring the selected response questions for the posttest was to ensure that the instrumentation of internal validity was not a threat (Creswell, 2008). Each pretest and posttest questions receive one point if the participant selected the correct answer and received no points if the participant selected the wrong answer. The performance events and constructed response questions were optional and were not included in their posttest score. These problems were not the type of problems the participants were required to complete on the pretest.

The first attitudinal survey was completed during week one of the program and served as the base line for participant's attitude, self-perception and motivation to choose a science career. On day five of the program, the participants took Attitudinal Survey II, which was immediately following the visit from the role models from Washington University. The two open-ended questions on this survey were: 1) Explain in detail(s) if your attitude about science has changed; 2) What specifically caused your change in attitude about science. Two weeks later the participants completed Attitudinal Survey III, which allowed them to evaluate the entire program and reflect on the overall impact the program had on their attitude about science and their self-perception of science. On this survey, five open-ended questions were asked. The questions were:

1) Which activity (ies) did you enjoy the most in the after-school program? 2) Which science content do you know for sure? 3) Which science content do you still struggle with? 4) Explain in detail if your attitude about science changed. 5) What do you feel caused this attitudinal change? If your attitude changed about science, which part of the program do you feel caused your attitudinal change? The participants were asked to be specific as possible.

Sample Size & Procedures

The sample size for the TFS program was thirteen 11-14 year old African-American females that were members of The Boys & Girls Club of Greater St. Louis. Out of the thirteen participants that completed Attitudinal Survey I, only nine of these participants completed the pre-test and post-summative assessment, and only six participants completed all three surveys.

In the TFS, the science content knowledge was measured using a pre-test and a summative posttest. The pre-test was completed at the beginning of each unit of study. The posttest was completed during the last week of the TFS program. This approach was different from the method discussed in the methodology because the number of participants was a lot fewer than what was needed to implement the initial lesson plan. (See Appendix for original and revised lesson plans) The initial lesson plan was designed for a minimum of 5-10 girls to complete each review section for a total of 15-30 girls for each review. Unfortunately, we only had three girls to complete each review and an average of eight participants to attend per day. So for the second week I revised the lesson plan by reducing the amount of writing and encouraged the peer leaders to complete a portion of the content pages. This shift allowed us to reach the majority of the goals of the Physical Science unit, but the emphasis on the vocabulary words using Quizlet. com was eliminated because we simply ran out time. The goal was to complete one unit a day, but in reality, it took one week to complete one unit, which included a pretest, posters for each objective for the entire units and at least one hands-on lab for each review section. The review posters contained the objective written at the top and a picture or graphic explaining and/or describing the meaning of the objective.

The Physical Science unit was the only unit we completed fully, because once again time was limited. We completed one more pre-test for Life Science, completed the content worksheet pages, and performed three different hands-on labs under close supervision of the peer leaders. After we completed this unit the participants and peer leaders starting completing a study guide, which was a copy of a practice test that went with the Buckle-down curriculum. This study guide contained three sessions. Session one was comprised of eighteen constructed response questions; session two contained ten performance event problems; and session three contained twenty-five selected response and six constructed response questions. The participants and peer leader really seemed to like the shift, or differentiation in instruction, because the practice test required the knowledge they had gained from working in the Buckle-down workbook and completing the hands-on labs. This allowed them to see how all of their hard work would influence future science assessments. Once all of the participants went over the entire workbook with peer leaders to record and discuss the correct responses, each participant took this study guide home to use as a review for the post test during week five.

Constructivism using Hands-on Lab Experiences

Nature of Science Labs

The lab topics the TFS program that the participants completed were the formation of scientific knowledge, scientific investigation and presenting and interpreting data for the Nature of Science unit. The Physical Science unit labs were physical properties of matter, chemical properties of matter, force and motion and forms of energy. The last unit completed in the TFS program was the Life Science unit. The topics for that unit were structure and function of organisms' reproduction and heredity and ecosystems.

Some of the goals for the hands-on experiences in the Nature of Science unit were to make sure the participants learned the different elements in the scientific method. The Formation of Scientific Knowledge and Presenting and Interpreting Data required the participants to perform an actual lab, while Scientific Investigations only required the participants to write up a lab with the materials listed in the lab write-up. Two or more peer leaders who assisted two or more TFS participants supervised each group. The Formation of Scientific Knowledge lab focused on teaching the participants to use their observation skills to determine what was inside a sealed box. The lab asked the participants to "…..come up with some words indicating the characteristics of each object in the box." Some of the responses were, "two or three cards or packs of something; the box feels light and it sounds like it is heavy; and it feels light and it sounds like money." Stasia wrote in her reflection after this lab, "I had fun today and I will be back next time and I learned that you can be wrong on your first guess." Even though this was a simple lab, the pressure the participants placed on themselves to guess the right answer was beneficial for constructing their own learning.

The second lab that required an experiment was an experience with tennis balls at two different temperatures. The challenge with this lab was access to a freezer to keep the tennis balls cold. We stored them in a cooler until time to complete the lab and the room temperature balls were left out. The content pages discussed the different steps in the scientific method and defined and listed an example of each variable. This lab began with the participants creating a hypothesis statement, identifying some constant variables, writing the procedures to implement the experiment, creating a data table and graph of the data and finally writing a conclusion for the experiment. The hypothesis the participants created was, “If a tennis ball is colder than the room temperature tennis ball, then it will not bounce as well.” The constant variables they recorded were, “the tennis ball brand and the height the balls were dropped from.” The procedures they recorded were, “First I will bounce it from 3 m, next I will measure the height of the bounce, third I will bounce it over, and then do it with a cold ball all over again.” The data table the participants designed was:

Heights of Balls

Trials	Cold (cm)	Room temp. (cm)
1	36	45
2	37	46
3	45	50
Average	39.3	47

The participants did not write a conclusion because we ran out of time, but one of the participants that worked on this lab wrote in her reflective journal, “I learned about core of the sun and more about hypothesis.”

The final lab for Nature of Science asked the participants to design an experiment to study the effect that temperature of water has on water’s ability to dissolve sugar. The original goal was to have two or more groups complete this lab, since we only had nine participants to attend the TFS program that day. The evaluation of the procedures did not occur because the three participants worked together to design this experiment. This experiment focused on the first three steps in the scientific method, the hypothesis, the distinction between the variables and the materials and procedures. The hypothesis the participants created was, "If sugar is placed in different water temperatures then the results will vary." The independent variable was "the different water temperatures." The dependent variable was , "What happens to the sugar?" The constant variables were "the beaker and type of sugar." The purpose of the materials "Thermometer, to determine the temperature of the water; Stopwatch, to watch and record the time the sugar dissolves and Stirring rod, to stir the sugar." The procedures were:

1. Gather all of your materials.
2. Put the different water in the beaker.
3. Measure the temperature of the water.
4. Measure the sugar with the scooper.
5. Put the sugar in the different temperatures of water.
6. Stir with the stirring rod.
7. Take the stopwatch and time how long it takes the sugar to dissolve.
8. Record your data.
9. Repeat with the other temperatures of water.

One of the participants wrote a reflection after this experience, which stated, "I learned how to use the steps in order. I sort of like it, because the experiments. No I will not come back." Another participant wrote in her reflective journal, "I learned what an independent variable, dependent variable, control variable and constant is. I will come back because I had excellent helpers and now I understand science better." The young woman who wrote the first reflection never returned to the TFS program, but the second young woman had perfect attendance in the TFS program, and was the only participant whose pretest score was higher than her posttest summative assessment.

Physical Science Lab Results

The labs for this unit were furnished and facilitated by the Washington University Young Scientist Program. To make sure all the TFS participants had the same information regarding the Periodic Table at the beginning of session three I presented a brief Power point sharing the "Secrets of the Periodic Table". The first lab was a demonstration with liquid Nitrogen and different types of objects. The purpose for this demonstration was to allow the participants to see how temperature has an effect on matter's physical and chemical properties. The peer leaders and participants were all actively engaged in this activity. After this demonstration, the TFS program participants were divided into two separate groups to complete hands-on labs focused on chemistry and physics concepts. The chemistry labs allowed the participants to see additional chemical and physical changes by placing silver paper clips in boiled egg yolks to tarnish, then placing the tarnished silver paper clip in some hot water plus sodium bicarbonate to remove the black tarnish. This simple experiment taught the TFS participants how to clean silver utensils without purchasing silver polish but instead use hot water and sodium bicarbonate, also known as baking soda.

The physics volunteer provided each TFS participant a pair of diffraction glasses that allowed each participant to see all the different colors in florescent white light. He explained how the different colors represented wavelengths in the electromagnetic spectrum, which was a little over their heads, but at least he provided the participants an explanation for why the different colors lined up the way they did.

Some of the reflections the TFS participants wrote about this experience were,

- "It felt good and it is so easy."

- "The science program is very motivating and educational, but I have learned much from it."
- "…For the days I have been here, I think that I learned a lot about physical science."
- "This program has done a lot for me. It has taught me a lot and has taught me that science is used a lot in life."
- "I learned how to put the scientific steps in order when doing an experiment and different variables. I like this club it is good to learn and it is so fun."

The peer leaders were regular participants during the visit from Washington University to increase the number of participants in each experimental group. This experience impacted them as well and was recorded in one of their reflective journal entries. She wrote,

- Today was very interesting. Washington University students came today to teach the girls and peer leaders about chemistry and physics. Although the use of the egg was disgusting, it was quite informative. Now I know how to clean my class ring if it ever gets tarnished. The girls were very excited, especially for the dry ice. They loved to watch the object freeze in seconds then shatter. I feel it is things like this that can draw people into science. Show people that it is not just work. Some of the things are very fun.

Life Science Lab Results

The last group of labs addressed the concepts to increase the TFS participants' understanding of Life Science. We did not complete all the labs in this unit because one lab required access to a library both online or in books. Since we did not have access to these two venues this lab was not implemented, but the students did complete the ecosystem content pages. Eight participants attended the TFS program that day, but one participant was out of the room most of the day for costume measurements, so two groups completed the lab that explained the Structure and Function of Organisms and two groups completed the lab focused on Reproduction and Heredity.

For the Structure and Function of Organisms lab, instead of the participants writing a formal hypothesis, the participants had to list the beakers in order from lowest to highest concentration of water. Each member of both groups recorded “A, B & C”. Buckle-down provided a hint, which stated, “The more salt in the water, the lower the concentration of water.” The next step was to label three slices of a potato, 3 cm x 3 cm and weigh each slice separately. They recorded the mass in their data tables, and then placed one potato cube in each beaker of water. The potato stayed in the water for twenty minutes, and then the participants removed the potato cube and weighed the potatoes again. During the incubation period, the participants made a prediction about what happened during the time. Two participants wrote, “The cube in beaker A will float up; the cube in beaker B will be near the bottom; and the cube in beaker C will go down.” The other two participants recorded numerical predictions. In beaker A, the potato weighed the same; in beaker B the potato increased 0.4 g and in beaker C the mass stayed the same. Both groups found the percentage of change in mass, which can help them answer the analysis questions.

The first analysis question stated, “Did water seem to move into any of the cubes? If so, which one(s)?” Two of the participants reported “C” and two of the participants reported “B”. The second analysis question stated, “Did water seem to move out of any of the cubes? If so, which one(s)?” Two of the participants answered correctly, “A & B” and other two participants answered incorrectly. The third question asked to “Predict what would happen to the mass of a cube placed into a beaker with a water concentration equal to the water concentration inside the cube.” The group of participants that got question two correct also got this question correct. They stated, “It will not increase or decrease" which was correct. The second group said, "The potato got smaller and it lost mass." The last question wanted the participants to infer, "What happens to your cells when the concentration of water outside of your cells is lower than the concentration of water inside your cells?" The first group answered this question correct, too and stated, "The cell decreases in volume." The second group did not answer this question correctly either, because they wrote, "It gets lower and goes down into the water."

The second experiment explored how an organism's trait, such as color, influenced its survival within an environment. One participant had to work with the peer leaders because her partner did not return to the classroom to complete her portion of the lab because of the costume fittings. This participant only completed one trial and she collected more white beans than black, which is opposite to what was expected. The second group completed three trials and each time they collected more black beans than white beans. Even though group two had a partner to work with they did not complete their analysis questions because they had to leave for costume fittings, too.

The participant that worked alone completed her analysis questions with the assistance from her peer leaders. The first question asked, "Which color provided better camouflage against the birds? How do you know?" She reported, "Black because it's hard for the birds to find." The second question stated, "Suppose that the birds eat the organisms and the survivors keep reproducing several more times. Over several generations, what change will occur in the coloration of the population? Explain why this change takes place." She wrote, "The white will die because they can see it. The black will not die because they cannot see it." The third question stated, "Suppose that, after several generations, you introduce some simulated pollution to the environment by painting the gravel white. What will happen to the overall coloration of the population after several more generations?" She stated, "The black will die," which is correct, but incomplete. The last question stated, "Some people think that evolution involves individual plants or animals somehow "choosing" to adapt to a change in the environment. Use this simulation to explain why that understanding of evolution is incorrect." She wrote, "The white ones died because they did not fit the environment." This was partially true, but incomplete like question number three.

The procedures used to confirm the influence of the TFS program on attitude and self-perception about science was to provide the students' access to a female teacher-researcher, knowledgeable peer leaders that were female that facilitated the participants completion of science content workbook pages in the Buckle-down workbook and hands-on labs, which were included for review. The peer leaders and participants also worked in cooperative-learning groups with role models from Washington University to complete hands-on labs. There is definitely a need to educate and expose underrepresented females, age 11-15, access to authentic science instruction and experiences using active learning strategies. Because the N for this project was very small, no generalizations to the 11-15 year old female population were possible.

Semi-structured Interviews

The semi-structured interview was another data collection method used in this program. According to Merriam (1998), this format allows the researcher to respond to the situation at hand, evaluate the emerging worldview of the respondent and synthesize the new ideas on the topic (p. 74). In the semi-structured interview, open-ended questions were used. Open-ended questions allowed the participants to construct details of their experiences concerning the relevant ideas and issues, which were being studied. According to Merriam (1998), it is through these details that participants tell stories from their streams of consciousness, thus giving access to the most complicated social and educational issues (p. 1). The main intent of the interviews was to encourage participants to discuss their perceptions, beliefs, and thoughts about learning and their experiences when faced with these opportunities. The open-ended questions that fueled this semi-structured interview were: 1) What are some of the benefits of the program? Be specific and support your answer. 2) What strategies and/or activities were the most affective for you in the program? Be specific and support your answer.

Since the researcher was a participant in the interview, a peer leader facilitated the interview. Three additional peer leaders monitored the interview and documented in a notebook a few words from each participant to assist the researcher when she began the transcription process. This security check was embedded, because the semi-structured interview was facilitated as a focus group, instead of individual semi-structured interviews. The focus group contained the researcher as participant, two TFS peer leaders, three TFS participants and one TFS graduate assistant. The interview environment was free of distractions. The researcher transcribed the interview verbatim immediately. The researcher then checked for accuracy by listening to the recordings several times while reading the transcripts. Spelling and punctuation errors were corrected. A copy of the entire transcription for the interview is attached to this document (see Appendix N).

“Data analysis is a complex process that involves moving back and forth between concrete “bits of information” and “abstract concepts”, between inductive and deductive reasoning and between description and interpretation” (Merriam, 1998, p. 177). As qualitative researchers through analysis, we attempt to understand the meaning behind the phenomenon of interest. “The overall purposes of qualitative research are to achieve an understanding of how people make sense out of their lives, delineate the process … of meaning-making, and describe how people interpret what they experience” (Merriam, 1998, p. 14). Preparing data for analysis is a process of transformation, which involves the researcher as the instrument. According to Merriam (1998):

> The analysis of the data involves identifying recurring patterns that characterize the data. Findings are these recurring patterns or themes supported by the data from which they were derived. The overall interpretation was the researcher’s understanding of the participants’ understanding of the phenomenon of interest (p. 23-24).

The types of coding used in the data analysis were “open coding” an initial organization of the data and “axial coding” bringing the categories/concepts together (Strauss & Corbin, 1990). As I identified relationships, the coding process became clearer since I could see “alternative explanations” (Strauss & Corbin, 1998). This insight into the data itself made it possible for me to “relate categories to sub-categories along the lines of their properties and themes” (Strauss & Corbin, 1998, p. 124).

Results

Research Question & Hypothesis 1

What effect does female participation in the TFS after-school program with a peer leader working in cooperative-learning groups have on learning science content?

Hypothesis: The female students that participated in the TFS after-school program with a peer leader working in cooperative-learning groups did increase in their science content knowledge.

Posttest and Pretest Results from TFS Participants

Paired Samples Statistics

Mean	N	Std. Deviation	Std. Error Mean
5.78	9	2.489	.830
12.33	9	5.074	1.691

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
Pair 1 Pre-test – Post test	-6.556	5.790	1.930	-11.006	-2.105	-3.396	8	.009

Table 4

The paired-samples t test was conducted to evaluate whether students' science content knowledge improved from the beginning of the TFS program to the end of the program. The results indicated that the mean for the post test (M = 12.33, SD = 5.074) was significantly greater than the mean for the pre-test (M = 5.78, SD = 2.489), t (8) = -3.40. The p value is .009. Since $p < .05$, the research hypothesis is accepted. The 95% confidence interval for the mean difference between the two tests was -11.01 to -2.11.

Bubbles was the first participant to realize how the TFS program influenced her science content knowledge in her regular classroom. She wrote in her reflective journal, "I have always liked science, but this program made me love science. Even though I did not attend every session I still learned a lot from it and I thank Ms. Hill for that." (Lines 7-9) When she participated in the semi-structured interview she said, "…that it help me to ace the MAP test for the science part and that science is easier for me in HS." Hearing her say this really made me say, "Wow", because this was the initial purpose for implementing it in the spring to help the participants be successful on the MAP.

Bubbles answered 6 out of 25 correct on the pre-test and an answered 21 out of 25 on the post test. Her pre-test score was very close to the mean score for the program, but her post test score was eleven points higher than the post test mean. This huge increase in correct responses explained her comment during the semi-structured interviews that she had, "Aced the MAP for science."

Stasia, the 7th grader answered 6 out of 25 on the pre-test and 19 out of 25 on the post test. Her pre-test score was close to the TFS mean score and her post test was over six points higher than the TFS post test mean. The peer leaders voted Stasia as the best participant in the program because she was so cooperative and engaged in all of the activities, no matter what the activity was. Her test results were a huge surprise, because her reflective journal responses did not reveal how much she was learning, or her semi-structured interview discourse. She reported in her reflective journal,

> In this program, I have learned about the Nature of Science. Also in this program, I have learned about scientific investigations. Then I learned about the scientific method. In this program, I learned force and motion. I really like this program; it helps me a lot. (Stasia, Lines 5-7)

During her semi-structured interview, she appeared shy. The first time she tried to speak, she said, "Uhm", but finally by the end of the interview she finally said, "The book work and the hands-on and all of the lab stuff it helped me learn science more, like learn more than I knew at first when I came into the program."

