The Effects of “Girls in Science Day” on Middle School Girls’ Attitudes and Interests in Science

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This dissertation titled
The Effect of “Girls in Science Day” on Middle School Girls’ Attitudes and Interests in Science

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Abstract

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The Effect of “Girls in Science Day” on Middle School Girls’ Attitudes and Interests in Science

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Because of the underrepresentation of women in STEM fields, many organizations are hosting days to promote middle school girls’ interest in science. The purpose of this dissertation examines one of these days, and is three-fold: Number one, to determine if the event “Girls in Science Day [GIS]” affected the interests and attitudes of the middle school girls who attend. Number two, to examine how GIS affected their interests and attitudes in science, and number three, to examine if there is a long time impact on the girls who attend GIS in middle school by interviewing them when they are older and determine if attending GIS made lasting impressions on their lives. It utilizes a mixed-methods approach by using a quantitative Likert-type scale to determine the first purpose mentioned, pre- and post- attendance interviews to examine purpose two, and longitudinal interviews of past participants to determine purpose three. These methods are then combined using meta-inference and results and implications are examined. Future research is then recommended to improve the status of women in science careers.
Dedication

This dissertation is dedicated to my parents, Pat and Steve Dixon, for their undying support of my education and their unlimited love.
Acknowledgments

I would like to acknowledge the commitment and dedication of my committee and friends, Dr. Krisanna Machtnes for her love and support, Dr. Ginger Weade for stepping in at the last minute and being wonderful about it, Dr. John Henning for teaching me how to write academically, and especially Dr. Eugene Geist, who chaired my committee and taught me so much about educational philosophy.
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Chapter One: Introduction

Problem Statement

In 2009 President Obama launched his “Educate to Innovate” campaign, which cites as one of its three goals to “…expand STEM [Science, Technology, Engineering, Math] education and career opportunities for underrepresented groups, including women and girls” (AAUW Educational Foundation Commission, 2000, p. 3). Despite this, in 2010, “only 18.1% of four-year engineering degrees went to women” (Gibbons, 2011, p. 1). In 2009, the percentage of women earning degrees in other areas of science was lower, 38.9% of earth, atmospheric, and ocean science degrees, and 41.5% of physical science degrees (National Science Foundation, 2013, p. 1). Clearly, not enough women are entering the STEM fields. But what can be done about this?

In response, many programs aimed at maintaining girls’ interest in science have been founded for children (Hammrich, 1998), adolescents (Jayaratne Thomas, & Trautmann, 2003), and adults (Cronin & Roger, 1999). These programs recruit females from schools to come and have a positive experience in the STEM field. These programs can take place for any time duration, including weeks or months, or even in a time of one day. Clearly, not having enough females in STEM careers, what we need to do is increase opportunities for females at a young age to experience science activities.

Significance of Study

Why is the lack of women in STEM professions so significant? The absence of women from STEM education and careers affects not only themselves, but others in the field. Milgram (2011) states that the lack of women in STEM fields is a missed opportunity from those areas. She says “Women bring a different perspective that shapes
and influences STEM disciplines. Having more women in the picture will not only help women themselves, it will also help society benefit from their expertise…” (p. 5).

Also, women should not lose the way to fulfilling, rewarding careers in technology. In 2011, Langdon, McKittrick, Beede, Khan, and Doms showed that over the past ten years, “growth in STEM jobs was three times as fast as grow in non-STEM jobs, even in difficult times” (p. 8).

This research hopes to show that if young girls can be interested in science soon enough, more of them will become women who go into STEM programs in college. It is significant for many audiences. Science teachers and administrators all around the United States can benefit by reading what one school district did in holding “Girls in Science Day (GIS),” and the results of it. By acknowledging that one small school district made the effort, they will have more confidence that they can do the same thing. Parents and community members can make grassroots efforts to support programs like GIS in their areas, because every donation helps the cause. Local colleges and universities will benefit by having students that are very interested in and attracted to science courses, and will ultimately sign up for those programs. Local employers will have a pool of job applicants that will have a more diverse academic experience overall.

Purpose of Study

We need to find a way to recruit more women into STEM professions. Yanowitz and Vanderpool (2004) say that students’ experiences in late elementary and early middle school have emerged as critical periods for maintaining girls’ interest in pursuing science careers. So this study has focused on this age group, middle school grades six through eight, to assess girls’ interests and attitudes towards science.
This research uses a mixed methods design where quantitative survey data will be collected, then followed by qualitative interviews. The purpose of this mixed-methods study is three-fold: 1) To discover if a day long program will have a positive effect on middle schools’ girls’ attitudes and interests toward science, 2) To examine the impact of how girls’ attitudes and interests change after attendance, and 3) To determine if there is a long-term impact of attending this event. The reason this study is mixed-methods is because the researcher wanted not only to calculate if effects occurred, but also to explore how and why they occurred.

Objectives

This study investigates the impact of ‘The Effects of “Girls in Science Day” on Middle School Girls’ Attitudes and Interests in Science,’ a program aimed at increasing female students’ interest in science. GIS was started in 2008 and was open to middle school girls (grades 6 - 8) from six schools in Rural Midwest and has continued for each year since the inception. Participants from schools around the county were selected by their science teachers and came together for a day to complete several hands-on activities in chemistry, physics, biology, and environmental science. The researcher hoped this activity would answer the following questions:

1. Does “Girls in Science Day” have an effect on the participants’ perceived attitudes and interests towards science?

2. How does “Girls in Science Day” affect girls’ attitudes and interests in science?

3. Explore the long-term effect that participating in “Girls in Science Day” could have on the participants’ decision to continue in science courses or in the field of science.
This study hopes to answer each question and look at the further implications of having such events. If communities and school districts, large and small, can come together for a grass-roots activity such as “Girls in Science Day,” much can be done to change many girls’ attitudes and interest toward science, which would hopefully motivate them to sign up for more science classes, and ultimately, choose a career in science.

Research Questions

1. Does “Girls in Science Day” have an effect on the participants’ perceived attitudes and interests towards science?
2. How does “Girls in Science Day” affect girls’ attitudes and interests in science?
3. Explore the long-term effect that participating in “Girls in Science Day” could have on the participants’ decision to continue in science courses or in the field of science.

This study hopes to answer each question and look at the further implications of having such events. If communities and school districts, large and small, can come together for a grass-roots activity such as “Girls in Science Day,” much can be done to change many girls’ attitudes and interest toward science, which would hopefully motivate them to sign up for more science classes, and ultimately, choose a career in science.

Limitations

There are a couple of limitations the researcher sees in this study. First of all, participants were selected by their home school science teachers to attend this event. Their selection could have been based on several factors such as: current interest in science, grades in science, and/or positive classroom behavior. This could bias the results of the quantitative research so that the pre-surveys about attitudes and interest in science would be skewed. This would make it harder to show effects of the post-survey. Also, for
the qualitative research, they would already be interested in science, so many of the things done in “Girls in Science Day” would appeal to them and might not appeal to the ‘average’ student not necessarily showing a pre-interest in science.

The other limitation the researcher has encountered in this research is that there is not much diversity in the racial or socioeconomic status of the participants. The rural county in which the event takes place in is a predominantly white, middle-class area.

**Definition of Terms**

- “STEM” – Science, technology, engineering, and mathematics (AAUW Educational Foundation Commission, 2011).
- “Girls in Science Day (GIS)” – The once a year event held in the rural Midwestern United States that girls from all over their county attend to complete four hands-on workshops in chemistry, physics, biology, and environmental science that was researcher-developed.
- “Students/Participants” – Girls from the rural Midwest who are in grades six through eight who come to GIS for the entire day.
Chapter Two: Literature Review

There are many facets that involve associating girls with science. The reader is led through these, beginning with a review that examines current and past programs for girls in science, followed by the theoretical framework for learning at these events. Next, girls in science programs that have had evaluations are explored, followed by techniques of recruitment, and variables affecting participants. Finally, the rural vs. urban aspect of where these programs are generally held is perused.

Review for Examining Programs for Girls in Science

This movement of having science events just for girls is not an isolated one. Over the years, many organizations have set up programs of this type that vary in several ways (Konrad, 2003). Many target higher-achieving middle school and high school girls (Yanowitz & Vanderpool, 2004) while others target racially diverse or socioeconomically disadvantaged girls with no prior interest in science at all. (Wheaton & Ash, 2008). These programs also vary in length (Yanowitz & Vanderpool, 2004), ranging from one-day workshops for younger students to summer-long research projects for high school and college students.

Some of these programs are nationwide. Explorers, for example, is a national program that provides opportunities for girls in middle school and high school to participate in science activities and to interact with women scientists as role models and mentors (Davis, 1996). Expanding Your Horizons in Science and Mathematics™, is a program that also focuses on middle school and high school girls (Expanding Your Horizons, 2000). Also, Girl Scouts of America have developed a national program that encourages girls to consider careers in science (Girl Scouts of America, 2002).
Technology companies, like IBM, Hewlett-Packard, and Microsoft sponsor summer camps for girls to explore science and technology (Konrad, 2003).

There are also regional or more local programs that are usually associated with universities. Project WISE (Women in Science), developed by Stony Brook University, engages high school girls in activities throughout the year, such as an all-day workshop designed to promote equity in math and science. Workshop leaders discuss their interests, how they balance family and work, and allow students to participate in exploratory science activities (Katkin, 1998). Other universities, like Chatham College and Wesleyan College, offer residential science programs for high school girls (Just for Girls Summer Camps, 2013). More recently, in March 2014, Princeton University invited 400 seventh through tenth graders into their labs, where exhibitors offered hands-on demonstrations and experiments as part of the Young Women’s Conference in Science, Technology, Engineering, and Mathematics.

Other community grassroots efforts result in science programs for girls. One program, the Mother/Daughter science club in San Francisco, lets fifth grade girls and their mothers listen to workshops by various women scientists, from chemists to veterinarians. The scientists discuss how they become interested in their work, the schooling required to become a scientist, and a bit about their personal lives (Chandler & Parsons, 1995). The Brainy Bunch began as a small community group of female science professionals in North Dakota. Volunteers from the professional community developed programs, raised funds, and sponsored classes for elementary age children to provide after-school science enhancement including the chance to engage in hands-on science
activities taught by science professionals (S. Vanderpool, personal communication, July 15, 2003).

More recently, programs like the GRASP (Girls Reaching to Achieve in Sports and Physics) Summer Camp occur around the country. GRASP is hosted by the Ohio State University Department of Physics. This office, coordinated with physics faculty, staff and students, “consists of hands-on, interactive physics demonstrations and projects followed by a physical activity that shows how physics relates to everyday phenomena. Staff are present at all sessions to supervise and share their understanding and love of physics with the participants” (Girls Reaching to Achieve in Sports and Physics, 2008, p.5). YWSI (Young Women’s Summer Institute) is a response to girls’ lack of interest in math, science, and engineering. It introduces girls to exciting careers and job opportunities. It is a week-long program sponsored by Ohio Supercomputer Center for middle school girls in Ohio. It promotes “computer, math, science and engineering skills as well as provide hands-on experiences” (Young Women’s Summer Institute, 2014, p.1). The Girlstart program provides a year-round intensive suite of STEM education programs for k-12 girls. It’s core programs “foster STEM skills development, an understanding of the importance of STEM as a way to solve the world’s major problems, as well as an interest in STEM electives, majors, and careers” (Girlstart, 2011, p. 2).