Jasmine, the 6th grader really surprised me, because she answered 4 out of 25 problems correct on the pre-test and answered 12 out of 25 problems correct on the post test. This was a huge surprise, because Jasmine was a 6th grader and had not been exposed to science instruction in her regular classroom.

Research Question and Hypothesis 2

What effect does female participation in the TFS after-school program with a peer leader working in cooperative-learning groups have on their affective domain, namely attitude toward science and self-perception?

Hypothesis: The attitude of the female students that participate in the TFS after-school program with a peer leader working in cooperative-learning groups can change positively toward science.

In order to change a person's attitude or self-perception about something new the person must have authentic access to opportunities that influenced the affective domain. In 1996, The National Research Council (NCR) reported that current US science education reform needed to move to more constructivist practices instead of passive ones. In the constructivist model, the teacher is the facilitator and the students are actively constructing their own understanding based on how they connect the new information to their prior knowledge. This phenomenon not only produces students that are motivated to achieve and learn, but students that can see themselves in science careers because of the successes they have had in the classroom or after-school programs. I decided to measure a change in attitude toward science and self-perception with these participants by allowing them to complete in an attitudinal survey at three different points throughout the program.

Below in Table 2 is a summary of the participants' frequency results based on the data ran in Statistical Package for the Social Science (SPSS) from all three attitudinal surveys. The complete results are for the frequencies for each question are in Appendix O.

TFS Summary Table of Survey Frequencies – Attitude

Table 5

Q #	Questions & Survey	Disagree				Agree
1	**Can women be as good in a science career as men?**	**1**	**2**	**3**	**4**	**5**
	S-I				1	5
	S-II				1	5
	S-III					6
2	**Can women make important scientific discoveries?**	**1**	**2**	**3**	**4**	**5**
	S-I			1	2	3
	S-II			1		5
	S-III				2	4
3	**Are successful science careers just as important to a woman as it is to a man?**	**1**	**2**	**3**	**4**	**5**
	S-I	1			2	3
	S-II				3	3
	S-III	1			1	4
4	**Should women have the same job opportunities in science careers as men?**	**1**	**2**	**3**	**4**	**5**
	S-I		1		1	4
	S-II	1		1	1	3
	S-III	1			1	4
5	**Should women have the same chances for advancements in science careers as men do?**	**1**	**2**	**3**	**4**	**5**
	S-I		2		1	3
	S-II	2			2	2
	S-III			1		5
6	**Do you like science?**	**1**	**2**	**3**	**4**	**5**
	S-I	1		2	1	2
	S-II	1	1		2	2
	S-III	1		3		2
7	**Is science easy for you?**	**1**	**2**	**3**	**4**	**5**
	S-I			4	1	1
	S-II	1	1	2	1	1
	S-III	1	1	3		1

8	**Do you think science is fun?**	**1**	**2**	**3**	**4**	**5**
	S-I	1		2	1	2
	S-II	2	1	1		2
	S-III		2		2	2
9	**Do you feel it is better for a woman to study home economics than a science subject?**	**1**	**2**	**3**	**4**	**5**
	S-I		2	3		1
	S-II		1	2	1	2
	S-III	1	2	1		2
10	**Do women that choose a science career have an unhappy life?**	**1**	**2**	**3**	**4**	**5**
	S-I	3	2		1	
	S-II	3	1	1		
	S-III	3	2		1	1

Due to the small N for this study, Question 1, Can women be as good in a science career as men?, is the only question whose responses have progressively improved as the participants time in the program increased. The remainder of the survey questions did not support the comments the participants reported in their open-ended questions on surveys II and III. For example, on attitudinal survey II there was an increase for several questions from attitudinal survey, I demonstrating a positive change. When the same questions were evaluated for attitudinal survey III, there was a decrease indicating a negative change. These inconsistent responses were attributed to some of the participants wanting to run around the Club with their peers and some of the participants wanted to attend athletic practice or theatrical rehearsals. Fortunately, these issues did not surface until after week three. We overcame this challenge by everyone demonstrating patience and having motivational talks from several TFS staff on the benefits of participating in the TFS program for their future.

The second analysis ran in SPSS on this data was the correlation results comparing the survey responses between surveys I, II, III.

TFS Attitudinal Survey Correlation Results for Attitudinal Changes

	Attitudesum 1	Attitudesum 2	Attitudesum 3
Pearson Correlation	1	.958**	.742*
Sig. (1-tailed)		.001	.046
N	6	6	6
Pearson Correlation	.958**	1	.805*
Sig. (1-tailed)	.001		.027
N	6	6	6
Pearson Correlation	.742*	.805*	1
Sig. (1-tailed)	.046	.027	
N	6	6	6

**. Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).

Table 6

The correlation between survey 1 and survey 2 is significant ($p = 0.958$) at the 0.01 level (1-tailed). The correlation between survey 1 and survey 3 is significant ($p = 0.742$) at the 0.05 level (1-tailed). The correlation between survey 2 and 3 is significant ($p = 0.805$) at the 0.05 level (1-tailed). These outcomes show that the elements of the survey vary together.

The graph below displays the trend analysis for attitudinal changes from Attitudinal Surveys I, II and III.

TFS Attitudinal Trend Analysis from Attitudinal Surveys

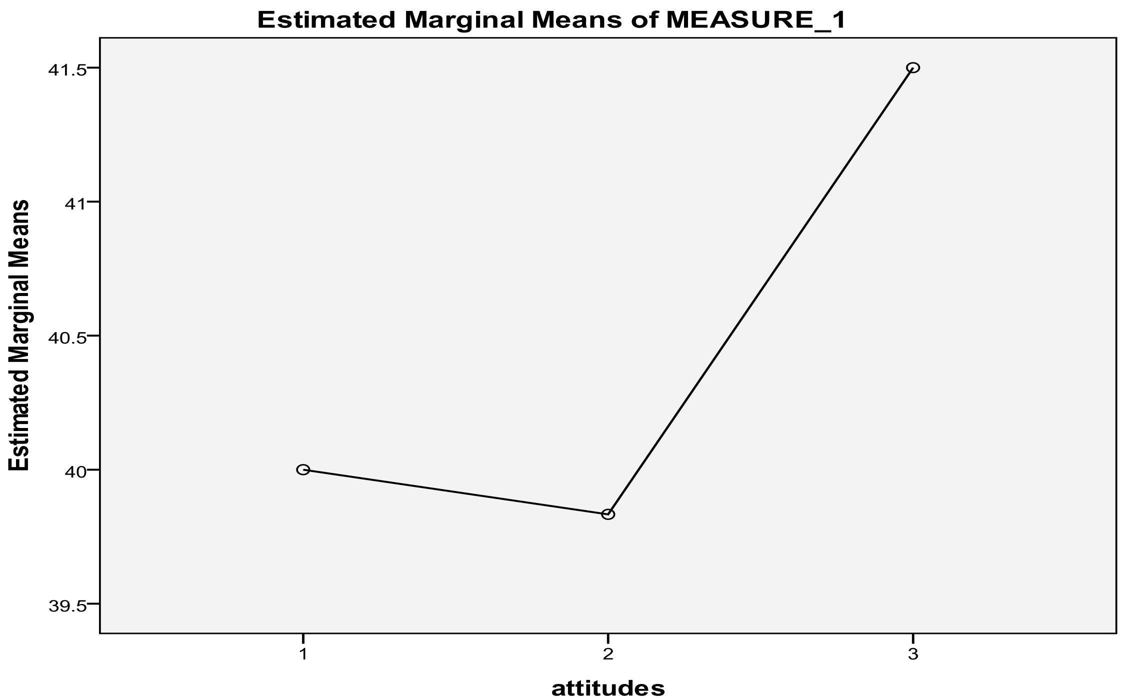


Figure 2

This graph shows the change in attitudes from one survey to the next. The *x-axis* indicates the three different times the participants completed a survey and the *y-axis* is the average sum for each survey. There is a -0.17 change from survey one to survey 2 and a +1.67 change from survey 2 to survey 3. From survey 1 to survey 3 there is a +1.50 change. This shows that even though the changes were small, the participants' attitudes did increase positively, but non-significantly from the beginning to the end of the program.

The last test ran on the attitudinal survey data using SPSS was the paired samples test comparing Attitudinal Survey I to Attitudinal Survey III.

TFS Attitudinal Paired Samples Test for Attitude Results

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	sum1	36.67	6	3.777	1.542
	sum3	37.83	6	3.869	1.579

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	sum1 & sum3	6	.721	.106

Paired Samples Test

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	sum1 - sum3	-1.167	2.858	1.167	-4.166	1.832	-1.000	5	.363

Table 7

Figure 14 a paired-sample t test was conducted on the sums of the first survey and the third survey to evaluate whether there was a significant difference in attitude changes from the beginning of the program and the end of the program. The results indicated that the differences between the mean of the first survey (M = 36.67, SD = 3.777) and the third survey (M = 37.83, SD = 3.869) are non-significant. The p value is .363 (2-tailed) or .182 (1-tailed), which is non-significant at $p < .05$.

On day five of the program the students took Attitudinal Survey II, which was immediately following the visit from the role models from Washington University. The two open-ended questions on this survey were: 1) Explain in detail(s) if your attitude about science has changed and 2) What specifically caused your change in attitude about science? Three of the participants, Bubbles, Marie Babee and Jasmine said their attitude about science changed. Bubbles said, "I have always enjoyed science and science related things. So now I have realized that science is important so I enjoy science much better now." Marie Babee said, "My attitude had changed a little but I would not choose it for my career, because it is not fun. Also at the same time it is fun, because I learned new things and new chemical from this program." Jasmine said, "Yes, because my attitude has changed and helped me to get along with people and stay out of fights." Jasmine not only changed her attitude, but her self-perception was also affected. Stasia, Tiff and Riah all responded with either "No and/or science is not fun to me." Marie Babee and Jasmine were the only two participants to respond positively to the second question. Marie Babee said, "What changed my attitude was the science program on Wednesday." Jasmine, on the other-hand, said, "Because I get along with the people in there and it teach me how to get along with people outside the club, work as a team in school and out of school. Because we are always working in groups." These testimonials substantiate what the researchers believe as well.

The five open-ended questions for Attitudinal Survey III were:

1) Which activity (ies) did you enjoy the most in the TFS after-school program? 2) Which science content do you know for sure? 3) Which science content do you still struggle with? 4) Explain in detail if your attitude about science changed. 5) What do you feel caused this attitudinal change? If your attitude changed about science, which part of the program do you feel caused your attitudinal change? Be specific. The majority of the participants responded to question number one as the hands-on activities in general with

two participants acknowledging Washington University in their response; and one participant said she enjoyed all the classes because it helped her learn more about science. The concepts the participants reported they know for sure were the Chemistry and Life science content, but one participant reported gravity. The content the participants said they still struggled with was sexual and asexual reproduction and plant cells. This time when I asked if their attitude about science changed, four participants now reported that their attitudes had changed. Stasia now said, “In the beginning I didn’t like science, but now I like it.” Tiff one of the other students who said participation in the program had not changed her attitude on Attitudinal Survey II now says, “It helped me learn when I move up a grade and when the teacher ask me a certain question I can know the answer.” Jasmine did not write in her reflective journal as I instructed, but responded on Attitudinal Survey III, “The parts of the program that changed my mind about science were the experiments, because they taught me new things and made science seem more fun.” The participants that did report a change said the part of the program that caused the change was the hands-on labs and experiments, and Jasmine included, “because it taught them new things and made science seem more fun.”

Research Question and Hypothesis 3

What effect does female participation in the TFS after-school program with a peer leader working in cooperative-learning groups have on her career choice?

Hypothesis: The female students that participate in the TFS after-school program with a peer leader working in cooperative-learning groups can consider a science career.

In order for a change in career choice can be considered a person’s attitude must be impacted. The results from the three Attitudinal surveys did not indicate any significant different between each survey. Below are the summary results from running frequencies on this data for each attitudinal survey.

TFS Summary Table of Survey Frequencies – Career
Table 8

Q #	Questions & Survey	Disagree				Agree
11	**I would like to choose a science career someday.**	**1**	**2**	**3**	**4**	**5**
	S-I		1	2	1	2
	S-II	1		2	1	2
	S-III	1	2	1	1	1
12	**I would like to find a cure for cancer or HIV-AIDS.**	**1**	**2**	**3**	**4**	**5**
	S-I	1		3		2
	S-II	1		2	1	2
	S-III		1	2	2	1
13	**I would like to design a vehicle to reduce the amount of carbon dioxide in the environment.**	**1**	**2**	**3**	**4**	**5**
	S-I	1		1	2	2
	S-II	1		2	3	
	S-III	2	1	1	2	
14	**I would like to teach science to others in a traditional classroom or after-school program?**	**1**	**2**	**3**	**4**	**5**
	S-I		1	2	1	2
	S-II	1	2	1	1	1
	S-III	2	1	2	1	
15	**Without good math and science skills one cannot choose a science career.**	**1**	**2**	**3**	**4**	**5**
	S-I	1	2	1	1	1
	S-II		2	1	1	2
	S-III	2	1		2	1

Similar to the attitudinal results from the surveys I, II and III none of these survey questions supported the comments the participants reported in their open-ended questions on survey III. For example, on attitudinal survey II there would be an increase for several questions from attitudinal survey I demonstrating a positive change. When the same questions were evaluated for attitudinal survey III was a decrease indicating a negative change. These inconsistent responses can be attributed to the participants wanting to do hands-on labs all the time, instead of learning the content first, then performing the hands-on labs and due to the small sample size and the students being younger than eighth grade. These challenges increased the amount of time the participants needed to complete the content pages, so we only completed hands-on labs for three days with the peer leaders and one full day of hands-on experiences when the role models from Washington University Young Scientists came in.

The second analysis using SPSS was correlations between each survey. The table below displays this data.

TFS Attitudinal Survey Correlation Results for Decision to Choose a Science Career
Correlations

		Careersum 1	Careersum 2	Careersum 3
Careersum1	Pearson Correlation	1	-.232	.646
	Sig. (1-tailed)		.329	.083
	N	6	6	6
Careersum2	Pearson Correlation	-.232	1	.414
	Sig. (1-tailed)	.329		.207
	N	6	6	6
Careersum3	Pearson Correlation	.646	.414	1
	Sig. (1-tailed)	.083	.207	
	N	6	6	6

Table 9

There is no correlation between the survey questions pertaining to career choice. This shows that the elements of the survey do not vary together.

The graph below displays the trend analysis for career choice changes from Attitudinal Surveys I, II and III.

TFS Attitudinal Trend Analysis for Career Choice

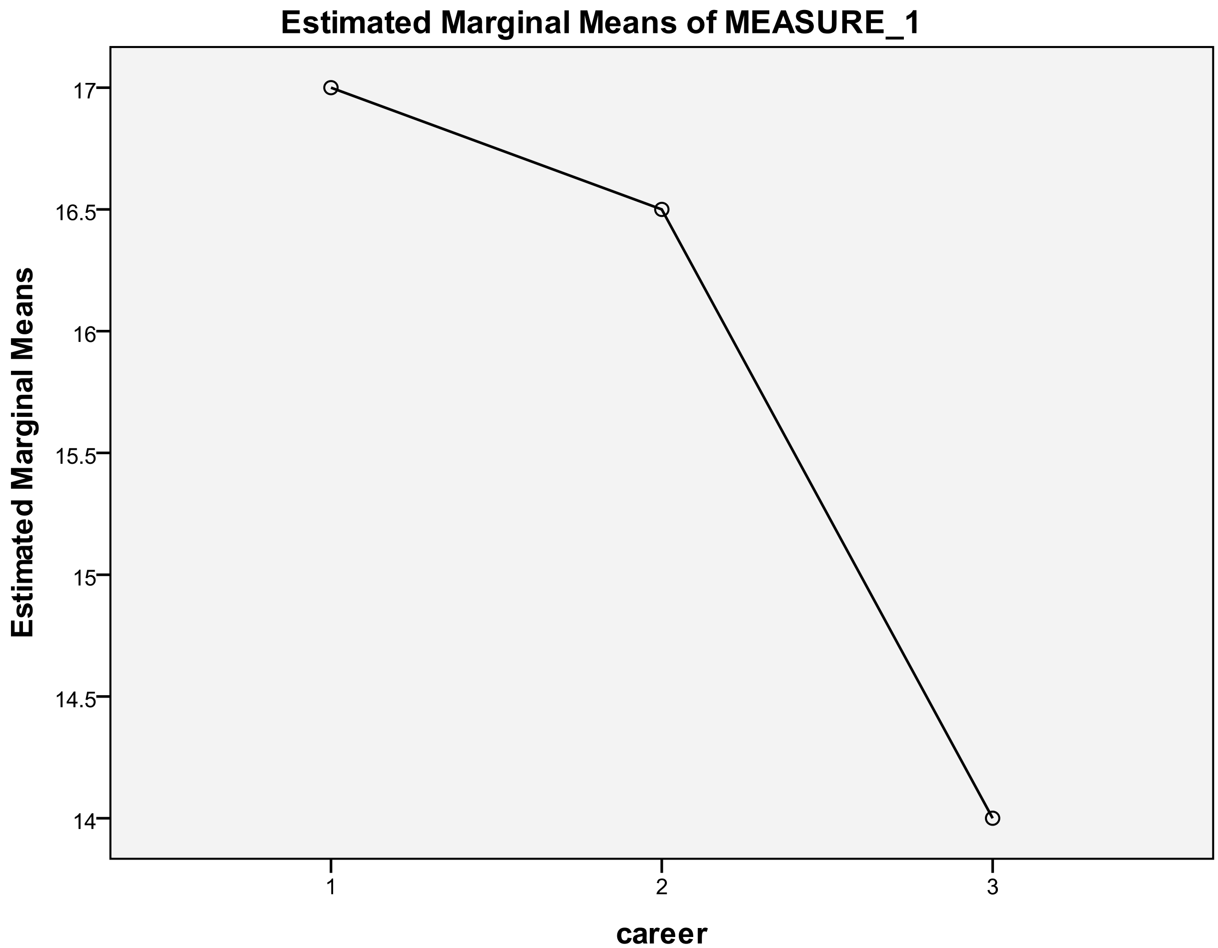


Figure 3

This graph shows that from the beginning of the program to the end of the program there was a decline in whether or not the participants' would choose a career in the STEM fields. The *x-axis* indicates the three different times the participants completed a survey and the *y-axis* is the average sum for each survey. There is a -0.5 change from survey one to survey 2 and a -2.5 change from survey 2 to survey 3. From survey 1 to survey 3 there is a -3.0 change. This shows that even though the changes were small, the participants' career choice decreased.