There are a couple of factors related to this process, though. Several of these programs require some sort of a fee for materials, residence, food, or field trips (Girls Reaching to Achieve in Sports and Physics, 2008). These fees have the potential of eliminating the participation of disadvantaged or impoverished girls. Also, while some of these programs have evaluations to examine their effectiveness, many do not. Yanowitz
and Vanderpool (2004) say that many programs that form at the local level rely on volunteer effort and donated supplies to function, which often precludes formal evaluations. They go on to explain that programs that do have them typically focus on general changes in students’ overall attitudes about science before and after the workshop. However, those evaluations for Mother/Daughter science club found a change in the types of science girls were interested in. Before the workshop, students were mainly interested in life science, but after they heard the presentations from the scientists, 25% of students expressed an interest in physical and earth sciences (Chandler & Parsons, 1995).

Theory of Learning at these Events

There are several theories and theorists that can apply to programs like GIS, but the one that stands out the most to this researcher is constructivism. Hammrich, Richardson, and Livingston (2000) said that constructivism serves as the foundation for many strategies of science and mathematics reform movements. Driver (1995, p. 345) said that “learning involves changing pre-existing schema using new information acquired through varied experiences. Human beings interact with objects in their surroundings and with each other and as they do this they construct mental models of their environment. The constant interaction of human and environment creates learning about the world” (Driver, 1995, p. 346).

Constructivism means that individuals “create or construct their own new surroundings or knowledge through the interaction of what they already believe and the ideas, events, and activities with which they come into contact” (Piaget, 1930, p. 24). One theorist who originated this concept was Lev Vygotsky, and he further specialized
constructivism into social constructivism. Social constructivism focuses on “an account of individuals as they function in social contexts” (Piaget, 1969, p. 10), like a public school classroom. Piaget (1969) goes on to say that a social constructivist perspective “recognizes that learning involves being introduced to a specific cultural community” (p. 14). In this perspective, “knowledge and its understanding are constructed when individuals engage socially in talk and activity about shared problems and tasks” (Lee, 2006, p. 5), like laboratory activities. Social constructivists’ view meaning making as “originating in social interactions between individuals, or their interactions with cultural products that are made available to them in books or other sources” (Leach & Scott, 2003, p. 93). But this applies especially to science classes and learning activities. When we teach science, we should foster a critical perspective on scientific culture among students. We should teach the “limitation of scientific knowledge and its application as social products” (Lee, 2006 p. 125).

John Dewey is also a theorist who developed ideas of constructivism. Even though he is known as progressive in most circles and regarded as a philosopher, he continually argued that education and learning are interactive processes (Dewey, 1902). Many people shared his belief in progressive education, to “facilitate the naturally developing tendencies and potential of the child” (Matthews, 2003, p .55). Dewey explained that the relationship between knowledge and reality is “a result of a person’s unique and social experiences” (Dewey, 1902, p.21). Making inferences out of real-world experience constructs the wrong and right about the world. Enriched experiences “change people’s perceptions about what is right” (Bulut, 2006, p. 82). According to Dewey (1998), real education is achieved “via experience, even though not all experience is
equally educational” (p. 32). Ultanir (2012) explains this, saying “the principle of continual experiences is that every experience should acquire something from those that have come before it and in some way should change the attributes of experiences that follow it” (p. 199).

The girls who participate in GIS are creating their knowledge working on laboratory activities, and they are doing it in groups. The groups become the cultural communities talked about above that build their knowledge base of the STEM fields. This also applies because girls as a whole prefer to work in group settings to accomplish goals rather than work individually. The experiences the girls have at GIS will build upon future encounters, like Dewey explained that above, and “give them more favorable attitudes” (p. 25) towards science. Also, even though the girls will be doing guided laboratory activities, a lot of them will be self-directed as the girls make observations, record data, and make analyses and conclusions about their hypotheses. Some of the activities involve inquiry-based learning, which has the girls doing even more self-direction as they decide the design of the experiment, and identify variables to achieve the desired results.

Jean Piaget was another leader in constructivism. His main focus had to do with the individual and how he constructs his knowledge. He proposed that humans cannot be given information which they immediately understand and use, but must construct their own knowledge (Piaget, 1953). According to him, “Essential functions of the mind are formed by developing a foundation consisting of understanding and innovation and constructing reality” (Piaget, 1971, p. 27). Piaget (1969, p. 17) states that “the development of a person’s intelligence is made through adaptation and organization.”
Adaptation is assimilating and accommodating new information. Assimilation is when children have to change their viewpoints, or “schemas,” to accommodate the new information. Piaget’s (1969) view is that, during their process of cognitive development, children rely upon their perceptions.

What Piaget said made sense for this research as well. The girls in GIS are going to construct their own knowledge about the subject presented in each workshop through the adaptation of the activities, and the organization of the program. Participants will have to change their viewpoints on some of the subjects presented at GIS. Also, it is the organizer’s responsibility to give the girls experiences to develop perceptions about and make sense of. The goal is for them to really think about science in ways they never have before, and to experience it positively and develop new ideas and thoughts about it. This all goes in with what Piaget is saying should happen, too.

Maria Montessori is another theorist with constructivist leanings. She questioned the traditional classroom mode of students sitting at their desks quietly all of the time, going through basic tasks over and over again. Instead, she emphasized times for children to move around and have experiences in the classroom that is safe and supports their curiosity (Ultanir, 2012). Montessori carefully planned the students’ environment, and had lessons and exercises in daily living as well as academics that included basic health tasks, social situations, and discipline (Hedeen, 2005). Montessori encouraged independent work (Ultanir, 2012). Students should choose what to do, how long to work, and whom to work with. In doing this, they develop discipline that encourages “individual creativity when solving problems, and also teaches independence and supports the development of self-control” (Montessori, 1997, p. 21).
Montessori’s work clearly puts the student at the top of the ladder. careful planning and friendly, encouraging teachers create an atmosphere where children are free to learn not only academics, but how to be good citizens as well. GIS should have all of these characteristics as well, and create well-informed citizens of the 21st century. Another expert in the world of behavior but who is not necessarily connected with constructivism is Howard Gardner. Gardner said people do not learn in the same way, and there are many different ways of acquiring and representing knowledge (Beliavsky, 2006). This led Gardner to develop his theory of Multiple Intelligences (MI), which claims there are many ways to understand the world around us. Gardner says (Beliavsky, 2006) there are seven or eight intelligences, many ways to understand the world, and so ideas should be taught in many ways to appeal to all learners.