The last test run on the Attitudinal Survey data using SPSS was the paired samples test comparing Attitudinal Survey I and Attitudinal Survey III. A paired-sample t test was conducted on the sums of the first survey and the third survey to evaluate whether there was a significant difference in career choices from the beginning of the program and the end of the program. The results indicated that the differences between the mean of the first survey (M = 17.00, SD = 5.727) and the third survey (M = 14.00, SD = 4.000) are non-significant. The p value is .154 (2-tailed) or .077 (1-tailed), which is non-significant at $p < .05$.

Semi-structured Interview

The two categories that emerged in this study were Benefits of Program for the participants and Learning Environment*.* The Findings table in Appendix E summarizes the results from these categories, but each category is described separately below. The Benefits of the Program were separated into two sub-categories, personal growth and development and peer leadership. Both of these attributes to the program are very beneficial to female academic achievement as cited by Keili (1969), Wentzel (1996) and the Johnson research team (2010). The themes of personal growth & development were visible in the teaching skills and academic preparation. The themes for peer leadership were evident in peer interaction and social skills, leadership skills, completion of labs and assignments and grade increase.

The influence that teaching skills had on personal growth and development was seen as important by the researcher, graduate assistants and a peer leaders. “Some of the benefits of the program for me, hum I get to learn more.” (PL Victoria, Lines 3) I noticed even though the peer leaders “were older than them, they really seemed like they enjoyed the experience." (PI, Line 50) The graduate assistant felt, "Where everybody did not want to do their work, so it really was important for me to try and isolate and figure out why someone did not want to do their work…." (GS Leslie, Lines 68-69)

The academic preparation influenced the participants and two of the peer leaders in their personal growth and development. The participants reported, "Hum the benefits is of the program is that it help me learn more an when I go to 7th grade it give me prepared for 8th grade and for science test." (P Jasmine, Lines 10-11) Another participant said, "Some of the benefits for me were that it help me to ace the MAP test for the science part and that science can be easier for me in high school." (P Bubbles, Lines 12-13) One of the peer leaders acknowledged during this discussion that, "Using hands-on things and I think that made me learn more science material better " (PL Chel, Lines 76-77).

The peer leadership benefits were tri-fold because the participants, peer leaders and the graduate student had experiences that influenced them in this sub-category. The peer interaction & social skills evidence was, "It help me by, hum, when we get together in a group and we help each other and we get the job done. " (P Jasmine, Lines 37-38) A peer leader said, "Also when going back to the younger people in our group, hum, I felt like it taught me more that age does not define how, hum, how intelligent you are or the capacity for your mind space." (PL Victoria, Lines 53-55) On her first day she noticed, "Something that I noticed is on my first day was that if a student was not really doing what they was suppose to do when they were doing it, this effected other girls…" (GS Leslie, Lines 65-67)

The peer leaders and graduate students felt this program enhanced their leadership skills. Several of the peer leaders reported how participation helped build their leadership

and the graduate student said she had to use her skills to determine if a participant was "hungry or were they tired, did they have a bad day, hum, so I learned how, the fact that learning can be connected to many things in somebody's life…" (GS Leslie, 70-71)
The third theme of peer leadership dealt with completion of labs and assignments. The main point the peer leaders and participants reported was how much fun the hands-on labs were. I noticed, "they were using the equipment, they were not abusing the equipment." (Line 42) The final theme addressed grade increase and one participant said, "Some of the benefits of this class help me and it help me get a good grade in science." (PL Stasia, Line 24) Another participant said, "I didn't want to do any book work, but the book work help me to be more successful in science class and then like it help me get a better grade in science." (PL Bubbles, Lines 79-80)

The second category, learning environment, was divided into two sub-categories, learner's participation and strategies. The themes for learner's participation were willingness to participate, self-confidence, enthusiasm and motivation. The themes for strategies were experiential learning and effectiveness of strategies.

The learner's willingness to participate was felt by the peer leaders and me. One of the peer leaders reported working in the program, "Helped me remember more things for me chemistry class rather than just staring at notes over and over again." (PL Victoria, Lines 35-36) "I also realized the importance of the participants' to participate even when some of them had never participated in a lab before, but they jumped right in." (Line 41) The self-confidence was visible because even, "Though the girls were 6th graders they were not shy about lab even though they had never participated in a lab before." (Lines 40-41) I had enthusiasm when I saw the enjoyment and energy the participants had when they answered the questions after the labs and when Washington University came to work with the girls. One participant realized that she had to be motivated to learn, so she admitted, “When I first came into the program I did not want to work at all, like to be honest. I did not want to do any book work, but the book work help me be more successful.” (P Bubbles, Line 78-79)

A 7th grade participant realized the effectiveness of the strategies and said, “The book work and the hands-on and all of the lab stuff helped me learn more, like learn more than I knew at first when I came into the program.” (P Stasia, Lines 81-82)

Conclusion

The TFS program was comprised of eight peer leaders, who were former 8th grade students that are currently in the 9-12th grades in high-school; three role models that volunteered in the Young Scientist Program at Washington University; 11-15 year old females that were members of Boys & Girls Club of Greater St. Louis – Herbert Hoover; two graduate students, one in a master’s program and one in a doctorate program and the researcher as the principle investigator. The purpose of this program was to determine what would happen if we provided these 11-15 year old female participants access to work in cooperative-learning groups with similar age peer leaders and role models, performing hands-on labs and using the Buckle-down curriculum as a guide. The three target areas were to increase science content knowledge, positively change attitudes about science and self-perception and influence decisions to choose a science career. The data collection modes were a pretest, summative posttest, attitudinal surveys, semi-structured interview and reflective journal entries from all the participants, except the role models.

The evidence for the TFS study was supported with quantitative and qualitative results. This data also revealed that age and grade level is not critical when it comes to increasing science content knowledge, because as long as you commit yourself to the experiences offered by the program and your attendance is 60 % or greater your learning can improve. The small sample size inhibits overall generalizations for larger populations, but for smaller sample sizes these results are encouraging. Many of the studies I reviewed and cited for this study had small sample sizes too, but fortunately this N = 6 did provide me with some insight into what to do to help underserved female participants increase their science content knowledge in five or six weeks.

Even though the results from the attitudinal surveys were statistically non-significant I was pleased to see that the surveys did have a positive correlation and positive trend analysis. These results also reveal that when working with this age group it is important to make sure each participant is supervised to ensure that the participants are reading each question for understanding and not just selecting any answer so they can get the survey completed. The open-ended questions did reveal some insights into what the participants were feeling and the responses from Attitudinal Survey III went even deeper into what the participants received from the program.

Even though all of the results were no significant for each test run on the career choice data, the majority of the participants did express how they enjoyed the hands-on experiences, so maybe with additional exposure to these types of settings this might influence their future aspirations. Bubbles expressed an interest in science at the onset of the program and Marie Babee shared with the audience at the culminating event that, "I kinda like it, so now she might be inspire me to probably be a scientist someday." I am still hopeful even though the quantitative data did not support the message the participants were conveying in the qualitative results.

Based on the results of the TFS study the first hypothesis stated the participants' would have an increase in their science content knowledge was accepted. The difference between the post-summative assessment and pretest results was significant with a p value of 0.009. The second research hypothesis stated the participants' would have a positive change toward science after participation in the TFS program. This hypothesis was rejected because the differences between survey 1 and survey 3 were non-significant. There was a strong correlation between survey 1 and survey 3 at the 0.05 level, which yielded a positive trend line. The third hypothesis stated the participants' would consider a science career. This hypothesis was also rejected, because the difference between survey 1 and 3 were non-significant. These results were non-significant and yielded a negative trend line. Due to the small number of participants in the TFS program no generalization across larger groups of participants can be assumed.

The final chapter discussed a general overview of design and methodology for the TFS program. I provided a thorough overview and discussion of the findings with some reflections from several representatives of the different participants in the program and myself. The reflections documented how participation in the TFS impacted and changed their lives. I reviewed each hypothesis and provided support for what influenced the hypothesis to be accepted and speculations of hope for the hypotheses that were rejected. There is a brief section that explains how the TFS program contributes to the existing research. Lastly I discussed my future aspirations for the TFS program, summary and conclusion for this study.

Chapter 6 - Discussion

Introduction

Why are African-American females underrepresented in careers that focus on science, technology, engineering and math (STEM) as compared with males (Brickhouse, et al. 2000; Hill et al., 2010)? The purpose of this study was to see if exposing underrepresented urban 11-15 year old females to peer-led cooperative learning and if access to role models could influence their affective domain regarding science and science careers and increase their science content knowledge. The quantitative and qualitative research questions to guide this study were: 1) What effect does female participation in an after-school program with a peer leader working in cooperative-learning groups have on learning science content? 2) What effect does female participation in an after-school program with a peer leader working in cooperative-learning groups have on their affective domain, namely attitude toward science and self-perception? 3) What effect does female participation in an after-school program with a peer leader working in cooperative-learning groups have on her career choice?

Middle school is an ideal academic level to promote and implement peer learning. Keill (1969) reported that this theory can be applied in collaborative learning, peer tutoring, cross-age tutoring, learning communities, peer-assisted learning, and team-based learning, which was demonstrated in the Training Future Scientist (TFS) program. The purpose of this chapter is to provide some reflections from the participants on the findings from the TFS program. The chapter will also reveal the outcomes of the TFS program and the impact participation in this program had on each individual participant. A brief literature review explains how the TFS program was similar to other programs cited in the literature. Finally, this chapter discussed how the TFS program can be facilitated in the future as an after-school program in a regular classroom or experiential setting.

Review of Methodology

The TFS program was implemented at the Boys and Girls Club of Greater St. Louis – Herbert Hoover (the Club), an after-school facility located in an urban area. This facility provides academic and recreational programs for children ages 5-18.

The purpose of the TFS was to expose female participants to as much science content that could be packed into two hours each day. Most days began with the participants completing an attitudinal survey, taking a pre-test, adding the final touches to science posters or finishing content pages from the review section they had been assigned. After one hour snacks were provided for all of the program participants as motivation to keep working. The facility provided snacks to all of the Club members at 4:30 pm, so I scheduled my snack later in the program.

The facility provided access to two different rooms and a computer lab. On Mondays the program was located in the cafeteria, which was a large spacious room with tables and chairs. On Wednesdays the program was in the music room because another program for younger children was scheduled in the cafeteria. This was a smaller room, but it had sufficient tables and chairs for the participants in the program. When the participants needed to use the computer the TFS participants shared the computer lab with the Teen Center, which was in close proximity to both of our designated rooms. Below, in table 6.1, is an overview of the entire TFS program.

TFS Program at a Glance

Day	Lesson Plan & Activities
1	• Program member introductions • Pretest and take Attitudinal Survey I • Complete review for Unit 1: The Nature of Science (Scientific Investigations, The Scientific Method, Science and Technology)
2	• Finish review & lab for The Nature of Science • Re-take Attitudinal Survey I • Write reflection, "How do you like the program, will you come back?"
3	• Revise lesson plan • Take pretest for Unit 2: Physical Science (Physical Properties of Matter, Chemical Properties of Matter, Forms of Energy, Force and Motion) • Complete content pages for Physical Science • Create posters for each objective for Physical Science
4	• Role models visit from Washington University • Girls rotated through Physics and Chemistry stations
5	• Complete Attitudinal Survey II • Finalize Physical Science posters • Take pretest for Unit 3: Life Science (Structure and Function of Organisms, Reproduction and Heredity, Ecosystems)
6	• Write a reflection, "What does the program mean to you?" • Begin completion of content pages for Life Science
7	• Revise lesson plan again • Begin Study guide completion with select girls • Dismissed some girls early for play rehearsal
8	• Finalize the completion of study guide • Girls took the student guide home to review for summative assessment on the following Monday • Dismiss select girls for facility activity • Record Focus group interview with remaining participants, peer leaders, graduate student and researcher
9	• Take post summative assessment • Complete hands-on labs for Life Science
10	• Complete Attitudinal Survey III • Take summative assessment • Culminating event with TFS participants, families, friends, women scientist and community members
11	• Complete Attitudinal Survey III • Take summative assessment

Table 10

TFS Program Participants

The TFS program consisted of four different groups of participants not including myself, the researcher as participant. The different groups were Boys & Girls of Greater St. Louis club members, peer leaders, graduate students and role models from Washington University. The first group was seventeen females that were all members of the Club. Thirteen out of these seventeen girls completed the revised first survey. The first survey had to be revised because a space for the name was not included and in order to track the girls' responses a name line had to be included. Three of these young women, Roxy, Lee Lee and Bre (pseudonyms) did not return for the second session; however, we gained two additional girls, Stasia and Joy (pseudonyms) that started attending on the second day of the program. Joy only came for one session because her mother said, "She could not promise that she could stay at the Club until 7 p.m. every day," so I told her "She did not have to participate."

Another young woman, J. Shelrocks came on day four but did not return because she wanted to participate in a Fine Arts production the Club was presenting in May. I told her "Okay too" because she had already missed three sessions. Now we were down to nine girls out of thirteen that continued in the program. These young women were 11-14 years old and in the 6^{th} -8^{th} grades, attending public and charter schools. The following girls were Mya, Riah, Marie Babee, Tiff, Stasia, Jasmine and Yah Yah (pseudonyms) who attended public schools and Bubbles and Oreo (pseudonyms) who attended a charter school. The attendance rate for these participants ranged from 60 – 100%, with only Marie Babee maintaining perfect attendance.

The second group was the peer leaders. At the onset of the program we started with ten peer leaders ranging in age from 15 – 18, who were in the 9th through 12th grades. Since the program did not start until later in the spring versus early spring, two of the peer leaders had enrolled in sports programs at their perspective schools and the practice schedule and/or track meets were on the same days as the TFS program. Fortunately, eight peer leaders were sufficient, especially with the number of participants being so low. On the first day of the program only three peer leaders, Dinah, Chic and Rye (pseudonyms) arrived because we had so many false starts. The other five girls simply did not receive the notice that the program was starting on April 15. On Wednesday of that first week, four additional peer leaders, Dorf, Morf, Chel, and Ria (pseudonyms) arrived but Diah was not able to begin until the second week of the program because of her sports schedule.

The third group was the graduate assistants who were invited to participate in the TFS program to monitor any issues with the participants and peer leaders. They also served as additional adult supervision when the researcher had to leave the room to work and/or talk with the facility staff. The first graduate student, Shu, was a student receiving her masters from the University of Missouri-St. Louis. She was only able to participate in the program for two sessions because of her own academic schedule. The second graduate student, Leslie, is one of my past students from fifteen years ago that was so overjoyed that she would be able to assist with the TFS program. Due to her work schedule she was not able to join the TFS program until session six.

The fourth group was the role models from Washington University Young Scientist Program. There were three representatives, two who worked with the TFS participants with chemistry concepts and one who worked on physics concepts. Neither one of these role models had visited this facility before. They were very impressed with how easy the participants were to work with, despite their age. Each role model facilitated three experiments with five TFS participants and four peer leaders for 50 minutes for each science concept.

The final participant was myself, who is a teacher-researcher that believes that peer-led cooperative-learning is an effective strategy to use in secondary science education. I have used this strategy for many years in my regular classroom and decided as a dissertation project to see if the strategy could be effectively implemented in an after-school program even though I was not the students' primary science teacher. I identify myself as a teacher-researcher because my adult professions include fifteen years as a teacher and over twenty years as a research scientist. Because I have had so much success using this strategy in my regular classroom and after-school program I was shocked and surprised at all the struggles I encountered during the facilitation of the TFS program.

The focus group members for the TFS program were three participants that scored in the high and middle range on Attitudinal Survey I and completed Attitudinal Surveys II & III. The participants were Bubbles (pseudonym), an 8th grader attending a local Charter school, Stasia (pseudonym), a 7th grader attending a local public middle school and Jasmine (pseudonym), a 6th grader attending a local public elementary school. These participants were selected as members for the focus group because they demonstrated a strong interest in science, attended the TFS program at least 60 % of the time, volunteered to participate in the semi-structured interviews and made the most improvements on the pretest and posttests. Neither participant was very expressive in their reflective journals regarding the benefits and impact the TFS program had on them but very articulate and forth coming during the semi-structured interviews and when they answered the open-ended questions on Survey III.

Major Findings

According to the research, females that are exposed to a rich, participatory science environment with knowledgeable teachers and peer leaders had an increase in their science content knowledge (Gafney & Varma-Nelson, 2007). The goal was to complete one unit a day but in reality it took one week to complete one unit, which included a pre-test, posters for each objective in the entire unit and at least one hands-on lab for each unit review. The first working hypothesis stated the female students that participate in this after-school program with a peer leader working in cooperative-learning groups had an increase in their science content knowledge. This hypothesis was accepted and the post test mean was significantly higher than the pre-test mean. My initial goal was to implement the program in the early spring so that the participants could use the skills from the TFS when they took their state spring assessments. Several reflections from Bubbles affirmed this rationale. She said, “I have always liked science, but this program made me love science. Even though I did not attend every session I still learned a lot from it and I thank Ms. Hill for that.” She also said during the semi-structured interview, “that it help me to ace the MAP test for the science part and that science can be easier for me in HS.”

The second research hypothesis was not accepted because the results from survey three were not significantly different from survey one. There was a correlation between the three different surveys and a positive trend analysis. Based on what I have observed in the classroom for the past fifteen years in order to change a person's attitude or self-perception about something, the person must have authentic access to opportunities that can influence the affective domain. In 1996, The National Research Council (NCR) reported that current US science education reform needed to move to more constructivist practices instead of passive ones. The first time I asked the participants if they had a change in attitude about science, only two participants out of nine said "Yes". Marie Babee said, "My attitude had changed a little but I would not choose it for my career because it is not fun. Also, at the same time, it is fun because I learned new things and new chemicals from this program." Jasmine, said, "Yes, because my attitude has changed and helped me to get along with people and stay out of fights." Jasmine not only changed her attitude but her self-perception was affected because she learned how to get along with people better and practice self-control.

Two weeks later the participants completed Attitudinal Survey III, which allowed them to evaluate the entire program and reflect on the overall impact the program had on their attitudes about science and their self-perception of science. This time, when I asked if their attitude about science changed, four participants now reported that their attitudes had changed. Stasia said, "In the beginning I didn't like science but now I like it." Tiff, who previously said participation in the program had not changed her attitude on Attitudinal Survey II now said, "It helped me learn when I move up a grade and when the teacher asks me a certain question I can know the answer." The participants that did report a change said the part of the program that caused the change was the hands-on labs and experiments. Jasmine exemplified the feeling by stating, "because it taught them new things and made science seem more fun."

The frequency results ran in SPSS from all three attitudinal surveys measuring attitudinal changes were inconsistent with what the participants reported in their reflections. Question 1, stated, "*Can women be as good in a science career as men?"* was the only question whose responses have progressively improved as the participants time in the program increased. By the end of the program all of the participants unanimously reported that women could be just as good in science as men.

The third research hypothesis was not accepted either for the same reasons indicated for the second hypothesis. There was not a correlation between all three surveys for choosing a career in science and there was a negative trend analysis. I was not too upset with these findings because almost all of the participants enjoyed participating in the hands-on activities and labs. This keeps me hopeful because I believe with additional exposure to hands-on experiences might influence their future aspirations. Bubbles expressed an interest in science at the onset of the program and Marie Babee shared with the audience at the culminating event that, "I kinda like it, so now she might inspire me to probably be a scientist someday. " My archival data from my past students reinforced my hopes because out of the fifteen past students of which I received responses from eleven have chosen a science career and/or pathway in college.

Findings Related to the Literature

Vygotsky's (1978) sociocultural theory of human learning purports that social interaction plays a fundamental role in the development of cognition. This was the critical element I used in exposing the underserved females ages 11-15 that participated in this study. Since most of the participants were at the low end of our target population age group, my peer leaders and I made sure we stayed in their zone of proximal development to ensure that cognitive development would occur. Vygotsky (1978) defines the zone as the distance between the actual developmental level as determined by independent problem solving and the level of potential development through problem solving under adult guidance or in collaboration with more capable peers. The support the peer leaders provided to these female participants to help them learn was very beneficial for their development and understanding of the knowledge contained in the Buckle-down curriculum. The concepts presented were two grades above their grade level.

Maslow's Theory of Human Motivation and Maslow's Hierarchy of Needs provide the theoretical foundation for the success of the TFS program (Maslow, 1971). The levels of Maslow's Hierarchy of Needs are physiological, safety, belongingness, esteem and self-actualization (Maslow, 1971). A reflection from one of the graduate students provided insight into how effective the relationship between peer leaders influenced the participants. She wrote in her reflection,

> …it was exciting to see the way that the participants looked up to the peer leaders. It was understandable that the students would not be completely motivated to participate in the program after school hours and while the majority of their friends was engaging in other extra-curricular activities. However, it immediately became clear that the students looked up to the peer leaders and were in awe of their ability to identify with their frustration if they didn't understand a concept while admiring their ability to guide them through the process. Even as a graduate leader, it was encouraging to witness the exchange that happened between the students and the peer leaders. It was not only about the science material, but they connected with the peer leaders on multiple personal levels.

Maslow (1971) calls these the dynamics of the basic needs and are the starting point for the motivation theory, the so called physiological drives. The attributes I afforded my students in my regular classroom were definitely required for each session of the TFS program. Since my program was implemented after regular school hours, providing all of the participants with healthy snacks and a sense of safety and love, increased the participants self -esteem, as well as the peer leaders and graduate students. Below are some reflections to support this philosophy:

- "I had a certain friendship with each and every last girl. It was fun to watch them grow with their knowledge, and to see them try to apply the learning concepts to real life situations. If I could continue this program I would. I would love to see this program branch out to be involved with more than just a few girls." (PL Dah)

- "This program taught me that knowledge does not discriminate against age and anyone that wants to learn can. This program benefits the participants by giving them a solid foundation and keys in order to help them with future science classes and tests." (PL Ria)

- "There was confusion with what students had to do. I would suggest the instructor make the task instructions clearer for the whole class. I would also suggest group reports at the end of each class, as I think it can nicely wrap up the class work, and at the same time will be a reflection and revision for other groups, too." (GS1 Nik)

- "I was so impressed with how engaged the girls were despite all the challenges we had to endure with the online survey. The girls were friendly and were calling my name when they needed me. They were cooperative with my peer leaders, which really made me feel good. The snacks were a good hit, but one young lady was allergic to peanut butter, so she asked for cheese crackers along with peanut butter crackers too." (PI)

The TFS program modeled the research of Rohrkemper (1989), which indicated that Vygotsky places a strong emphasis on the learner having access to rich social environments to increase their development and skill set. On most days we averaged eight participants and eight peer leaders, so each participant had their own peer leader to guide their learning. We always paired both groups to ensure cooperative-learning practices between the participants as well as the peer leaders. This reduced frustration and promoted confidence building of both groups.

Interpersonal or social activity also supports cooperative learning because this is a phenomenon that explains the changes that occur in the conscience and then establishes a psychological theory that connects the behavior with the mind (Kozulin, 1986; Wertsch, 1985). The social environment influences cognition because of the tools or cultural objects, language and social institutions to which a learner has access. The social interactions help coordinate the three influences on development by causing cognitive changes due to internalizing and mentally transforming these interactions (Bruning, et al., 2004).

The TFS program fostered peer learning and required the peer leaders to work actively with the participants to successfully complete assignments. The initial goal of the TFS program was to target 12-15 year old African-American females, preferably in the 7th and 8th grade. Since the majority of the participants were in the 6th grade and we were only averaging eight girls a session, the peer leaders helped to create some of the final posters. Middle school is an ideal academic level to promote and implement peer learning. Keill (1969) reported that peer led cooperative learning can be applied in collaborative learning, peer tutoring, cross-age tutoring, learning communities, peer-assisted learning, and team-based learning, which was demonstrated in the TFS program. Each one of these strategies illustrates effective methods to improve academic achievement for both the participant and the peer leader.

Literature Connection

The TFS program was a reflection of the research cited by the literature for this dissertation. From observing how the peer leaders interacted with the participants in their cooperative learning groups to the benefits of using constructivism as the framework by using hands-on labs and opportunities to work with a researcher that was a role model, other role models in the science field and similar aged peer leaders. Using Vygotsky’s

(1978), Maslow's Hierarchy of Needs (1971) and Granger's NET (1998) philosophies as the guide for the TFS program, all of these researchers beliefs and principles were evident as the key motivations for increased participants science content knowledge, revealed a positive trend in science attitude, but did not reveal a significant influence on choosing a science career at this time. Because the TFS program was a replication of the teaching and learning strategies I implement in my regular classroom in an experiential environment, just as my past students have chosen a science career as reported in the testimonials in Chapter 4, I believe the TFS participants will have similar testimonies too.

The first objective of the TFS program was to determine if peer-led cooperative learning groups could work with my past students serving as the peer leaders, but working with students that were not their classroom peers. Immediately I noticed how well the peer leaders and participants interacted together and respected one another. Jasmine expressed gratitude for this opportunity to work with older females because her experience influenced some of her home, school and community interactions. She even contributed her chance to work in cooperative learning groups as positive because, "It helps me because I work with older girls and they teach me more..." This cognitive link supports Wentzel (1996) who reported students who behave cooperatively with others tend to excel academically and gain acceptance from their peers more so than those students who do not participate in the process.

The second objective focused on how patient, caring and engaging the peer leaders were to the TFS participants. From the first day to the last day of the TFS program, I observed how important it was that I chose my past students, not just any high-school students wanting to volunteer. Observing the peer leaders working with the younger participants reminded me of the times I had worked with these students in my after-school school program and the patience and engagement I had provided them. This positive relationship made me realize how important it was that I chose my past students and not just high school students that had not worked with me. This cognitive link, I believe, supported Martin, Blanc and Arendale (1977) who reported that in order for this model to work successfully, teachers have to train the peer tutors to ensure they have the prerequisites and patience to work with a specific age group of students in an after-school setting.

The third objective looked at the influence of engagement with role models that the participants had access to during every session of the program. The second group of role models was the Washington University Medical School YSP graduate and medical students and fellows who came to the TFS program on session four. These volunteers spent two hours supervising the participants and peer leaders in hands-on labs covering concepts in chemistry and physics. The TFS girls rotated through two hands-on experiences that lasted for fifty minutes each. During the TFS rotation, the girls worked with either a physicist or two chemists. Each scientist facilitated three to four different activities with the girls and the Physicist even sent the girls home with some special glasses that diffracted white light. All of the TFS participants were encouraged to complete a survey to evaluate the participants' feelings about working with the YSP volunteers. The cognitive link I think was to the "Girls' Night Out" program implemented by Weber (2011) at a California Middle school. Weber's program involved two "Girls' Night Out" which allowed the girls to rotate through four hands-on activities and a culminating event for students and parents. The constructivism philosophy was the theoretical or philosophical perspective and they used cooperative-learning, hands-on activities thus allowing the facilitators to teach through inquiry.

The fourth objective investigated the idea that all of the above objectives caused an increase in science content knowledge, change in attitude and decision to choose a science career, even though the majority of the participants were in the sixth grade and had not had any exposure to science in the regular classroom. Since the initial goal of the TFS program was to provide underserved females an opportunity to work with a science-teacher researcher, peer leaders trained by the researcher and role models from Washington University, the TFS program was going to be an excellent resource for the participants, especially since they did not have science instruction in their regular school. I hope that participation in the TFS program helped reduce the alienation of females in science by providing the participants access to hands-on experiences that allowed them to bring the written material to life. There were cognitive links to Brickhouse (2000), Bandura (1977) and Ferreira (2002) which supports the constructivist model for girls instead of the traditional passive models. All of these researchers, including myself, believe these programs must strive to produce structured educational programs that cater to the needs of females by providing them access to inquiry activities using cooperative-learning groups and peer leaders (Ferreira, 2002). Brickhouse (2000) believed that in order for this type of program to work the attributes needed for success were: 1) facilitation by experienced teachers and/or peer leaders; 2) interaction with role models that are scientists, technologists, engineers and mathematicians also known as STEM representatives; 3) access to materials and strategies that promote inquiry and hands-on lab experiences to increase science content knowledge; and 4) opportunities for reflection and evaluation to document attitudinal and career changes. Finally, Bandura (1977) reported in order to promote positive social change the participants must pay attention, demonstrate retention, and be motivated to reproduce a product to demonstrate what they have learned.

Surprises

Jasmine, the 6th grader, really surprised me because she answered 4 out of 25 problems correctly on the pre-test and answered 12 problems correctly on the post test. The reason I was so overjoyed by her achievement was she reported this was the first time she had ever been exposed to science instruction. In addition, the instruction was two whole grade levels above her current grade in her elementary school and this was her first time participating in peer-led cooperative instruction. She did not write in her reflective journal as instructed but responded to one of the open-ended questions from Attitudinal Survey III. Jasmine stated, “The parts of the program that changed my mind about science were the experiments because they taught me new things and made science seem more fun.” When the older girls were shy about responding, Jasmine was right there ready to tell the group what she was thinking about in reference to the question from the facilitator. The graduate student Leslie was finalizing how much the program had helped her when Jasmine chimed in right behind her and said, “It help me because I work with older girls and they teach me more and they teach me how to be a Diva.” She definitely honored my desire for the participants to be honest and sincere in what they say and when they write about their experiences in the TFS program.

Another surprise occurred during week four. We took the participants outside to work because the program participants were giving the peer leaders a hard time by not settling down, so I decided a change of venue was necessary. I would use this strategy in my regular classroom, especially on the first day of spring. This adjustment was very effective for most of the girls but we still had one young woman that was still disruptive, so we assigned one of the graduate students to work with her. This relationship was a perfect match for the program participant and a valuable learning experience for the graduate student. The graduate student named Leslie said,

> "…. something that I noticed is on my first day was that if a student wasn't really doing what they were suppose to do when they were doing it, this effected other girls, hum, whether it was distracting them or it just got contagious just where everybody didn't want to do their work, so it really was important for me to try an isolate and figure out why someone didn't want to do their work, whether they were hungry or were tired, did they have a bad day, hum, so I learned how, the fact that learning can be connected to many things in somebody's life and it doesn't have to be that they just can't do the work or it could be that they just can't do it because they are hungry, or these other things or they are upset, so." Lines 65- 73

This reflection let me know that the program participants were not just learning science but it also allowed everyone to reach their goals even if they were having a bad day. I am also glad the facility gave us the flexibility to work outdoors, especially this particular day because many of the girls were off task and moving the program outdoors was just what we all needed.

The biggest surprise for me was the competition I endured with the recreational programs offered at the facility. In the past, my after-school programs were implemented in a regular middle school, not an after-school facility with a focus on recreation. What I learned was to make this program more effective and more attractive was to implement the program in the fall or early spring before the spring sports programs begin.

Conclusions

Based on the qualitative and quantitative results, the TFS program was a success.

Even though only one of the interventions was statically significant, the participants unanimously agreed that women could perform in science as well as men. These observation gave me hope when working with this age group of underrepresented urban females ages. (PI Reflections, Lines 11-15) If these females continue to have access to programs similar to the TFS program their attitude can possibly change and their career pathways might be influenced. Serving as an African-American female science teacher in an urban public school has had a great impact on my female students based on the responses from past students. Working in an after-school program can enable me to provide access to females that might not have a science teacher in their school, especially in underrepresented urban areas. One of my peer leaders wrote at the end of her reflection a comment that said it all, "This program should be well known many homes because it shows that young ladies can succeed and understand science just like a young man can, especially African-American women." (PL Dah)

Implications for Action

The rationale for the significance of the TFS program is to produce citizenry that is scientifically informed and trained with the technical skills within the fields of science, technology, engineering and math (STEM) in order to facilitate economic growth. The TFS program provided 11-15 year old African-American females access to authentic science experiences using peer-led cooperative learning groups and working with role models. The interactions between the participants benefitted the program participants, peer leaders, graduate assistant role models and myself. The benefits included personal growth and development and enhanced peer leadership skills. The participants and peer leaders felt the influence of the program on their personal growth and development, which confirmed the expectations I had at the programs onset.

The benefits the participants cited in their reflections mainly dealt with improving their success in future science courses in high school or in grades seven and eight. The benefits expressed by the peer leaders were that they realized that age does not influence "how much a person can learn, how intelligent a person is, nor the capacity of their mind space." The benefits expressed by the graduate students were that it was so important for them to be aware of any challenges that were happening in the learning environment that could inhibit the progress of the TFS program. One graduate student wrote in her reflection, "To improve the program, make sure you allow time before the end of the program for students to write what they learned by participating in the TFS program each day." The second graduate student wrote," One student not completing her assignment could impact the entire program so she had to act quickly to address this interruption so that the rest of the students could continue to work."

The benefit I noticed was how important it was to have peer leaders that looked like the participants who were similar in age. Providing these 6^{th} graders with this opportunity seemed to have changed most of these participants' perceptions and lives.

Recommendations for Further Research

The limitations indicated in the introduction were identical to the actual limitations for the TFS program. The female students that participated in the TFS program are only a sample representation of the female students that are members of Boys & Girls Club of Greater St. Louis-Herbert Hoover. The period for the TFS program was about six weeks, instead of a full school semester. Attrition was another limitation of the participants, especially since this program was not mandatory, and the only academic enrichment program at the facility from 5-7 pm. The difference between the TFS program and the other after-school programs these peer leaders served in during their 8^{th} grade year is, the peer leaders were mentoring their peers, and now the peer leaders can mentor females they might not know.

Some of the recommendations I have for this study are time of implementation, location of implementation and the minimum number of participants enrolled in the TFS program. The ideal time for implementation is before the standardized assessment period, preferably late fall or early winter. This gave the participants ample time to utilize the strategies taught in the program and hands-on experiences to bring the science concepts to life and apply them to classes and testing challenges. If the program is implemented in an experiential setting similar to Boys & Girls Club of Greater St. Louis, choose a time when other educational programs are offered to reduce the competition between recreational activities. If the TFS program can be implemented in a regular after-school program in a secondary school, the time and place can also have to be taken into consideration because the program requires space and materials to perform the hands-on lab activities as well as the reading and writing activities. Lastly, based on the adjustments I had to make to the lesson plan in order to implement this program effectively, a minimum number of twenty to thirty participants need to be enrolled. After working with this group of participants, age is not a huge factor but the number of participants is, especially if cooperative-learning strategies were utilized.

Concluding Remarks

I am so pleased to have had this opportunity to see if my family oriented style of teaching could be implemented in an experiential setting. It was even more refreshing to see my peer leaders "paying it forward" as I observed the patience and confidence they demonstrated when working with the TFS participants. I believed the TFS program could be implemented in an experiential setting based on this data and the success my students and I have had in the past in my regular classroom after-school program. I was inspired to share this program with other students to make sure urban females have access to authentic science learning.

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Appendix A

TFS Introductory Letter

Dear Parent(s) or Legal Guardian(s),

My name is Rona Robinson-Hill and I am a graduate student at the University of Missouri-St. Louis. The purpose of this letter is to invite your daughter, age 12-15, to participate in a science program and research study I am conducting at Boys & Girls Club of Greater St. Louis' after-school program. The program will last approximately eight weeks, and will be held on Mondays & Wednesdays from 5- 7 pm. If you and she consent to participate in the program and associated study, she will be partnered with a peer leader who will support her learning of science content through hands-on science activities. The study will evaluate the effectiveness of young women working with similar age peers in peer-led cooperative-learning groups along with role-models in science. My hope is that your daughter may increase her science content knowledge, science self-efficacy and may even decide to choose a science career. In addition, I want to see if this study may help your daughter be successful on the practice spring science assessments furnished with the Buckle-down curriculum.

Attached to this letter is a parent and student permission form that will provide you with additional information outlining the goals of the program and the specific procedures associated with the research study that I have designed. Please return in the envelope both completed permission forms that are signed by you and your daughter as soon as possible. If you have any additional questions, please feel free to contact me at 314-956-4266 or 314-644-6801, or my Faculty adviser at 314-516-6220. Please encourage your daughter to respond as honestly and accurately to all of the questions and/or surveys and to participate in all of the activities implemented in the study to maximize the benefits of this study.

Sincerely,

Mrs. Rona Robinson-Hill

Your signature below affirms your agreement to participate in this research study, as a peer leader or participant in a peer-led, gender specific after-school program facilitated by Mrs. Rona Robinson-Hill at Boys and Girls Club of Greater St. Louis.

Parent or Legal guardian signature ______________________________Date: ______

Student signature ____Date: ______

Principal investigator's signature ______________________________Date: _______

Faculty sponsor's signature ___________________________________ Date: _____

Appendix B

TFS Peer Leader Parent Permission Form

Division of Science Education

One University Blvd.
St. Louis, Missouri 63121-4499
Telephone: 314-516-6220
E-mail: Rona.Robinson-Hill@umsl.edu

Informed Consent for Child Participation in Research Activities

Preparing female students for the test
(Please choose one)

_______Peer leader

Participant ______________________HSC Approval Number ___418062-2_________

Principal Investigator: Rona Robinson-Hill PI's Phone Number: 314-956-4266

1. Your child is invited to participate in a research study conducted by Rona Robinson-Hill and Dr. Charles Granger & Dr. Gayle Wilkinson. The general purpose is to study the effectiveness of partnering 12-15 year old female students with similar age experienced females, working in peer led cooperative-learning groups to learn science content.