Most teachers only teach through two kinds of intelligences – linguistic and mathematical. This is due to traditions that have been passed on through the years, the way schools operate, and the way students are assessed (Beliavsky, 2006). If students are not intelligent in these areas, they are not included and not praised for their abilities. They may have other strengths such as musical or spatial. If these students are left out and unmotivated they can lose self-esteem and school can become harder (Beliavsky, 2006). Gardner says teachers should take advantage of multiple intelligences. Teachers can do this by teaching the same subject by coming at it from many different viewpoints, such as linguistic, math, music, and hands-on. Beliavsky (2006) believes “this can help teachers reach more students, motivate them, and give them an opportunity for creative growth” (p. 8). She goes on to connect MI with Vygotsky’s Zone of Proximal Development
(ZPD). She says teachers can teach ahead of development to maximize the ZPD by using Gardner’s MI theory. By reaching out to all intelligences, more girls can be reached.

One important aspect of constructivism that applies to the science classroom is the value of student activities. Lee (2006) says that being a constructivist teacher means that students should be engaged in activities that make them engage in deep-level thinking, so that they will have new learning that will encourage them and make them more involved with science. Perkins (1993) thought challenging exhibitions of knowledge make for opportunities for deep learning. This performance suggests that students form knowledge by engaging in learning projects that require them “to explain, obtain evidence, find examples, generalize, apply concepts, analogize, and represent in a new way” (Perkins, 1993, p. 29).

To science teachers, this means activity-centered teacher and student-based teaching. Activities such as creating laboratory experiments and talking about the results with their classmates and teachers can help them learn at a deeper level (Lee, 2006). Also, “during laboratory work students have opportunities to learn the procedure and skills that are facilitating conceptual changes” (Lee, 2006, p. 6). Activities do not have to be laboratory activities, however. They can also use controlled classroom activities to explain conceptual meaning. Any activities where students are challenged and involved can help these concrete changes occur (Lee, 2006).

It is important to note, however, that activities should have equal interest to boys and girls. Colley (2003) found that many science games and undertakings or computer competitions involving science were made specifically for boys only, not from the point
of view of girls, thus making it difficult to engage them. Fensham (2008) also said activities would be successful when they represented girls’ interests, too. Wen-jin, Chia-ju, and Shi-an (2012) found that girls preferred hand-on activities, but liked activities that were about daily life issues, such as soap and cleanliness. After different groups participated in three weeks worth of different types of hands-on activities, the daily life-type group scored the highest significantly in interest gained. This example shows that science teachers need to develop more activities that are closer to the life experiences of all students, not just the girls.
Figure 2.1 Theoretical Framework for “Girls in Science Day [GIS]”
**Girls in Science Programs with Evaluations**

This researcher found only three programs with published evaluation results, so these programs are going to be examined critically. One of the studies was Shoenfelt and Starling’s (2005), entitled “An Evaluation of the Western Kentucky University Girls in Science Day Program.” This program was founded in order to sponsor chances for girls in middle school (grades five through eight) “to experience and enjoy math and science in a hands-on approach” (Shoenfelt & Starling, 2005, p. 8). It takes place over one single day, where 125 girls came to the university, and chose to attend three of the thirteen different workshops available. After lunch, the girls competed in a team project that was also a contest and had awards. Each girl was charged a $5.00 fee to attend. Funding was made ready, however, for any interested girl who had financial difficulties. The purpose was to evaluate the perceptions of the girls and their parents about Western Kentucky University Girls in Science Day.

Two apparatuses were used to evaluate this program: students took the “Participant End-of-day Questionnaire;” parents took the “Parent Questionnaire.” These surveys were written by Dr. Shoenfelt based on input from Dr. Stacy Wilson, who is a researcher about women’s roles in science, math, and engineering (Shoenfelt & Starling, 2005). Student surveys were matched to parent surveys while maintaining anonymity. Students answers sixteen Likert-type items asking whether girls were interested in science and math classes at school, how they felt about asking science and math questions, if they are interested in science when they are not at school, if they planned on being a scientist, and whether science and math are enjoyable to them (Shoenfelt & Starling, 2005). Two additional questions using Likert-type items were asked about the
girls’ opinion on whether Western Kentucky University Girls in Science Day was a good experience and if they will recommend Western Kentucky University Girls in Science Day to their friends. Also, two open-ended questions asked what the girls thought about the positive aspects of the Western Kentucky University Girls in Science Day program and what should be changed to improve the program.

Girls’ parents who participated in the program were asked to complete the “Parent Questionnaire,” which contained seven Likert-type questions asking if their daughters received support taking science and math classes, in following a science-related career, and if they thought Western Kentucky University Girls in Science Day was a significant experience for their daughters (Shoenfelt & Starling, 2005).

The results of these surveys were pretty consistent. The items that received the highest ratings were that Western Kentucky University Girls in Science Day was a positive experience and that the girls would recommend the camp to a friend. The other items also specified encouraging attitudes towards science and math. The questions that had the most agreement from the participants were that girls that have operated activities or projects in science, consider that science is fun, and know a woman with a job in a science-related field. The girls also said they feel they are superior in math and science than the boys in their classes. The respondents slightly agreed that they enjoy math, that math and science classes at their school are exciting, that they have a friend or family member in science, that they enjoy watching a television show or movie about science, and would like to sign up for more classes in math or science in the future (Shoenfelt & Starling, 2005).
The open-ended items on the survey asked the participants to list three things they like best about Western Kentucky University Girls in Science Day and to list three ideas about how to improve the event. The responses were grouped into nine categories. The category with the most responses was that the participants liked the classes overall. These were sub-categorized into general and specific classes that were taken, such as “Bottle Your Own Genes, Crime Scene Investigation, Polymers, Polymers Everywhere, Hollywood Geology, and Summer Garden” (p. 8), among others. The second greatest number responded that the “Castaway Egg Project” (p. 9) was their favorite thing. This was a group project based on the movie “Castaway,” where each group was given an egg, VCR tape, a paper towel, and a few branches and were instructed to build a raft that would hold the egg. Girls opened the tapes and strung the branches together with the tape to make rafts, which were then put into an aquarium to see how long they held the egg (Shoenfelt & Starling, 2005). The next highest category was classified into ‘Friends/Meeting new friends.’ The girls like socializing with friends and other girls who were interested in science. Another activity the girls liked was categorized as ‘Making things/hands-on’ where they could create things related to math and science. Other lesser categories mentioned were the food, the learning, having fun, the teachers (presenters of the workshops), and the category labeled ‘other,’ which generally did not fit into another category such as gifts, the T-shirt, and everything (Shoenfelt & Starling, 2005).

The participants were also asked what changes could be made to improve the Western Kentucky University Girls in Science Day. The responses were grouped into several categories. The category with the most interest was ‘More activities/classes.’ Girls wanted to join more classes, have more of a variation of classes, have more projects
to take home, and have more hands-on activities. The next highest category was simply ‘Nothing.’ Other categories included ‘Food,’ ‘program size,’ indicating they needed more spaces in classes and having duplicate classes of the most popular ones. The ‘Group Project’ was mentioned next, to have no team projects or better team projects, then ‘More time for classes/project’ was mentioned to increase the time girls had in each workshop, ‘Volunteers/Supervision/Teachers,’ where the girls would have enjoyed more leadership during their projects, and other comments about the ‘Physical Setting,’ ‘Making it longer/more often,’ where the girls would like to see such an event being held on a regular basis, ‘Trophies,’ ‘Pick class,’ where girls could pick the classes they attend, and ‘Other,’ where comments included ‘not so early,’ ‘more fun,’ more advertising,’ etc. (Shoenfelt & Starling, 2005).

The parents’ perceptions of Western Kentucky University Girls in Science Day seemed to go right along with their daughters.’ Parents appreciated the program, they reported it was a valuable experience for their daughters, and what they agreed the most is that they would encourage their daughters to follow a job in science (Shoenfelt & Starling, 2005).

The parent responses of the open-ended questions were also categorized. For the most positive things about the event, they listed ‘Learning/positive experience,’ ‘encouragement,’ ‘Friends,’ ‘Fun,’ Self-esteem and confidence,’ ‘Teamwork,’ Girls-only experience,’ ‘Teachers/staff,’ ‘Exposure to Western Kentucky University,’ and ‘Other,’ (p. 10) which included the reasonable price to attend, time of day, organization, and that this even exists at all (Shoenfelt & Starling, 2005).
Parental response to the question concerning improving the program was quite
telling. Their responses were grouped into categories. The most popular category is to
‘Extend the program.’ Parents wanted to see a summer class, or invite more girls, or have
the program more than once a year. The second most common response was having more
volunteers, like speakers, parents, and students. They wanted a greater student-per-
teacher ratio. Other responses included ‘Nothing,’ ‘More promotion/marketing,’ and
‘Other,’ which included being more timely, not scheduling during state testing, and not
allowing parental assistance on group projects (Shoenfelt & Starling, 2005).

In general, parents and students gave Western Kentucky University Girls in
Science Day a very encouraging evaluation. The girls had an enjoyable time learning
about science and math, and hopefully this reinforces their attitudes in considering
careers in science and math. However, to expand the program like so many wish, there
would need to be more faculty involved who teach science or math and volunteers, and
greater funding (Shoenfelt & Starling, 2005).

Another study with program evaluation results was by Yanowitz and
studies were done over a one-day workshop, similar to the timeline of GIS. In the first
study, seventy-seven girls in fifth and sixth grades came to a university to participate in
workshops from northeast Arkansas region. Districts were primarily rural areas with low
to middle income populations. This study examined whether students’ attitudes about
careers in science changed as a result of attending the workshops. Students were also
asked if they perceived that the workshop facilitators discussed women in the field of
Science. Each participant was given a survey at the end of each workshop asking the
following questions and was asked to indicate their agreement to each statement (Yanowitz & Vanderpool, 2004):

- Did you ever think about becoming a scientist before today? (The term ‘scientist’ was replaced with the actual discipline the workshop leader worked in).
- How interested are you in becoming a scientist?
- Did coming to the workshop make you more interested in becoming a scientist?
- Do you think a lot of women usually become scientists?
- Did the leader of the workshop talk about any problems women might have if they want to become scientists?

A Likert-type scale was used by the participant to indicate how much they agreed with the statement “I like science” ranging from 5 (agree a lot) to 1 (disagree a lot) (Yanowitz & Vanderpool, 2004). The results were mostly positive. Organizers found that a majority of the participant in this program were not interested in science careers prior to attending the workshop. Forty-five percent were interested in medical careers, like becoming a physician or a nurse, but others wanted to be in non-scientific careers like teaching, acting, or farming. After attending the workshops, however, 85% of the students agreed that the workshops had increased their interest in that particular career involving science. This indicated that the workshops met their purpose. Sadly, only 31% of the participants that attended the 13 science workshops agreed that they would enter that field of science. Also, students did not perceive that the facilitators of the workshops talked about the problems women might face in the various fields, and 54% of the respondents that attended the workshops said that the facilitators did not talk about
potential problems that women might face in the field of science (Yanowitz & Vanderpool, 2004).