2. a) Your daughter's participation in this program and study will provide her with a variety of hands-on experiences with science content. She will be partnered with a similar age peer and work in cooperative-learning groups with the goal of improving her science content knowledge, science self-confidence and interest in science and possibly choose a science career. As part of her participation in the project, your daughter will facilitate, 3-4 female students completion of: activities using Buckle Down science curriculum as a guide; hands-on science labs in peer-led, cooperative-learning groups; three computer-generated attitudinal surveys at three different times in the study; pre and posttest for each science unit; daily reflective journal entries and one practice science MAP tests. She will also facilitate the female students' creation of vocabulary study tools, graphic posters and scavenger hunts exploring the science content covered in the Buckle Down units. All of these artifacts of her learning will become data sources in the study.

Additionally, she will participate in semi-structured interviews, which will be recorded using an audio-recorder. The interviews will take approximately 30 minutes at Boys & Girls Club of Greater St. Louis at an agreed upon time. In addition, your daughter may be invited to participate in a focus group interview. Focus groups are group interviews where a small number of the study participants will be asked some questions about the effectiveness of the program. This focus group interview will take approximately 30 minutes and will be recorded by the PI. The focus groups will take place at Boys & Girls Club of Greater St. Louis at a mutually agreed upon time.

The program and associated study will last approximately seven weeks, (2 hours/day, and two days per week). The maximum total length of time is approximately thirty hours. There is no financial compensation for participants in this program.

3. There are no anticipated risks to your child associated with this research. I will not disclose any identifiable information when the data is reported to any of the participants' employers or anyone not directly involved in this study.
4. The possible benefits for your daughter's participation in this study are to possibly 1) be more motivated to become engaged in school and community science activities; 2) become knowledgeable and better informed citizens; and 3) motivated to serve as leaders in the school and community.
5. Your child's participation is voluntary and you may choose not to let your child participate in this research study or to withdraw your consent for your child's participation at any time. Your child may choose not to answer any questions that she does not want to answer. You should be aware that if your child decides to withdraw from the study, she will also be asked to leave the program. If she leaves the program and study, her data will not be used.
6. We will do everything we can to protect your child's privacy. As part of this effort, your child's identity will not be revealed in any publication or presentation that may result from this study. In rare instances, a researcher's study must undergo an audit or program evaluation by an oversight agency (such as the Office for Human Research Protection). That agency would be required to maintain the confidentiality of your child's data.
7. If you have any questions or concerns regarding this study, cancel your child's participation in the study or if any problems arise, you may call the Principle Investigator, Rona Robinson-Hill at 314-956-4266 or 314-644-6801 or my Faculty adviser, Dr. Charles Granger at 314-516-6220. You may also ask questions or state concerns regarding your child's rights as a research participant to the Office of Research Administration, at 314-516-5897.

I have read this consent form and have been given the opportunity to ask questions. I will also be given a copy of this consent form for my records. I consent to my child's participation in the research described above.

________________________________ ____________________________
Parent or Guardian's Signature Date Parent or Guardian's Printed Name

____
Child's Printed Name

________________________________ Mrs. Rona Robinson-Hill__________
Signature of Investigator or Designee Date Investigator or Designee Printed Name

Appendix C

TFS Participant Parent Permission Form

Division of Science Education

One University Blvd.
St. Louis, Missouri 63121-4499
Telephone: 314-516-6220
E-mail: Rona.Robinson-Hill@umsl.edu

Informed Consent for Child Participation in Research Activities

Preparing female students for the test
(Please choose one)

_______Program participant

Participant ___________________________ HSC Approval Number 418062-2________

Principal Investigator: Rona Robinson-Hill PI's Phone Number: 314-956-4266

1. Your child is invited to participate in a research study conducted by Rona Robinson-Hill and Dr. Charles Granger & Dr. Gayle Wilkinson. The general purpose is to study the effectiveness of partnering 12-15 year old female students with similar age experienced females, working in peer led cooperative-learning groups to learn science content.

2. a) Your daughter's participation in this program and study will provide her with a variety of hands-on experiences with science content. She will be partnered with an experienced peer leader and cooperative-learning groups with the goal of improving her science content knowledge, science self-esteem and interest in choosing a science career. As part of her participation in the project, your daughter will complete: activities using Buckle Down science curriculum as a guide; hands-on science labs in peer-led, cooperative-learning groups; three computer-generated attitudinal surveys at three different times in the study; pre and posttest for each science unit; daily reflective journal entries and two practice science MAP tests. She will create vocabulary study tools, graphic posters and scavenger hunts exploring the science content covered in the Buckle Down units. All of these artifacts of her learning will become data sources in the study.

Additionally, she will participate in interviews, which will be recorded using an audio-recorder. The interviews will take approximately 30 minutes at Boys & Girls Club of Greater St. Louis at an agreed upon time. In addition, your daughter may be invited to participate in a focus group interview. Focus groups are group interviews where a small number of the study participants will be asked some questions about the effectiveness of the program. This focus group interview will take approximately 30 minutes and will be recorded by the PI. The focus groups will take place at Boys & Girls Club of Greater St. Louis at a mutually agreed upon time.

The program and associated study will last approximately seven weeks, (2 hours/day, and two days per week). The maximum total length of time is approximately thirty hours. There is no financial compensation for participants in this program.

5. There are no anticipated risks to your child associated with this research. I will not disclose any identifiable information when the data is reported to any of the participants' employers or anyone not directly involved in this study.
6. The possible benefits for your daughter's participation in this study are to possibly 1) be more motivated to become engaged in school and community science activities; 2) become knowledgeable and better informed citizens; and 3) motivated to serve as leaders in the school and community.
5. Your child's participation is voluntary and you may choose not to let your child participate in this research study or to withdraw your consent for your child's participation at any time. Your child may choose not to answer any questions that she does not want to answer. You should be aware that if your child decides to withdraw from the study, she will also be asked to leave the program. If she leaves the program and study, her data will not be used.
6. We will do everything we can to protect your child's privacy. As part of this effort, your child's identity will not be revealed in any publication or presentation that may result from this study. In rare instances, a researcher's study must undergo an audit or program evaluation by an oversight agency (such as the Office for Human Research Protection). That agency would be required to maintain the confidentiality of your child's data.
7. If you have any questions or concerns regarding this study, cancel your child's participation in the study or if any problems arise, you may call the Principle Investigator, Rona Robinson-Hill at 314-956-4266 or 314-644-6801 or my Faculty adviser, Dr. Charles Granger at 314-516-6220. You may also ask questions or state concerns regarding your child's rights as a research participant to the Office of Research Administration, at 314-516-5897.

I have read this consent form and have been given the opportunity to ask questions. I will also be given a copy of this consent form for my records. I consent to my child's participation in the research described above.

____________________________________ __________________________________

Parent or Guardian's Signature Date Parent or Guardian's Printed Name

____

Child's Printed Name

____________________________________ __________________________________

Signature of Investigator or Designee Date Investigator or Designee Printed Name

Appendix D

TFS Assent Form

Division of Science Education

At Herbert Hoover
One University Blvd.
St. Louis, Missouri 63121-4499
Telephone: 314-516-6220
E-mail: Rona.Robinson-HIll@umsl.edu

Assent to Participate in Research Activities (Minors)
Preparing female students for the test
(Please choose one)

________Peer leader ________Program participant

1. My name is **Rona Robinson-Hill.**

2. I am asking you to take part in an eight-week program and associated research study for females age 12-15 at the Boys & Girls Club of Greater St. Louis. We want to create a program that will provide urban females access to hands-on labs and resource activities using peer leaders and role models that might increase female science content knowledge, attitude about science and influence their decision to choose a science career. The program will run twice a week on Mondays and Wednesdays from 5-7 pm for about eight weeks.

3. If you agree to be in this program and research study as a peer leader or female participant, you will complete: 1) activities using Buckle-down science curriculum as a guide; 2) hands-on science labs in peer-led, cooperative-learning groups; 3) three computer-generated attitudinal surveys at three different times in the study; 4) pre and posttest for each science unit; 5) daily reflective journal entries and 6) two practice science MAP tests. You will create: vocabulary study tools; graphic posters and scavenger hunts exploring the science content covered in the Buckle-down units. All of these artifacts of your learning will become data sources in the study.

   Additionally, I will ask that you participate in an interview with me that will be recorded in a portable voice recorder. The interview will take approximately 30 minutes and will be conducted at Boys and Girls Club of Greater St. Louis. I may also invite you to participate in a focus group interview, which is a group interview with other participants from this program. This interview would also be recorded by the PI and would take approximately 30 minutes. I will also observe your participation in the program and record my observations in field notes.

4. There are minimum risks of injury during the hands-on labs and other activities. Your participation in all activities is completely voluntary.

5. You may experience the following benefits from participating in the program: being more motivated to be engaged in school and community science activities, becoming a knowledgeable and better informed citizen, and becoming more motivated to serve as a leader in the school and community.

6. Please talk this over with your parents before you decide whether to participate. I also will ask your parents to give their permission for you to take part in this study. Even if your parents say "yes," you still can decide not to do this. Your parents must also sign this agreement, but you will have the option to terminate this agreement at any point during the study.

7. Remember, being in this program and study is up to you. Participation in this study is strictly voluntary. If you choose to leave before the end of the study, then your data will not be included. If at any point during the study you decide to terminate your participation, please contact me immediately in person, via email at Rona.Robinson-Hill@umsl.edu or at one of the telephone numbers listed below.

8. You can ask questions that you have about the study. Any questions that you may have can be addressed during any session or by calling me at 314-644-6801 or 314-956-4266 or Dr. Charles Granger, my Faculty advisor at 314-516-6220.

9. By signing this agreement, you agree to participate in this study. All parties will receive a copy of this agreement.

______________________________________ ________________________

Participant's Signature Date Participant's Printed Name

______________________________________ ________________________
Parent or Guardian's Signature Date Parent or Guardian's Printed Name

______________ _________________
Participant's Age Grade in School

Appendix E

Semi-Structured Interview Codebook

Findings

Categories	Sub-Categories	Themes	References (Line #)
Benefits of Program	Personal Growth & Development	Teaching skills	3, 50, 54-56, 61-62, 68-69
		Academic Preparation	3, 10, 11, 12-13, 76-77, 79-80
	Peer Leadership	Peer Interaction & Social Skills	3-4, 21, 29-30, 36-38*, 52-54, 65-66
		Leadership skills	6, 23, 26-27, 54, 70*
		Completion of Labs & Assignments	38, 42, 75
		Grade Increase	24, 79-80
Learning Environment	Learner's Participation	Willingness to Participate	35-36, 41-44, 59-61
		Self-Confidence	39-40, 48-49
		Enthusiasm (Enjoyment & Energy)	44-45, 58
		Motivation	71, 74-75, 78*
	Strategies	Experiential Learning	16, 19-20, 33, 50, 75
		Effectiveness of Strategies	33-36, 78-80, 81-82

Appendix F

Codebook of Past Student Data

Codebook of Archival Student Data

Student #	Pseudonym	Question 1	Question 2	Year at MCK	Career
1	Leslie	Lines 12-21	Lines 38-48	1999	BA Administration of Justice & Spanish Masters Criminal Justice & Doctorate
2	Kia	Lines 7-9	Lines 11-16	2000	BS Chemistry & Pharmaceutical (graduate work)
3	Tia	Line 5-7	Lines 12-14	2002	B. S Audio production
4	Sha	Lines 2-8	Lines 11-14	2002	B.S. Geography, Sociology/Anthropology Masters Public Health
5	Alice	Lines 6-9	Lines 14-17	2006	B. S. in Civil engineering & Human Right Studies
6	Mary	Lines 14-16	Lines 10-11		
7	Kila	Lines 5-12	Lines 4-5	2008	PreVet; Vet School & a Doctorate in Veterinary Medicine
8	Chac	Lines 5-7	Line 9	2009	College professor
9	Siv	Lines 4-5		2010	Marine biology or Psychology
10	Dia	Lines 5-6 & 7-8		2012	Anesthesiologist
11	Tac	Lines 4-7	Lines 10-12	2011	Print journalism & Environmental studies
12	Dorf	Lines 4-5	Line 7	2011	Pediatrician or Medicine
13	Morf	Lines 4-5		2011	Psychology, Medicine or Design
14	Diah	Lines 4-11		2012	Forensic scientist
15	Tia	Lines 5-6	Line 8	2012	Anesthesiologist or Journalist

Appendix G

Semi-Structured Interview Transcript

Mary: What are some of the benefits of the program ? Be specific and support your answers.

Victoria: Uhm, some of the benefits of the program for me, uhm I get to learn more teaching skills being around youth and I like to see the progress in younger individuals and that makes me feel better about coming and doing things like this and it helps me get more leadership skills.

Mrs. Hill: whispers, "Say the question again"

Mary: What are some of the benefits of the program ? Be specific and support your answers.

Jasmine: Uhm the benefits is of the program is that it help me learn more and when I go to 7th grade it give me prepared for 8th grade and for science test.

Bubbles: Some of the benefits for me were that it help me to ace the MAP test for the science part and that science will be easier for me in HS.

Statia: Uhm… pause

Mrs. Hill: Well, some of the benefits to me being the facilitator I got to see that I could still implement some of the strategies I use in my regular classroom with girls in an alternative setting, like an experiential setting an after-school. Some of the other benefits was I got to work with 6th graders which was something I haven't done since I was uhm since I student teaching. Cause for the last fifteen years I have been working 8th graders so I had a chance to see that 6th graders can learn science even when they haven't been taught a lot of science in their regular classroom.

Rachel: Okay some benefits for me that I met new people and I've learned to ah have leadership skills and to uhm.. pause

Stasia: Some of the benefits of this class help me and it help me get a good grade in science class… pause

Leslie: Uhm as a graduate student I felt like the program really helped me .. pause uhm some like what Rachel said uhm in terms of helping with my leadership skills and uhm working with younger girls and really helping to give them confidence that they can do something even though they didn't want to.

Jasmine: It help me because I work with older girls and they teach me more and they teach me how to be a Diva. A few people laughed.

Mary: Does anyone have anything to say, okay. What strategies and/or activities were the most effective for you in the program be specific and support your answer?

Victoria: Uhm for me the pH strategies were very helpful, since I am in Chemistry and it helped me remember more things for my Chemistry class rather than just staring at my notes over and over again.

Jasmine It help me by, uhm when we get together in a group and we help each other and we get the job done. Uhm

Mrs. Hill: What impressed me the most were the lab times. I was impressed that.. even though the girls were 6th graders they were not shy about lab even though they had never, some of them had never participated in a lab before. But they jumped right in, they were using the equipment, they were not abusing the equipment. They could answer the questions at the end of the lab. They didn't just complete the lab and say "Ohh I don't feel like doing the question behind it" and they had reasonable answers and decisions they had to make. That was probably the most exciting time for me. And then the second most exciting time was when Washington University came in and the girls, I gave them a little "pep talk" and I explained to them to make sure they only spoke when it was time for them to speak, because the role models would have some important directions and they would. They were fabulous, they uhm, they were not afraid to speak to the scientists, even though they were older than them, but they really seem like they enjoyed the experience

Jasmine: I liked that when we did the observations and he had talked about, like that special stuff could really hurt you and it's dangerous.

Victoria: Also when going back to the younger people in our group uhm I felt like it taught me more that age does not define how uhm how intelligent you are or the capacity for your mind space and it just showed me that don't judge people by their age and give everybody a fair shot at learning.

Mrs. Hill: I agree with that. It definitely showed me that. My program was originally tailored for 8th graders, but when we got here they only had the majority of the girls were 6th graders and I was so impressed with their energy, with their willingness to learn and they didn't back down when they saw the work, the material, we had was for grade eight they persevered through.

Leslie: Uhm, I think as a graduate student, just kinda helping oversea. I think the strategy that worked best for me was to try pull aside a student that wasn't really in the mood to kinda do the work or they really didn't want to pay attention, so that they wouldn't distract the other students. Uhm, cause that's something that I noticed is on my first day was that if a student wasn't really doing what they was suppose to do when they were doing it, this effected other girls, uhm whether it was distracting them or it just got contagious just where everybody didn't want to do their work, so it really was important for me to try an isolate and figure out why someone didn't want to do their work, whether they were hungry or were they tired, did they have a bad day, uhm, so I learned how, the fact that learning can be connected to many things in somebody's life and it doesn't have to be that they just can't do the work or it could be that they just can't do it, because they are hungry, or these other things or they are upset, so.

Rachel: Uhm, I think as a student in HS and even in MS, I would not want to do the work sometimes and when Mrs. Hill would uhm let us do lab experiments that I guess taught us how to do different things, using hands-on things and I think that made me learn more science material better.

Bubbles: When I first came into the program I didn't want to work at all. Like to be honest I didn't want to do any book work, but the book work help me to be more successful in science class and then like it just help me get a better grade in science. Pause

Statsia: The book work and the hands-on and all of the lab stuff it helped me learn science more, like learn more than I knew at first when I came into the program

Mary: Does anyone else have anything to add.

Appendix H

TFS Graduate Student Reflections

GS student 1:

Preparedness for the class:
Everything was organized, well thought and brought for the first class of the project: there were books and the keys to the tasks on the desks; notebooks, pencils and badges for the students and the peer leaders, and even online pre-project surveys for the students to take before the actual class time. Taking into consideration that student had to spend 1.5 hours at the center from 5:30 to 7, the teacher also prepared snacks and soft drinks for the students not to stay hungry after already spending a few hours at the center.
Class-time:

- The beginning of the class was a little bit disorganized as it was the first day and students didn't appear on time, though the teacher was there half an hour before the class time and arranged everything for the class.
- Everything went a lot smother when the students started to take the pre-project surveys. The instructor did a good job organizing it, as only three students could take the online survey at a time, so she arranged it in a way that one group would take it in the computer lab, whereas other groups would start their assignments under the supervision of the peer leaders.
- The instructor was among the students most of the time, walking from one group to another to see the students' progress with the assignment, or when students would ask her for clarification.
- Peer leaders were always with the groups, helping and directing the students.
- Students were engaged and interested in the work they were doing. I even noticed some of them were helping their group members in completing the task.

Positives:
I find the idea of organizing the girls' science club a very good idea for several reasons:

- The students will spend their spare time improving their knowledge and skills in chemistry and physics;
- The students will improve their team working skills;
- Peer leaders being in the role of a teacher will also improve both their knowledge and skill in those disciplines.
- Peer leaders will serve as good models for seventh and eighth graders. The choice of peer leaders is also good, as they were active and friendly and would take the initiative if the instructor was not in the classroom. I liked it when one of the peer leaders started to tell the students how she became a leading student in science. How it impacted her choice of future career (one of the senior peer leaders told me that she is going to apply for the science education department at a college after graduating from school). Having such good examples is better for those girls than listening or reading several stories of others succeeding in science.

Suggestions:

- There was confusion with what students had to do. I would suggest the instructor to make the task instructions clearer for the whole class;

- I would also suggest group reports at the end of each class, as I think it will nicely wrap up the class work, and at the same time will be a reflection and revision for other groups, too.

GS student # 2

As a graduate student working with the Training Future Scientists Program, I was able to learn extremely valuable skills while improving upon others. The program was enriching both professionally and personally. As a leader helping to encourage the peer leaders as well as the students, I was able to exercise essential supervisory and motivation skills. During my time with the program, two main aspects of my experiences stuck out: (1) learning how to manage disruptive behavior amongst the students, and (2) understanding the importance of the relationship between the students and the peer leaders.

Perhaps one of the most important lessons that I learned was the ability to identify students that were disruptive to the learning process and the need to figure out ways to neutralize their behavior. I quickly learned that a disruptive student could be discouraging to the entire learning process for both the peer leaders and the students. With that in mind, I understood the importance of working separately with those disruptive students and attempting to get to the root/cause of their disruptive behavior and encouraging them to move forward with meeting their daily program goals.

Also, it was exciting to see the way that the participants looked up to the peer leaders. It was understandable that the students would not be completely motivated to participate in the program after school hours and while the majority of their friends were engaging in other extra-curricular activities. However, it immediately became clear that the students looked up to the peer leaders and were in awe of their ability to identify with their frustration if they didn't understand a concept while admiring their ability to guide them through the process. Even as a graduate leader, it was encouraging to witness the exchange that happened between the students and the peer leaders. It was not only about the science material, but they connected with the peer leaders on multiple personal levels.

While often off task, the students asked the peer leaders about their choices for high school, dress, and even future college decisions. To me, this showed that the students were connecting with the peer leaders on a number of levels other than just with the program material. As the students were able to develop relationships with the peer leaders, and the peer leaders were able to foster those relationships, from my perspective, the tutoring and learning process flowed easier. I believe that this was the case because the students were able to establish trust with the peer leaders and even though they felt like they might not have been on the level they should have been educationally, the students were not embarrassed to say so, and were actually able to work with the peer leaders to move forward.

Appendix I

TFS Principle Investigator Reflective Journal

Date: 4/15/13
Day one of my dissertation program
PI speaking

OMG, this is so much harder than I imagined, but I am still up to the challenge. Only three of my peer leaders showed up today, two had track meets and three of them forgot, because we had so many false starts and one young lady I haven't heard from at all. I was very understanding with their excuses this time, because only ten girls came today, even though I had 11 people take the survey. I think one of the girls took the survey twice or one of the girls had to go to another program offered at the same time. The ten girls that came were amazing. Ten girls came initially, but two of them had to go to another program called "Smart girls, so that left me with eight girls, three in two groups and two in one group. After about one hour two other girls came in and we placed one girl in the group with two girls and one in the group with three sixth graders. Since we had several technical difficulties with the online survey we did not get all of our objectives completed on this day. Hopefully we will complete the first unit on Wednesday including the graphic posters and the vocabulary words in Quizlet.

I was so impressed with how engaged the girls were despite all the challenges we had to endure with the online survey. The girls were friendly and were calling my name when they needed me. They were cooperative with my peer leaders, which really made me feel good. The snacks were a good hit, but one young woman was allergic to peanut butter, so she asked for cheese crackers along with peanut butter crackers too. One young woman that was working with PLM10 had used the Buckle-down workbook at her school and asked could she use her answers that were correct. I asked to see the assignment and said, "Yes, you hit the jack pot", because I had assigned her the same assignment she had been given at her school.

The program facilitator apologized for all the challenges we encountered today, but I reassured her that we still accomplished some of our goals today. I also realized that Buckle-down had sent me the wrong answer key for the workbook, so I sent my contact person an email requesting a new answer key book.

I'm wondering for the future how to market the program, so that there isn't so much competition from other programs at an after-school facility. Timing is definitely a key factor for getting the number of participants you need to get some significant data, but I am still very grateful for the ten girls I had today, because they stayed engaged despite the challenges of the online survey, limited computer access in the computer labs and the survey link not added to the program site data base.

I'm so glad we finally started this valuable program and I can't wait to hear what the other program participants have to say about the first day of the program.

I met three of the girls' moms and all of them seem interested in their daughter participating in the program. One young woman, her mother is a special education science teacher at a popular urban HS and she was very interested in the program and wants me to send her additional information about the science education I belong to. All of the girls acknowledged their mother was near me and wanted me to meet their mom. All of their mothers were very cordial and welcomed my introduction. I asked all of them to mark their calendars for the Awards program on May 10, 2013 at Washington University.

Date 2: 4/17/13
Day one of my dissertation program
PI speaking

Today we had 7 girls return from the original 11, but we gained 2 new girls. I would never have thought implementing a free science program would be so hard, especially when so many people are talking about providing urban females with science experiences. I'm convinced the parents need to be involved or at least made aware of this valuable opportunity and the fact that in the future science careers will be growing exponentially. The problem as I see it is the lack of knowledge, but I'm going to keep on going, because without this data, I won't graduate and I have to graduate. My peer leaders showed up strong and were very encouraging, even though I shedded a few tears in my car. The 7 girls that returned were very engaged, but we still have not finished all of our objectives. I can't wait until they experience the mentors from Washington University. I realized Buckle-down sent me the wrong books on the first day of the program, but they are giving me some new ones to start using next week. The girls all did the survey again, because we had to add their code name to their data, so I can distinguish the students' data from one another. Add the names to surveys is definitely something not to forget for future surveys. I'm going to revisit the lesson plan and procedures for the program to accommodate the small number of girls.

5/1/2013
I opened this session with a small class meeting explaining to the girls the purpose of the program again. All I can say is this is one of the biggest learning experiences of my life and I'm still not giving up. Today we had the least number of girls, but we were still able to start the third unit. My second graduate student came today and she was a lifesaver, because Riah (pseudonym) was so adamant about cooperating. My peer leaders are all just the best. They have so much patience with the girls even when they can be so uncooperative. I had a meeting with a Club representative today to see if I could do anything to improve the attendance and motivate the girls to keep coming and participating until the end of the program. We decided that since the Club has such poor parent involvement we would have the closing ceremony at the Club, because then the parents would only have to come to one place to pick-up their daughters. I thought Monday was hard, but today was even harder, but we made. I had a brief parent-conference with Riah's mom, because she had called her from school and told her to pick her up early from the Club, because it was going to be boring. I saw her in the hall after

leaving the teen center and explained to her that Riah was in the program, which she supports. Her daughter stomped away and needed a lot of coaching from the peer leaders and graduate assistant. Yah Yah came up to me and said the real reason she would keep coming to the program and cooperating, so that I would not get a bad grade on my project. Bubbles and Joy both dropped out of the program, but Bubbles said she would think about coming back on Monday, because she understands the purpose of the program and how important it is for girls to stay in the program to the end, but she is getting excited about graduating from 8th grade and all of the activities she will be involved in at her home school. I patiently reminded her about honoring your commitment, especially for a program like a dissertation. I hope Bubbles will be back for the remainder of the program, because before this week she had perfect attendance and was one of the most involved participant's. Joy's mother said she could not promise to pick her up at 7 pm, because the time she picks her children up is dependent on what time she got off of work and since she get up so early, she tries to pick her children up before 7 pm on most days, so I told her I understand. I said this, because I am a single parent and I know how valuable a parent's time is. I know if my child had this opportunity, especially in a time when girls are underperforming boys in science, I would let her take advantage of this opportunity. We went outside today to get a change of venue for about 1. 5 hours. Most of the girls enjoyed being outside, only one girl complained.

5/13/13
Today the participants had to take their assessments for the MAP. Since the students attending the program was so low I really could not implement the program as I had outline in my methodology. I made several adjustments to the lesson design, but when only six girls in attendance I had to stop working in the Buckle-down handbook to allowing the girls to complete a practice test with a peer leader. The participants seem to enjoy moving through the study guide recording the correct answers for all of the questions. This process took two sessions to complete during week four, ~ 50 minutes from each session. Unfortunately only eight girls came today, but we did finish the study guides and set-up the labs for Life science. Four girls completed the bean lab and four girls completed the potato lab. The peer leaders made sure the girls did all the work and they facilitated. Some of the girls had to leave today to get fitted for a play the Club was presenting on Thursday this week, but they came back after their fittings. The potato lab had a twenty-minute incubation period, so that's how long they could go out of the room for their fitting. All of these distractions were really hard to deal with, but all of the adults involved were very respectful and accommodating. The girls returned after their fitting and finished collecting their data and cleaned up their stations. The girls tried to leave without cleaning up, but that was not going to happen. The peer leaders were actively involved in making sure the girls cleaned up their stations and placed all the materials back on the equipment table. I was so impressed with the leadership demonstrated by my peer leaders and the positive energy the participants demonstrated. When I required more than one trial the participants immediately completed another trial, because they knew one trial was not sufficient for an authentic experiment. Since most of the girls in the program were 6th graders this whole science club experience was new to them, especially the hands on lab experience. The day Washington University came in was definitely one of the best days for the girls, because they did not have to write, just perform hands-on

experiences, which is what they loved. So this was the third time in the program that we were able to implement the hands-on experience I want to offer my students. I really hate that my numbers were so low, because it was almost impossible to implement the program the way I had designed it, especially when the content was targeted at 8th graders. One thing I admired about these young women was they never backed down to a challenge. They could all read on level and when they did not know a word they did not hesitate to ask for assistance and/or an explanation of what something means. My peer leaders were always right on their job to clarify any questions the participants entertained and if they could not answer the questions, they would invite me over to share my expertise. I noticed the girls realized how much we all cared about them and one young woman (Stasia) was always so excited to see us. During week 3, Bubbles had a small melt down, because she was getting overwhelmed at school, but she returned to the program during week 4, with an apology for not attending during week 3. I was so shocked by her decision, but was very grateful that she decided to come back. During week 5 she shared with me that she felt bad about not coming back, so she talked to her mother and her mother told her, “Go back to the program then”. I was happy that her mother encouraged her to come back, because I had met her mother during week 1 and she seemed very exciting about this opportunity for her daughter and the other girls at the Club.

May 15, 2013
This was the final day of the program and boy was it hectic. Eight girls showed up today, three girls that needed to take their final assessment. Unfortunately they did not get to finish the assessment, so hopefully I can have them finish the assessment on Monday. All of the girls did get to finish the final survey in time to make it to the culminating event. The culminating event took place in the auditorium at the Club. The turnout was awesome, but every participant did not have a family member in the audience and some of my peer leaders did not have a family member in the audience either. I arranged the room so that the participants sat on the front row; the peer leaders on two rows behind them; guest African-American women in science seated in front of the participants; participant parents, peer leader parents and community members sat in chairs across from the participants and peer leaders. I arranged the seating this way, so that the participants knew they had support all around them beginning with people that looked like them to their parents, family, friends, and community members from the Club and outside of the Club. My mother, children and committee members were even there to support me, which was evidence that support is always needed even when you are an adult student.

Appendix J

Attitudinal Survey I

Evaluating Yourself with the Science Attitudinal Checklist I

Directions: Please circle the number that answers each question as honestly as possible, with five (5) agree and one (1) disagree.

Question #	Question	Scale
1	Can women be as good in a science career as men?	5 4 3 2 1
2	Can women make important scientific discoveries?	5 4 3 2 1
3	Are successful science careers just as important to a woman as it is to a man?	5 4 3 2 1
4	Should women have the same job opportunities in science careers as men?	5 4 3 2 1
5	Should women have the same chances for advancement in science careers as men do?	5 4 3 2 1
6	Do you like science?	5 4 3 2 1
7	Is science easy for you?	5 4 3 2 1
8	Do you think science is fun?	5 4 3 2 1
9	Do you feel it is better for a woman to study home economics than a science subject?	5 4 3 2 1
10	Do women that choose a science career have an unhappy life?	5 4 3 2 1
11	I would like to choose a science career some day.	5 4 3 2 1
12	I would like to find a cure for cancer or HIV-AIDS.	5 4 3 2 1
13	I would like to design a vehicle to reduce the amount of carbon dioxide in the environment.	5 4 3 2 1
14	I would like to teach science to others in a traditional classroom or after-school program.	5 4 3 2 1
15	Without good math and science skills one cannot choose a science career.	5 4 3 2 1

Appendix K

Attitudinal Survey II

Evaluating Yourself with the Science Attitudinal Checklist II

Directions: Please circle the number that answers each question as honestly as possible, with five (5) agree and one (1) disagree.

Question #	Question	Scale
1	Can women be as good in a science career as men?	5 4 3 2 1
2	Can women make important scientific discoveries?	5 4 3 2 1
3	Are successful science careers just as important to a woman as it is to a man?	5 4 3 2 1
4	Should women have the same job opportunities in science careers as men?	5 4 3 2 1
5	Should women have the same chances for advancement in science careers as men do?	5 4 3 2 1
6	Do you like science?	5 4 3 2 1
7	Is science easy for you?	5 4 3 2 1
8	Do you think science is fun?	5 4 3 2 1
9	Do you feel it is better for a woman to study home economics than a science subject?	5 4 3 2 1
10	Do women that choose a science career have an unhappy life?	5 4 3 2 1
11	I would like to choose a science career some day.	5 4 3 2 1
12	I would like to find a cure for cancer or HIV-AIDS.	5 4 3 2 1
13	I would like to design a vehicle to reduce the amount of carbon dioxide in the environment.	5 4 3 2 1
14	I would like to teach science to others in a traditional classroom or after-school program.	5 4 3 2 1
15	Without good math and science skills one cannot choose a science career.	5 4 3 2 1

1. Explain in detail(s) if your attitude about science has changed.
____
____
____

2. What specifically caused your change in attitude about science ?
____
____
____

Appendix L

Attitudinal Survey III

Evaluating Yourself with the Science Attitudinal Checklist III

Directions: Please circle the number that answers each question as honestly as possible, with five (5) agree and one (1) disagree.

Question #	Question	Scale
1	Can women be as good in a science career as men?	5 4 3 2 1
2	Can women make important scientific discoveries?	5 4 3 2 1
3	Are successful science careers just as important to a woman as it is to a man?	5 4 3 2 1
4	Should women have the same job opportunities in science careers as men?	5 4 3 2 1
5	Should women have the same chances for advancement in science careers as men do?	5 4 3 2 1
6	Do you like science?	5 4 3 2 1
7	Is science easy for you?	5 4 3 2 1
8	Do you think science is fun?	5 4 3 2 1
9	Do you feel it is better for a woman to study home economics than a science subject?	5 4 3 2 1
10	Do women that choose a science career have an unhappy life?	5 4 3 2 1
11	I would like to choose a science career some day.	5 4 3 2 1
12	I would like to find a cure for cancer or HIV-AIDS.	5 4 3 2 1
13	I would like to design a vehicle to reduce the amount of carbon dioxide in the environment.	5 4 3 2 1
14	I would like to teach science to others in a traditional classroom or after-school program.	5 4 3 2 1
15	Without good math and science skills one cannot choose a science career.	5 4 3 2 1

Short answer: Please answer each question.

1. Which activity(ies) did you enjoy the most in the after-school program?
____
2. Which science content do you know for sure?
____
3. Which science content do you still struggle with?
____
4. Explain in detail if your attitude about science changed?
____
5. What do you feel caused this attitudinal change? Edited: If your attitude changed about science, which part of the program do you feel caused your attitudinal change? Be specific
____

Appendix M

TFS Lesson Plans Original & Revised

<table>
<tr><th>Week & Date</th><th>Assignment pages</th><th>MAP Review Daily Procedures</th></tr>
<tr><td>1</td><td>The Nature of Science
p. 3-42
Do Now Day 1:
Copy Keys to Keep:
pp. 13, 25 & 36
Copy VCW you don't know for sure:
pp. 4, 18 & 31
Pretests & posttests:
pp. 16-17, 29-30 &
40-42
Do Now Day 2:
Prepare for lab(s)</td><td>Read <u>select pages</u> and record the answers in your handbook.
<table>
<tr><th>Table s</th><th>R-1</th><th>R-2</th><th>R-3</th></tr>
<tr><td>1</td><td>4-5</td><td>18-19</td><td>31-32</td></tr>
<tr><td>2</td><td>5-6</td><td>20-21</td><td>33</td></tr>
<tr><td>3</td><td>7-8</td><td>21-22</td><td>34</td></tr>
<tr><td>4</td><td>9-11</td><td>23</td><td>34-35</td></tr>
<tr><td>5</td><td>12-13</td><td>24-25</td><td>36</td></tr>
</table></td></tr>
<tr><td>2</td><td>Physical
Science
p. 44-69
Do Now Day 3:
Copy Keys to Keep:
pp. 50, 65, 81 & 94
Copy VCW you don't know for sure:
pp. 44, 55, 70 & 86
Pretests & posttests:
pp. 53-54 & 68-69
Do Now Day 4:</td><td>Read <u>select pages</u> and record the answers in your handbook.
<table>
<tr><th>Tables</th><th>R-1</th><th>R-2</th></tr>
<tr><td>1</td><td>44-45</td><td>55-56</td></tr>
<tr><td>2</td><td>45-47</td><td>56-58</td></tr>
<tr><td>3</td><td>47-48</td><td>58-60</td></tr>
<tr><td>4</td><td>48</td><td>60-62</td></tr>
<tr><td>5</td><td>49-50</td><td>63-64</td></tr>
</table>
<table>
<tr><th>Tables</th><th>R-3</th><th>R-4</th></tr>
<tr><td>1</td><td>70-72</td><td>86-88</td></tr>
<tr><td>2</td><td>72-73</td><td>88-89</td></tr>
<tr><td>3</td><td>74-76</td><td>90-91</td></tr>
<tr><td>4</td><td>77-78</td><td>92-93</td></tr>
<tr><td>5</td><td>79-81</td><td>93-94</td></tr>
</table>
Role model visit from Washington University YSP volunteers</td></tr>
<tr><td>3</td><td>Physical
Science
p. 70-98
Do Now Day 5:
Prepare for lab(s)

Do Now Day 6:
Evaluate MAP test
Complete lab(s)</td><td>Read <u>select pages</u> and record the answers in your handbook.