These findings are both positive and negative for the proposed research. It shows that workshop leaders need direction to emphasize that women do enter their fields. Having women presenters may not be enough to make that point. However, the study (Yanowitz & Vanderpool, 2004) found that shorter workshops can provide a good introduction to scientific careers for elementary school students without being overly taxing for students or for organizers of the programs. The current study suggests that if a one-day workshop will make a difference for elementary students (grades four through six), it would also make a difference for middle school students (grades six through eight).

The second study by Yanowitz and Vanderpool, 2005 was different from their first study. There was another evaluation with the same program in a different year with a different group of students from the same area. The purpose here was to see if students’ understood what it means to say someone is a “scientist,” and if students would gain knowledge about the profession by attending the workshops. Another goal was to examine participants’ viewpoints of whether or not the workshop leaders presented information about the education needed for scientific careers. At the conclusion of the workshops, students discussed the one most important item they learned in the workshop, and pre-event questions were asked about what they would like to do when they are older and how much they liked science.

The results this time around were better. 55% of students generated statements that scientists do some type of general, nonspecific study or learning. A typical statement
was “They do experiments and try to figure things out.” 34% had more specific
descriptions, and 16% said scientists help people in some way. A t-test was calculated
and found that a significant portion of participants said their workshop presenters talked
about what scientists do, but only 65% said they talked about the education needed to
become a scientist. 77% said the most important thing they learned were specific, factual
items about the subjects presented in the workshops, 4% talked about educational
requirements, and 10% said things like “Science is fun.” The study proved very effective
about presenting the day-to-day activities of scientists in various fields, however
(Yanowitz & Vanderpool, 2004).

Yanowitz and Vanderpool (2004) made a very important statement that pertains
to the proposed study. They said “Longitudinal studies should be conducted to determine
if participating in this and other workshops have long-term effects on students’
continuation in science” (p. 358). The proposed study intends to do just that.

One more study associated with evaluating a science program is Weavers, et al.
(2011) “Assessing an Engineering Day Camp for Middle School Girls.” The goals for
this camp are for girls to “learn about engineering and to increase participants’ potential
to hold an interest in math and science” (p. 131). This would let them prepare for more
derived, advanced coursework such as engineering. Other purposes include letting the
girls meet female peers with like interests, and learning it is fine for them to like science
and math (Weavers et al., 2011).

Future Engineers’ Summer Camp (FESC) has many positive components. The
camp is a week long, and meant for thirty eighth grade girls, and the cost is free. The
camp sets out to recruit girls who already have a curiosity in math and science but are not
necessarily aware of advanced fields like engineering. The camp covers engineering topics and are led by engineering faculty that are both male and female, and if not sponsored, the cost is approximately $1,000/girl. The camp is focused around modules that are made to introduce girls to the topics covered in engineering. The concepts are college-level with activities for eighth graders that are feasible, relevant, and have an excitement to them. The main requirement is that the activity “is engaging but also intellectually honest to the relevant engineering discipline (Weavers et al., p. 128).” Activities included things like building a hovercraft, creating an algorithm by using chimes, and evaluating leaves at a Scott’s plant for durability and reliability.

Evaluations were conducted in three ways. There were “evaluation cards,” a “retrospective survey”, and “focus groups”. Evaluation cards seem equivalent to ‘exit slips’ used in the classroom. After each activity, these cards would be passed out. They would have four questions on them, along with a place for the participant’s name and date. The questions asked were rated on a scale of one to five, one being worst, five being the best. The questions were (Weavers et al., 2011):

- The person leading this activity was (hard to understand, easy to understand)
- This activity taught me (a little, a lot)
- Fun meter (boring, super cool)
- Overall, this activity was (poor, excellent)

The retrospective survey addresses how girls’ expertise, abilities, outlooks, or understanding have changed since this experience. Noticeably different is that there was not a pre- and post-survey, but one survey that evaluates how the girls’ changed. Studies show that “individuals tend to inaccurately rate their ability level as higher before an
experience compared with participants evaluating changes in their ability level after participating in an experience” (Pratt, McGuigan, & Katzev, 2000, p. 345). This survey did not ask for names or identifying information and given at the end of the day camp. Questions about knowledge, attitude, and aspiration were used, and a 4-point Likert-type rating scale ranging from 1 (no) to 4 (yes) to answer the questions. Example statements were “I understand engineering,” or “I feel as capable as my male counterparts in math and science classes and/or activities.” Paired t-tests were used to examine whether the mean difference in the before and after scores for understanding, outlook, and target are significantly different from zero.

The third method of assessment is the use of focus groups. A neutral moderator who has been trained in leading focus groups met with ten different participants three times. Each session is audio recorded and had a scribe present, and all participants were given a chance to speak to the moderator (Weavers et al., 2011).