Take first practice
MAP test.</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th>Week & Date</th><th>Assignment pages</th><th>MAP Review Daily Procedures</th></tr>
<tr><td>4</td><td>Earth &
Space Science p. 100-146
Do Now Day 7:
Copy Keys to Keep
p. 109, 121, 132 & 142
Copy VCW you don't know for sure:
pp. 100, 114, 126 & 136
Pretest & posttest:
pp. 112-113 & 124-125
pp. 126 & 136
Do Now Day: 8
Prepare for lab(s)</td><td>Read <u>select pages</u> and record the answers in your handbook.
<table>
<tr><td>Tables</td><td>R-1</td><td>R-2</td></tr>
<tr><td>1</td><td>100-103</td><td>114-116</td></tr>
<tr><td>2</td><td>103-104</td><td>116-117</td></tr>
<tr><td>3</td><td>105-106</td><td>117-118</td></tr>
<tr><td>4</td><td>106-107</td><td>119-120</td></tr>
<tr><td>5</td><td>108</td><td>120-121</td></tr>
</table>
<table>
<tr><td>Tables</td><td>R-3</td><td>R-4</td></tr>
<tr><td>1</td><td>126</td><td>136-137</td></tr>
<tr><td>2</td><td>127-128</td><td>137-138</td></tr>
<tr><td>3</td><td>128-129</td><td>138-139</td></tr>
<tr><td>4</td><td>129-130</td><td>140</td></tr>
<tr><td>5</td><td>131</td><td>141-142</td></tr>
</table></td></tr>
<tr><td>5</td><td>Life Science
p. 148 -179
Do Now Day 9:
Copy Keys to Keep:
pp. 155, 166 & 175
Copy VCW you don't know for sure:
pp. 148, 160 & 171
Pretests & posttests:
pp. 158-159 & 169-170
pp. 178-79
Do Now Day 10:
Prepare for lab(s)</td><td>Read <u>select pages</u> and record the answers in your handbook.
<table>
<tr><td>Tables</td><td>R-1</td><td>R-2</td></tr>
<tr><td>1</td><td>148-150</td><td>160-161</td></tr>
<tr><td>2</td><td>150-151</td><td>161-162</td></tr>
<tr><td>3</td><td>152-154</td><td>163-164</td></tr>
<tr><td>4</td><td>154</td><td>164</td></tr>
<tr><td>5</td><td>155</td><td>165-166</td></tr>
</table>
<table>
<tr><td>Tables</td><td>R-3</td></tr>
<tr><td>1</td><td>171-173</td></tr>
<tr><td>2</td><td>173-174</td></tr>
<tr><td>3</td><td>174-175</td></tr>
</table>
Role model visit from Washington University YSP volunteers</td></tr>
<tr><td>6</td><td>Life Science
p. 180 -206
Do Now Day 16:
Copy Keys to Keep:
pp. 175 & 188
Copy VCW you don't know for sure:
pp. 171 & 180
Pretests & posttests:
pp. 178-79 & 191-192
Do Now Day 17:
Take second practice MAP test.</td><td>Read <u>select pages</u> and record the answers in your handbook.
<table>
<tr><td>Tables</td><td>R-4</td><td>R-5</td></tr>
<tr><td>1</td><td>180-182</td><td>193-194</td></tr>
<tr><td>2</td><td>182-184</td><td>194-196</td></tr>
<tr><td>3</td><td>184-185</td><td>196-197</td></tr>
<tr><td>4</td><td>185-186</td><td>198-200</td></tr>
<tr><td>5</td><td>187</td><td>200-202</td></tr>
</table></td></tr>
</table>

Science Review Program Weekly Procedures

1. Obtain a MO MAP Buckle-Down workbook. **Record all your answers in your workbook.**

2. Complete Do Nows & Pretest in your **reflective journal** for each review section **before** you read each review section(s).

3. **Read select pages** assigned to your table and record the correct answers in your handbook. **Create** a visual-aide to explain the objective for your pages.

4. **Discuss** reading information & finalize your answers in your **expert** group, then create vocabulary webs and interactive posters/scavenger hunt questions.

5. **Create** a **jigsaw group** from 1-2 representatives from each expert group. Discuss the key facts from each reading & answers for each review section.

6. **Divide** each jigsaw group into smaller groups with 3-4 persons. **Create** an experiment for each "Explore it Yourself" and answer the "What does it Mean? questions for each review section in your handbook.

7. **Complete** posttest in your handbook.

8. **Evaluate/compare** pre/posttest results.

9. **Record** in your **reflective journal** the new information you learned between the pre/posttests. **Record** any information you still do not know for sure.

10. **Select** **one person** from each **jigsaw group** to add vocabulary words your group did not know for sure to the Quizlet.com program to create an additional study tool.

TFS Revised Lesson Plan

<table>
<tr><th>Week & Date</th><th>Assignment pages</th><th>MAP Review
Daily Procedures</th></tr>
<tr><td>1</td><td>The Nature of Science
p. 3-42
Do Now Day 1:
Copy Keys to Keep:
pp. 13, 25 & 36
Copy VCW you don’t know for sure:
pp. 4, 18 & 31
Pretests & posttests:
pp. 16-17, 29-30 &
40-42
Do Now Day 2:
Prepare for lab(s)</td><td>Read <u>select pages</u> and record the answers in your handbook.
<table>
<tr><th>Tables</th><th>R-1</th><th>R-2</th><th>R-3</th></tr>
<tr><td>1</td><td>4-5</td><td>18-19</td><td>31-32</td></tr>
<tr><td>2</td><td>5-6</td><td>20-21</td><td>33</td></tr>
<tr><td>3</td><td>7-8</td><td>21-22</td><td>34</td></tr>
<tr><td>4</td><td>9-11</td><td>23</td><td>34-35</td></tr>
<tr><td>5</td><td>12-13</td><td>24-25</td><td>36</td></tr>
</table></td></tr>
<tr><td>2</td><td>Physical
Science
p. 47-105
Do Now Day 3:
Copy VCW you don’t know for sure from your reading assignment:
pp. 48, 63, 90 & 105
Complete your pretest
Pretests & posttests:
pp. 60-62; 72-74; 102-104; & 115-118
Do Now Day 4:
Prepare for Role
model visit</td><td>Read <u>select pages</u> and record the answers in your workbook.
<table>
<tr><th>PL</th><th>R-4</th><th>R-5</th></tr>
<tr><td>1</td><td>48-57</td><td></td></tr>
<tr><td>2</td><td></td><td>63-68</td></tr>
</table>
<table>
<tr><th>PL</th><th>R-7</th><th>R-8</th></tr>
<tr><td>3</td><td>90-98</td><td></td></tr>
<tr><td>4</td><td></td><td>105-112</td></tr>
</table>
Role model visit from Washington University YSP volunteers</td></tr>
<tr><td>3</td><td>Life
Science
p. 120-164
Do Now Day 5:
Copy VCW you don’t know for sure from your reading assignment:
pp. 120, 135 & 150
Complete your pretest
Pretests & posttests:
pp. 133-134; 147-149; & 162-164
Do Now Day 6:
<u>Take</u> first MAP test in cooperative-groups</td><td>Read <u>select pages</u> and record the answers in your handbook.
<table>
<tr><th>PL</th><th>R-9</th><th>R-10</th></tr>
<tr><td>1</td><td>120-129</td><td></td></tr>
<tr><td>2</td><td></td><td>135-144</td></tr>
</table>
<table>
<tr><th>PL</th><th>R-11</th></tr>
<tr><td>3</td><td>150-159</td></tr>
</table>
Complete 2nd TFP survey</td></tr>
<tr><td>4</td><td>Earth & Space
Did not complete this unit
p. 166- 224
Do Now Day 7:
Copy VCW you don’t know for sure from your reading assignment:
pp. 166, 178, 191 & 208
Complete your pretest
Pretests & posttests:
pp. 176-177; 189-190; 205-207 & 222-224
Do Now Day 8:
<u>Complete</u> first Map test, use as a study guide</td><td>Read <u>select pages</u> and record the answers in your workbook.
<table>
<tr><th>PL</th><th>R-12</th><th>R-13</th></tr>
<tr><td>1</td><td>166-173</td><td></td></tr>
<tr><td>2</td><td></td><td>178-185</td></tr>
</table>
<table>
<tr><th>PL</th><th>R-14</th><th>R-15</th></tr>
<tr><td>3</td><td>191-201</td><td></td></tr>
<tr><td>4</td><td></td><td>208-219</td></tr>
</table>
Friday, May 10, 2013
Awards Banquet</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

Week & Date	Assignment pages	MAP Review Daily Procedures
5	**Final Days** **Day 9:** Take second MAP test **Day 10:** Participate in Focus Group interviews	**Write reflections about the program and take the Final TFP survey.**

TFS Science Review Program Weekly Procedures Revised

On Mondays:

1. Obtain a MO MAP Buckle-Down workbook. **Record all your answers in your workbook.**

2. Complete Do Nows & Pretest in your **reflective journal** for each review section **before** you read each review section(s).

3. **Read select pages** assigned to your group and peer leader and record the correct answers in your workbook. **Create** a visual-aide to explain the **keys to keep** for your pages.

4. **Discuss** reading information , go over questions for the pretest & finalize the workbook answers in your **expert** group, then **create vocabulary webs** and combine your visual-aides into **one large poster**.

On Wednesdays:

5. **Set-up the experiment** for your" Explore it Yourself" and answer the "What does it Mean ?" questions for your review in your handbook.

6. Allow each expert group to **share what they learned** from their review section and the results of their experiment.

7. **Complete** posttest in your handbook.

8. **Evaluate/compare** pre/posttest results.

9. **Record** in your **reflective journal** the new information you learned between the pre/posttests. **Record** any information you still do not know for sure.

10. **Select one person** from each **jigsaw group** to add vocabulary words your group did not know for sure to the Quizlet.com program to create an additional study tool.

Appendix N

TFS Review Poster

Appendix O

TFS SPSS Frequencies Results - Attitude

Question 1: Can women be as good in a science career as men?

	Frequency (scale response = frequency)		Percent	
Survey 1	4 = 1	5 = 5	16.7	83.3
Survey 2	4 = 1	5 = 5	16.7	83.3
Survey 3	5 = 6		100	

At the beginning and the middle of the program 83.3% of the participants strongly agreed that women would be just as good in a science career as men. By the end of the program 100% of the participants strongly agreed that women would be as good in a science career as men.

Question 2: Can women make important scientific discoveries?

	Frequency (scale response = frequency)			Percent		
Survey 1	3 = 1	4 = 2	5 = 3	16.7	33.3	50.0
Survey 2	3 = 1	5 = 5		16.7	83.3	
Survey 3	4 = 2	5 = 4		33.3	66.7	

At the beginning of the program 16.7% of participants were neutral regarding women being able to make important scientific discoveries, 33.3% of the participants agreed that women can make important scientific discoveries and 50% of the participants strongly agreed that women can make important scientific discoveries. By the end of the program 33.3% of the participants agreed that women can make important scientific discoveries and 66.7% of participants strongly agreed that women could make important scientific discoveries.

Question 3: Are successful science careers just as important to a woman as it is to a man?

	Frequency (scale response = frequency)			Percent		
Survey 1	1 = 1	4 = 2	5 = 3	16.7	33.3	50.0
Survey 2	4 = 3	5 = 3		50.0	50.0	
Survey 3	1 = 1	4 = 1	5 = 4	16.7	16.7	66.7

At the beginning of the program, 16.7% of the participants strongly disagreed that successful science careers are just as important to women as they are to men, 33.3% of the participants agreed that successful science careers are just as important to woman as they are to men and 50% of the participants strongly agreed that successful science careers are just as important to women as they are to men. Midway through the program, one participant changed their outlook from strongly disagree to agreeing that successful science careers are just as important to women as they are to men. By the end of the program 16.7% of the participants strongly disagreed that successful science careers are just as important to women as they are to men, 16.7% of the participants agreed that successful science careers are just as important to women as they are to men and 66.7% of the participants strongly agreed that successful science careers are just as important to women as they are to men.

Question 4: Should women have the same job opportunities in science careers as men?

	Frequency (scale response = frequency)				Percent			
Survey 1	2 = 1	4 = 1	5 = 4		16.7	16.7	66.7	
Survey 2	1 = 1	3 = 1	4 = 1	5 = 3	16.7	16.7	16.7	50.0
Survey 3	1 = 1	4 = 1	5 = 4		16.7	16.7	66.7	

At the beginning of the program 16.7% of the participants disagreed that women should have the same job opportunities in science careers as men, 16.7% of participants agreed that women should have the same job opportunities in science careers as men and 66.7% of the participants strongly agreed that women should have the same job opportunities in science careers as men. Midway through the program 16.7% of the participants strongly disagreed that women should have the same job opportunities in science careers as men, 16.7% of the participants neither agreed or disagreed that women should have the same job opportunities in science careers as men, 16.7% of the participants agreed that women should have the same job opportunities in science careers as men and 50% of the participants strongly agreed that women should have the same job opportunities in science careers as men. By the end of the program 16.7% of the participants strongly disagree that women should have the same job opportunities in science careers as men, 16.7% of the participants agreed that women should have the same job opportunities in science careers as men and 66.7% of the participants strongly agreed that women should have the same job opportunities in science careers as men.

Question 5: Should women have the same chances for advancements in science careers as men do?

	Frequency (scale response = frequency)			Percent		
Survey 1	2 = 2	4 = 1	5 = 3	33.3	16.7	50.0
Survey 2	1 = 2	4 = 2	5 = 2	33.3	33.3	33.3
Survey 3	3 = 1	5 = 5		16.7	83.3	

At the beginning of the program 33.3% of the participants disagreed that women should have the same chances for advancements in science careers as men, 16.7% of the participants agreed that women should have the same chances for advancements in science careers as men and 50% of the participants strongly agreed that women should have the same chances for advancements in science careers as men. By the end of the program, 16.7% of the students neither agreed nor disagreed that women should have the same chances for advancements in science careers as men and 50% of the participants strongly agreed that women should have the same chances for advancements in science careers as men.

Question 6: Do you like science?

	Frequency (scale response = frequency)				Percent			
Survey 1	1 = 1	3 = 2	4 = 1	5 = 2	16.7	33.3	16.7	33.3
Survey 2	1 = 1	2 = 1	4 = 2	5 = 2	16.7	16.7	33.3	33.3
Survey 3	1 = 1	3 = 3	5 = 2		16.7	50.0	33.3	

At the beginning of the program 16.7% of the participants strongly disliked science, 33.3% of the participants neither liked nor disliked science, 16.7% of the participants liked science and 33.3% of the students strongly liked science. By the end of the program 16.7% of the participants still strongly disliked science while 50% of the participants neither liked nor disliked science and 33.3% of the participants strongly liked science.

Question 7: Is science easy for you?

	Frequency (scale response = frequency)					Percent				
Survey 1	3 = 4	4 = 1	5 = 1			66.7	16.7	16.7		
Survey 2	1 =1	2 =1	3 =2	4 =1	5 =1	16.7	16.7	33.3	16.7	16.7
Survey 3	1 = 1	2 = 1	3 = 3	5 = 1		16.7	33.3	16.7	33.3	

At the beginning of the program 66.7% of the participants neither agreed nor disagreed that science was easy for them, 16.7% of the participants agreed that science was easy for them and 16.7% of the participants strongly agreed that science was easy for them. Midway through the program 16.7% of the participants strongly disagreed that science was easy for them, 16.7% of the participants disagreed that science was easy for them, 33.3% of the participants neither agreed nor disagreed that science was easy for them, 16.7% of participants agreed that science was easy for them and 16.7% of the participants strongly agreed that science was easy for them. By the end of the program 16.7% of the participants strongly disagreed that science was easy for them, 16.7% of the participants disagreed that science was easy for them, 33.3% of the participants neither agreed nor disagreed that science was easy for them and 16.7% of the participants strongly agreed that science was easy for them.

Question 8: Do you think science is fun?

	Frequency (scale response = frequency)				Percent			
Survey 1	1 = 1	3 = 2	4 = 1	5 = 2	16.7	33.3	16.7	33.3
Survey 2	1 = 2	2 = 1	3 = 1	5 = 2	33.3	16.7	16.7	33.3
Survey 3	2 = 2	4 = 2	5 = 2		33.3	33.3	33.3	

At the beginning of the program 16.7% of the students strongly disagreed that science is fun, 33.3% of the participants neither agreed nor disagreed that science is fun, 16.7% of participants agree that science is fun and 33.3% of participants strongly agree that science is fun. Midway through the program 33.3% of the participants strongly disagreed that science is fun, 16.7% of participants disagreed that science is fun, 16.7% of the participants neither agreed nor disagreed that science is fun and 33.3% of the participants strongly agreed that science is fun. At the end of the program 33.3% of the participants disagreed that science is fun, 33.3% of the participants agreed that science is fun and 33.3% of the participants strongly agreed that science is fun.

Question 9: Do you feel it is better for a woman to study home economics than a science subject?

	Frequency (scale response = frequency)				Percent			
Survey 1	2 = 2	3 = 3	5 = 1		33.3	50.0	16.7	
Survey 2	2 = 1	3 = 2	4 = 1	5 = 2	16.7	33.3	16.7	33.3
Survey 3	1 = 1	2 = 2	3 = 1	5 = 2	16.7	33.3	16.7	33.3

At the beginning of the program 33.3% of the participants disagreed with woman studying home economics instead of a science subject, 50% of the participants neither agreed nor disagreed that women should study home economics instead of a science subject and 16.7% strongly agreed that women should study home economics instead of a science subject. By the end of the program 16.7% of the participants strongly disagreed that women should study home economics instead of a science subject, 33.3% disagreed that women should study home economics instead of a science subject, 16.7% of the participants neither agreed nor disagreed that women should study home economics instead of a science subject and 33.3% of the participants strongly agreed that women should study home economics instead of a science subject.

Question 10: Do women that choose a science career have an unhappy life?

	Frequency (scale response = frequency)				Percent			
Survey 1	1 = 3	2 = 2	4 = 1		50.0	33.3	16.7	
Survey 2	1 = 3	2 = 1	3 = 1	4 = 1	50.0	16.7	16.7	16.7
Survey 3	1 = 3	2 = 1	4 = 1	5 = 1	50.0	16.7	16.7	16.7

At the beginning of the program 50% of the participants strongly disagreed with the idea of women that choose a science career have an unhappy life, 33.3% of the participants disagreed with the idea of women that choose a science career have an unhappy life and 16.7% of the participants agreed with the idea that women that choose a science career have an unhappy life. By the end of the program 50% of the participants strongly disagreed with the idea of women that choose a science career have an unhappy life, 16.7% of the participants disagree with the idea of women that choose a science career have an unhappy life, 16.7% of the participants agreed with the idea of women that choose a science career have an unhappy life and 16.7% of the participants strongly agreed with the idea of women that choose a science career have an unhappy life.

The second analysis ran on this data using SPSS was the correlation between each attitudinal survey.

Appendix P

TFS SPSS Frequencies Results – Careers

Question 11: I would like to choose a science career someday.