The results were very positive and analyzed statistically. On the evaluation cards, the girls rated the activities as excellent. Ratings of activities changed the most in the “Knowledge” category, with some activities thought of as having greater educational value than others, although most were considered satisfactory. Among the four questions, the “Leader” was the most well perceived. The highest mean ratings were found here and the smallest standard deviation. The “Fun” aspect was rated high also, but not as dependably as the “Leader” category. Surprisingly, the “Knowledge” aspect was the least favorably rated, and the “Fun” aspect was the most projecting of overall ratings. Weavers et al., 2011, said that the association of how much fun the activities were to the total mark recommends that if the main goal of FESC is to improve girls’ attitudes toward
engineering, then it’s important to offer activities the participants think of as fun. They went on to say that “girls correlate “Fun” with active; so there need to be hands-on activities that the girls think are fun and have great effects (p. 131).” For the retrospective survey, the “Knowledge” category was significantly different from zero after attending FESC. In “Attitude” the change was statistically significant, but was not thought to be significant. For “Aspirations,” the change was noted as considerable, and the results indicate that FESC “significantly improved the girls’ knowledge of engineering as a whole, affirmed their positive attitudes, and reinforced their aspirations in engineering” (p. 132). The focus group results support the evaluation cards and retrospective surveys. Over half of participants said they learned about engineering and how it fits into their environment. 40% of girls reported an increased ambition to follow engineering as an occupation. They were pleased to meet other girls like themselves, and claimed they will stay in contact with their new friends in the future. Eight participants said that FESC reinforced the necessity to take more math and science courses. Some campers offered potential improvements, like less lecturing with power points and more hands-on activities (Weavers et al., 2011).

Interestingly enough, Weavers et al, 2011, attempted to do a longitudinal study. They sent surveys to all past participants to learn of girls’ continuing goals toward engineering until they graduate from high school. The results, however, are disappointing because maintaining contact for that long was difficult, and they got a low response rate. For example, 19 out of 30 participants responded to the inquiry one year after attending FESC, but only five out of 30 responded two years after participating. The first cohort was in 2007, the researchers received a 0% response rate.
There is definitely a need for more evaluations for these types of programs. The effectiveness of a day-long program needs to be calculated, but more than that, founders of these types of programs need to know why they are effective, and what parts are the most effective. This way, programs can make even more progress attracting girls to science. The biggest need, though, is a longitudinal study that can measure the effects of the program years after girls participate in it. The contact issues and response issues need to be overcome, perhaps by persistence or good record-keeping, to decide if GIS has long term effects for participants into high school and college.

**Recruitment**

The first step in planning a program such as GIS for anyone is the recruitment of participants. The program needs to be set up and advertised so that it is “girl-friendly” and appeals to females of middle school age. There are many ways this can be done.

The first aspect that needs to be publicized in recruiting for events such as GIS is the portrayal of female role models for girls to see who look like them. Presenting these role models tells young girls that female scientists are just like them – they look like them, sound like them, and still do the job of a scientist. When advertising events like GIS, advertising campaigns need to be used that feature women in them. Posters, flyers and brochures showing pictures of female role models should be used as well as vocation film shorts of women in their area of study (Milgram, 2011).

Milgram (2011) also suggests when making these types of recruitment tools, that the designers use the color pink. National baseball teams have used pink to advertise to women coming to games, and pink baseball hats are the second best-selling color at the souvenir store (Dreilinger, 2005).
Milgram (2011) says girls need to get the message that women can still be successful in science careers and enjoy their work while they still have a meaningful personal life. She (2011) goes on to explain that this message needs to be repeated over and over again. In studies of messages sent to young girls, she (Milgram, 2011) found that the messages sent are mixed at best and negative at the worst, such as “This is not a career for you (p. 5).” This concept is reinforced by the small amount of women in STEM fields today (Milgram, 2011). In response, educators and community members need to send strong messages to girls saying that they too, can be a scientist.

Another point in recruiting females to these events is to show that there can be a balance between a woman scientist’s work life and personal life. In fact, the American Association of University Women’s study, “Tech-Savvy: Educating Girls in the New Computer Age,” found that girls “did not want to engage in computer careers because they were concerned they would have to work constantly, with no time for personal or family activities” (AAUW Educational Foundation Commission, 2000, p.8). Many other studies had similar results (Milgram, 2011).

This works hand in hand with the next concept of female role models stressing the point that women can have both a work and family life. The role models can emphasize how women got these STEM careers, the passion and fulfillment they found in their work, and their personal lives (Milgram, 2011).

Another strategy to recruit girls to programs like GIS, science classes, colleges, and universities is to reach out to counselors. If teachers, administrators, and community members, and colleges and universities can bring counselors such as high school guidance counselors and college career counselors, to encourage girls and young women
to take these classes and target females as a goal to these programs, this can serve as a pipeline for female students into these programs (Milgram, 2011).

This point is illustrated by the Computer Networking and Information Technology (CNIT) department at the City College of San Francisco. They “increased the percentage of women in their classes from 18.1% to 33.2% using a strategy of having the department make a presentation to the counseling department about the program and related careers” (Ragan & Elworth, 2011, p. 2). If more schools could get counselors involved and motivated to increase the recruitment of girls in to STEM classes, perhaps this result could be replicated in other institutions.

There are other strategies that can help in this line. The director of an electronics academy used ideas such as making presentations about his camp for boys and girls to various homerooms in his school (Milgram, 2011). In doing this, he explained how the presentations were a great experience for all students, but specially emphasized how he wanted girls as well as boys in the program. He went so far as to reserve half of the slots for female participants. He found (Milgram, 2011) the boys’ slots filled faster than the girls.’ It was more difficult to get the first few girls to sign up, but once they did, it was much easier to tell other girls who was going so they knew they would not be alone if they went. Milgram (2011) says that “Generally, girls prefer to have the company of other girls, so it’s more effective to recruit them together in groups” (p. 7).

While women prefer to learn in groups, they also have diverse learning styles, and in what they are interested in the STEM fields is different from boys (Margolis & Fisher, 2001). Their research shows that women most care about how STEM can make a difference in the world. These examples include making prostheses to help people, while
men enjoy the technology itself, like how fast a processor works (Extraordinary
Women Engineers Project, 2005).