	Frequency (scale response = frequency)					Percent				
Survey 1	2 = 1		3 = 2	4 = 1	5 = 2	16.7	33.3	16.7	33.3	
Survey 2	1 = 1		3 = 2	4 = 1	5 = 2	16.7	33.3	16.7	33.3	
Survey 3	1 = 1	2 =2	3 = 1	4 = 1	5 = 1	16.7	33.3	16.7	16.7	16.7

At the beginning of the program 16.7% of the participants strongly disagreed with the fact that they would like to choose a STEM career, 33.3% of the participants neither agreed nor disagreed that they would like to choose a STEM career someday, 16.7% of the participants agreed with the fact that they would like to choose a STEM career someday and 33.3% of the participants strongly agreed with the fact that they would like to choose a STEM career someday. By the end of the program 16.7% of the participants strongly disagreed with the idea of choosing a STEM career someday, 33.3% of the participants disagreed with the idea of choosing a STEM career someday, 16.7% of the participants neither agreed nor disagreed with wanting to choose a STEM career someday, 16.7% of the participants agreed that they would like to choose a STEM career someday and 16.7% of the participants strongly agreed that they would like to choose a STEM career someday.

Question 12: I would like to find a cure for cancer or HIV-AIDS.

	Frequency (scale response = frequency)				Percent			
Survey 1	1 = 1	3 = 3	5 = 2		16.7	50.0	33.3	
Survey 2	1 = 1	3 = 2	4 = 1	5 = 2	16.7	33.3	16.7	33.3
Survey 3	2 = 1	3 = 2	4 = 2	5 = 1	16.7	33.3	33.3	16.7

At the beginning of the program 16.7% of the participants strongly disagreed with wanting to find a cure for cancer or HIV-AIDS, 50% of the participants neither agreed nor disagreed with wanting to find a cure for cancer or HIV-AIDS and 33.3% of the participants strongly agreed with wanting to find a cure for cancer or HIV-AIDS. At the end of the program 16.7% of the participants strongly disagreed with wanting to find a cure for cancer or HIV-AIDS, 33.3% of the participants neither agreed nor disagreed with wanting to find a cure for cancer or HIV-AIDS, 33.3% of the participants agreed with wanting to find a cure for cancer or HIV-AIDS and 16.7% of the participants strongly agreed with wanting to find a cure for cancer or HIV-AIDS.

Question 13: I would like to design a vehicle to reduce the amount of carbon dioxide in the environment.

	Frequency (scale response = frequency)				Percent			
Survey 1	1 = 1	3 = 1	4 = 2	5 = 2	16.7	16.7	33.3	33.3
Survey 2	1 = 1	3 = 2	4 = 3		16.7	33.3	50.0	
Survey 3	1 = 2	2 = 1	3 =1	4 = 2	33.3	16.7	16.7	33.3

At the beginning of the program 16.7% of the participants strongly disagreed with wanting to design a vehicle to reduce the amount of carbon dioxide in the environment, 16.7% of the participants neither agreed nor disagreed with wanting to design a vehicle to reduce the amount of carbon dioxide in the environment, 33.3% of the participants agreed with wanting to design a vehicle to reduce the amount of carbon dioxide in the environment and 33.3% of the participants strongly agreed that they want to design a vehicle to reduce the amount of carbon dioxide in the environment. At the end of the program 33.3% of the participants strongly disagreed with wanting to design a vehicle to reduce the amount of carbon dioxide in the environment, 16.7% of the participants disagreed with wanting to design a vehicle to reduce the amount of carbon dioxide in the environment, 16.7% of the participants neither agreed nor disagreed with wanting to design a vehicle to reduce the amount of carbon dioxide in the environment and 33.3% of the participants agreed with wanting to design a vehicle to reduce the amount of carbon dioxide in the environment.

Question 14: I would like to teach science to others in a traditional classroom or after-school program?

	Frequency (scale response = frequency)					Percent				
Survey 1	2 = 1	3 = 2	4 = 1	5 = 2		16.7	33.3	16.7	33.3	
Survey 2	1 = 1	2 = 2	3 = 1	4 = 1	5 = 1	16.7	33.3	16.7	16.7	16.7
Survey 3	1 = 2	2 = 1	3 = 2	4 = 1		33.3	16.7	33.3	16.7	

At the beginning of the program 16.7% of the participants disagreed with wanting to teach science, 33.3% of the participants neither agreed nor disagreed with wanting to teach science, 16.7% of the participants agreed that they wanted to teach science and 33.3% of the participants strongly agreed that they wanted to teach science. At the end of the program 33.3% of the participants strongly disagreed that they wanted to teach science, 16.7% of the participants disagreed with wanting to teach science, 33.3% of the participants neither agreed nor disagreed that they wanted to teach science and 16.7% agreed with wanting to teach science.

Question 15: Without good math and science skills one cannot choose a science career.

<table>
<tr><th></th><th colspan="5">Frequency
(scale response = frequency)</th><th colspan="5">Percent</th></tr>
<tr><td>Survey 1</td><td>1 = 1</td><td>2 = 2</td><td>3 = 1</td><td>4 = 1</td><td>5 = 1</td><td>16.7</td><td>33.3</td><td>16.7</td><td>16.7</td><td>16.7</td></tr>
<tr><td>Survey 2</td><td colspan="2">2 = 2</td><td>3 = 1</td><td>4 = 1</td><td>5 = 2</td><td>33.3</td><td>16.7</td><td>16.7</td><td colspan="2">33.3</td></tr>
<tr><td>Survey 3</td><td colspan="2">1 = 2</td><td>2 = 1</td><td>4 = 2</td><td>5 = 1</td><td>33.3</td><td>16.7</td><td>33.3</td><td colspan="2">16.7</td></tr>
</table>

At the beginning of the program 16.7% of the participants strongly disagreed with the idea that one cannot choose a STEM career if they do not have good math and science skills, 33.3% of the participants disagreed with the idea that one cannot choose a STEM career if they do not have good math and science skills, 16.7% of the participants neither agreed nor disagreed with the idea that one cannot choose a STEM career if they do not have good math and science skills, 16.7% of the participants agreed with the idea that one cannot choose a STEM career if they do not have good math and science skills and 16.7% of the participants strongly agreed that one cannot choose a STEM career if they do not have good math and science skills. By the end of the program 33.3% of the participants strongly disagreed with the idea that one cannot choose a STEM career if they do not have good math and science skills, 16.7% of the participants disagreed with the idea that one cannot choose a STEM career if they do not have good math and science skills, 33.3% of the participants agreed that one cannot choose a STEM career if they do not have good math and science skills and 16.7% of the participants strongly agreed that one cannot choose a STEM career if they do not have good math and science skills.

Appendix Q

TFS Peer leaders Reflective Journal Entries

PL 1 (Ry)
While participating in the TFS program as a peer leader, I learned to work better with other and also enhanced my leadership skills. Positives for me in the program included being able to actually see the improvement in the girls I worked with. I could actually tell that they were learning new things. I also enjoyed seeing them becoming more open to participate in discussions about the lessons. On the other hand, I noticed that there were not many hands-on labs. Although some of the girls refused to cooperate and finish their work in a timely manner to be able to do any labs, I think that those who write up the lab should be able to go ahead and perform the procedure, regardless to whether or not everyone else finished. In other words, I think the students should be able to work at their own pace. I also think that there should be some type of repercussions (other than verbal chastisement) for the girls who choose to be disrespectful. I also think that there should be an incentive for the girls who score the highest on the tests and have the best behavior.
(Ry)reflection 6/2/13

PL 2 (Dia)
Dia: My name is Dia, uhm I really enjoyed this program. I got to meet a lot of girls who were just like me. Uhm I hope I inspired them to learn more about science. I really enjoyed coming on every Monday and Wednesday to teach these girls about science and I think it was a learning experience for all of us and I really enjoyed it. And I love Ms. Hill for everything she has done for us and I love the girls (she laughs)I taught, (Marie Babee) and (Riah) and everybody else. Audience applauds.

This program has really been a learning experience for me. I learned a lot from being a peer leader and a mentor to the girls. I learned how to interact with kids younger than me. I learned patience skills and teaching skills. I also improved my leadership skills. I had to step up and take charge, and tutor girls who did not know much about science. I was a “big sister” to the many girls in the program and learned so much about each of them. This program allowed me to meet new people, reconnect with my fellow classmates, and relearn science prompts. Participating in the program has helped me increase my leadership skills. I had to be a teacher and teach each girl everything that they need to know. I had to learn techniques to make sure that the information was staying in their heads. I was able to give back to my community and give my knowledge to younger girls who do not have the resources to learn science. Science is an important matter in everyday life. I feel like it is important for our younger generation to learn and excel in science, because almost every occupation involves some sort of science and math. Girls are pictured as the minority in the science field and always looked down upon. If we can instill these science subjects into the girls heads, they will not only be ahead of everyone in their class, but will maybe get more interested and want to go further and beyond. Also, as the peer leaders and the participants being so close in age, the participants better listened and understood. To make this program better in the future, I think more hands on activity should be in the schedule. The girls got bored with just reading and answering questions. We need to come up with a fundamental way to teach girls. We should do more than just read in science, take test and answer questions. The programs participants need to be more consistent; if they just come once a week, they will not remember the information. The participants should not be forced to come, they should want to come on their own. It should not feel like a punishment coming to the program; it should feel like an extracurricular activity. Overall, I think the program has a good cause and good end up being something big. For this to be the first year of the program we had a good outcome and it was a learning experience for everyone involved. (Dia 5/15/2013)

PL 3 (Dorf)

My experience in Ms. Hill's program was great. It was really fun teaching the kids about science. Surprisingly I learned some things that I'd didn't know before participating in the program. This program also helped me with my patience because when the girls got upset and bored I had to hold my emotions back and try to teach and help them. I had to basically be selfless because this program was not about me. It was about helping kids learn. I feel that they enjoyed themselves and learned new things. This program has been a huge success.

PL 4 (Morf)

For the most part I really enjoyed myself, as far as participating in the program and I looked forward to going every week. I liked the fact that I was able to watch most of the girls grow. A lot them had never experienced working on a lab and it was nice to see that they actually enjoyed doing them. There were definitely some ups and downs and some days were better than others. I didn't like the fact that almost every day, we had to go searching and chasing after people that felt like they just didn't want to come. I also didn't like the fact that some of the girls didn't really respect us as peer leaders and felt like instead of listening to us, they could just do what they wanted to do. There were a few times I did get a little frustrated because of their behavior. But I was happy about the fact that many of the girls said they learned a lot from the program and even they didn't really want to do the work, it helped them to better understand science. That helped me to realize that all the hard work and effort we put into the program was not in vain.

PL 5 (Dah)

The TFS program sponsored by Mrs. Robinson-Hill has had its ups and downs. On the first day of April 15, 2013 there were a lot of girls . All of them seeming to be interested in science. We took the time to get to know everyone and establish nicknames. We explained the underlying concepts of the program, which was the use of the buckle down books. Majority of the girls enjoyed the process. They liked the pretests and the post tests while others didn't enjoy it so much because they said that it was too much writing. The next session, the number of original girls dropped and new girls arrived. When I asked several of the girls why they did not wish to return, they responded by saying that the program was boring. As the sessions went by, the girls were kept interested with snacks and experiments. All of the girls loved the session when Washington University came. The girls were able to interact with liquid nitrogen, learned about how ions bounced around and they were able to experiment with different densities. All of the other sessions after the visit from Washington University, it seemed like the girls received an energy boost. They were more interested in science.

Some of the young women had been knowing each other through Herbert Hoover for several years. The fact that they were grouped together caused some of them to have tension. The girls argued and tried to involve themselves in a physical altercation. Another peer leader and I resolved the issue with having them talk about it and separate from each other.

As the end of the program neared, the patience level of the girls began to run out. They were eager for the program to end because they wanted to participate in the award ceremony.

Overall I really enjoyed this program. I had a certain friendship with each and every last girl. It was fun to watch them grow with their knowledge, and to see them try to apply the learning concepts to real life situations. If I could continue this program I would. I would love to see this program branch out to be involved with more than just a few girls. This program should be well known into many homes because it shows that young women can succeed and understand science just like a young man can. Especially African-American women.

PL 6 Ria

In the training Future Scientist Program, there were many benefits for peer leaders and participants. For me, as a peer leader, I benefitted by getting exposure for teaching youth. This will greatly impact my future, because I am considering going to college to major in high school education. Also, this program helped me grow in my perception towards youth. The 6th graders in the program astounded me when I learned that their scores had doubled after the course while they learned 8th grade material. Their fearlessness inspired me to challenge myself in my high school education. This program taught me that knowledge does not discriminate against age and anyone that wants to learn can. This program benefits the participants by giving them a solid foundation and keys in order to help them with future science classes and tests.

There were not any real negative in the program, but some things could be improved. I believe the program should have been held at a facility that encouraged more school-based work rather than extracurricular so that students would be less apprehensive about taking the course. I believe this would also help the attendance rate of the program. Also, I noticed that most of the girls enjoyed the labs more so I would suggest adding more hands-on learning to keep the girls interested. This was a wonderful program and I am honored to have been chosen to be a peer leader. I would gladly participate again.

6/6/2013

PL 7 Chac TFS Log
4/15
Okay today was a little rough. We had to find the girls that were going to participate in the program. We actually grabbed quite a few, though it was sad that we had to reject the girls who weren't old enough to be in the program yet. I hope to have a very successful program, as all the girls seemed interested. I'm glad I joined.

4/17
The program moved to the music room. It seems like we will be in the music room on Wednesdays. Today we worked on experiments. Well my group did not as our main focus was to write up a full lab report. The girls seem to understand what the different variables are and actually seem to enjoy some of the work we do. I am really enjoying the program and the girls involved.

4/22
This program is going to be a little difficult, I can tell that already. We have to compete with non-academic clubs, which is not the easiest thing to do when you are dealing with the middle school age group. I mean, I know I did want to do academics after school. We are trying to make sure that all of the girls finish the survey before we really get started. Over all it was a pretty productive day.

4/24
Today was very interesting. UMSL students came today to teach the girls and peer leaders about chemistry and physics. Although the use of the egg was disgusting, it was quite informative. Now I know how to clean my class ring if it ever gets tarnished. The girls were very excited, especially for the dry ice. They loved to watch the object freeze in seconds then shatter. I feel it is things like this that can draw people into science. Show people that it is not just work. Some of the things are very fun.

4/29
Today Mrs. Hill gave notes on the Periodic table. I'm glad she did. Not many people know how to read the periodic table and it is because of Mrs. Hill that I know how to today. Not as many girls showed up today. It was quite surprising since just last week SLU came and gave us fun demonstrations of science. sadly, it is what it is. Hopefully more attend Wednesday.

5/1
again not many people attended this session. some of the girls we actually had to coax to come in today. After making sure the girls took their pre and post tests, Mrs. Hill took the girls outside to start the new section on Life Science. I had to stay inside due to my allergies, but I did fix the posters the girls made last week, so we could hang them for the ceremony get together in two weeks.

5/6
Did not attended due to prior engagement

5/8
Today our group was put in the conference room due a dress rehearsal for a play. We had so many girls show up that day. Everyone was pretty productive. although I did not tutor much, I did walk around to make sure everyone was ok and didn't need anything, including Mrs. Hill. There was some drama but it was easily nipped in the bud and everyone returned to their experiments. Again today we saw the struggle of non-academic clubs and our program. Lucky, all the adults were on our side, but we still compromised some so that the girls would miss too much.

5/13
Did not attended due to prior engagement

PL 8 Chel
4/17/2013
My first time being a part of the TFS was very exciting. Even though it was a little bit unorganized everything still flowed and it all worked out well. The girls that I tutored were very eager to learn new things. They constantly asked questions, and they were very happy and kept a good conversation. During our lab, they proved to me that they were retaining what was being taught. I think that this will be a very beneficial program for them only if they continue to come and be engaged and participate the whole time.

5/1/13
Today was very hectic. The girls were acting out and they were being different, and had a total different attitude today. I think if there is less talking and everyone is focused for at least one hour then I think, we can get more accomplished and I feel that going outside was a good idea.

5/6/13
Today went better, the girls calmed down quite a bit, we are still receiving our regular girls, but it's okay, as long as we can be able to teacher something. I can say only good things about this program. The girls are really learning and seem to be enjoying their time when they focus.

5/9/13
At first I thought everything was going good and all the girls were having fun with their experiments and then one of my girls and one of India's girls started to argue and a lot just got out of order and from there the day just went downhill. I know that we're almost over and we will improve.

Appendix R

TFS Participants Reflective Journal Entries

TFS Participant 1
Marie Babee(Culminating event) What this program means to you !
And I want to give a thanks for my best friend Riah, because she helped me understand, who made me come every day. And I want to give a thanks to all people, to Ms. Rona, because she has inspired me to do science when I didn't like it at all. The audience laughs. But now I kinda like it, so now she might be inspire me to probably be a scientist someday.
Mrs. Hill: Very good audience applauds

TFS Participant 2
I learned how to put the scientific steps in order when doing an experiment and the different variables. I like this club, it's good to learn and it's so fun. Left the program after one day. Sima

TFS Participant 3
I learned how to use steps in order. I sort of like it, because the experiments. No I wouldn't come back. Left the program after one day. Roxy

TFS Participant 4
I learned what an independent variable, dependent variable, control variable and constant is. I will come back because I had excellent helpers and now I understand science better. Left the program after two sessions. Le le

TFS Participant 5
It helps me with science and also my math. It helps me with my writing and my reading. It helps me pronounce words I do not understand. I felt good and it was so easy.

TFS Participant 6
5/6/2013
For the days I've been here I think that I learned a lot about Physical science and Life science. Another thing I learned about is chemical properties and a chemical change. I am really grateful for the things that Ms. Hill and her peer leaders taught me. One day when I grow up it might be a job that deals with science and I may look back where I learned.
Yah Yah

TFS Participant 7
I learned how to put the scientific steps in order when doing an experiment and different variable. I like this club, it's good to learn and it's so fun. Miya

TFS Participant 8
4/17/2013
I had fun today and I will be back next time and I learn what you can be wrong on your first guess.

5/6/2013
In this program I have learned about the Nature of Science. Also in this program I have learned about scientific investigations. Then I learned about the scientific method. In this program I learned force and motion. I really like this program, it helps me a lot. Stasia

TFS Participant 9
5/6/2013
The science program is very motivating and educational, but I have learned much from it. It is fun at times and I feel we do too much work. We have science classes at school and do work so not do something more fun such as experiment and also take brief short work like two pages instead of ten. I can guarantee it will be a better session. Oreo

TFS Participant 10
I learned about core of the sun and more about hypothesis. Marie Babee

TFS Participant 11
This program has helped me a lot. I learned more about science than I knew. The best part I like is learning about life science. I love coming to this program and learning about science. Sometimes I do not want to come, but I have to. Riah

TFS Participant 12
4/17/2013
I think we need to do more experiments, but I really enjoy you doing this for us. Also I learned that if you take a sample out of the box, then it will contaminate it.

TFS Participant 13
5/6/2013
This program has done a lot for me. It has taught me a lot and has taught me that science is used a lot in life. When I grow up I wanted to be a Trauma surgeon and science has helped me a lot in this program. I have always liked science, but this program made me love science. Even though I did not attend every session I still learned a lot from it and I thank Ms. Hill for that. Bubbles