**Variables Affecting Participants**

Many factors in today’s schools influence what girls think and know about what scientists do, or what science is. Yanowitz and Vanderpool (2004) found from open-ended questions, that students possessed only a general conception of what scientists do, but lacked specific information. In their study, they found that 55% of students generated statements that scientists engage in some type of general, nonspecific study or learning. For example, one student said “They [scientists] do experiments and tries to figure out things.” Yanowitz and Vanderpool (2004) contend that besides content information about science, career development information should also be an important component of these types of science programs. Besides being covered in an annual event, these topics should be discussed in greater detail in the classroom on a regular basis. If girls are educated about what sciences do, all of the different types of science, and how they might contribute, they may be more interested in a science career.

It must be stated here, research indicates that girls are interested in how they might contribute to society, or just helping people or helping something in some way. “Girls who do persist in science often express a desire to use their knowledge in a socially relevant way” (Farenga & Joyce, 1999, p.70). In the study of Yanowitz and Vanderpool (2004) few students perceived the workshops as discussing how science can help people, which again, is an important aspect in girls’ career decisions. So to combat this, teachers and workshop facilitators need to implement in their lesson plans how science contributes to society.
Another aspect that influences girls about science is lack of role models. Girls need to be exposed to women scientist and engineers, get to know them on a first-name basis, and witness the reality of being a woman scientist. They also need to address the problems of being in that profession head-on, and discuss with the scientist how they keep their daily lives balanced with work and family. This reduces isolation commonly felt by girls who are already interested in math and science. Scheduling time for girls and mentors to “just talk” to each other helped students find out there are “girls just like me” who “have the same problems.” (Campbell, 1992, p. 38).

If girls do not have these role models, and don’t see women scientists, Bigler and Liben (2006) say they can “attribute gender differences to the essentially different natures or qualities of the sexes” (p. 48). They think that men perform some jobs better because they are greater in the skills required for that job. They would then see women as being better at the skills associated with conventionally female roles. Campbell (1992) agrees saying that while “TV role models appeared to have a short-term impact on career choice, talking with scientists and engineers about their work caused girls in several programs to consider those careers for themselves” (p. 54).

While legal barriers have been removed for girls in STEM careers, Shirley M. Malcom, the head of the American Association for the Advancement of Science, said there are still ‘barriers of the mind,’ the last factor presented here. This means that evidence is still current of the perceived “masculinity of science and mathematics,” along with the current teaching methods of science and math in schools. “Organizational characteristics of science and mathematics play important roles in diminishing the achievement of females in science and mathematics” (American Association of
University Women, 1990, p. 10). This perception of masculinity discourages girls’ interest in science and math and from choosing careers in those.

Another variable that can affect participants is the girls-only style of programs like these. There has been a lot of discussion about single-sex classes for science and mathematics especially in high school education. Research says that “classroom interactions, pedagogy, and curriculum disadvantages females” (Sadker & Sadker, 1994, p. 42). The research also indicates that “the cumulative effect of gender biased classrooms is negative toward science and mathematics, avoidance of science and mathematics courses, lower career aspirations and poor self-concepts” (Baker & Piburn, 1997, p. 21).

Most studies of single-sex learning environments come from other countries such as Australia, Jamaica, Nigeria, Great Britain, and New Zealand and have mixed results (Marsh & Rowe, 1996). Parker and Rennie (1995) found that “single-sex classrooms had a positive effect on both attitude and achievement for boys and girls,” (p. 8) although Mael (1998) found that single-sex schools aided girls more than boys.

In their study, Baker and Jacobs (1999) found that single-sex classrooms had a “positive effect” (p. 29) on girls. They found girls helped each other to comprehend and finish the class group work, while boys did not, and even actively restricted each other’s learning. They also saw that teachers asked girls more advanced questions than boys, and that girls said they were “more willing to participate in the single-sex classroom and were less embarrassed without boys” (p. 30). In comparison, boys lost a lot of their opportunity to learn because they could not complete their assignments or succeed in group work. A lot of instructional time was lost due to discipline issues.
Girls preferred the all-girl classes because they were kind to one another, everyone could add to a job and there were “opportunities to be both a leader and a follower” (Baker & Jacobs, 1999, p. 27). Girls described boys as “noisy, distracting and mean” (p. 28). However, at times a small number of girls would rather be in a mixed-gender class so they could ‘fraternize’ with the boys.

**Rural vs. Urban**

There is a gap in the literature regarding the opportunities for rural girls versus those open for urban girls. Big cities, with access to resources such as major universities and corporations can easily have these programs. This research was not able to find any available research concerning rural areas having science days for girls. This needs to be addressed and programs developed for girls from areas with fewer resources.
Chapter 3: Methodology

This chapter explores the mixed-methods design utilized in this study with a description of the approach, followed by explanations of the quantitative phase of design and the qualitative phase of design, followed by a section explaining the techniques of interviewing. Reliability and validity are examined next, and then concluding with the researcher’s lens.

Mixed-Methods Design

Mixed-methods design is “a procedure for collecting, analyzing, and “mixing” or integrating both quantitative and qualitative data at some stage of the research process within a single study for the purpose of gaining a better understanding of the research problem” (Creswell & Plano Clark, 2011, p. 35). The reason for mixing both kinds of data in one study is because neither type quantitative nor qualitative, provide enough data to understand the responses of the participants and the impact of the research. However, if both methods are used, they can complement each other and let the researcher perform a more complete analysis that uses the strengths of each kind of study (Miles & Huberman, 1994).

Mixed-Methods Approach

The mixed-methods design used in this study is the “mixed-methods sequential explanatory design” (Creswell & Plano Clark, 2011, p. 44). It first collects and analyzes quantitative data, and then uses qualitative data in two phases of the same study (Ivankova, Creswell, & Stick, 2006). There are issues to be considered with this type of study, however. “The researcher must determine the priority or weight given to the quantitative side and the qualitative side, and decide the sequence of the data collection
and analysis” (Ivankova et al., 2006, p. 5). Later, it must be determined the states in the research process where results of both methods are integrated and analyzed (Morgan, 1998). For example, the researcher should decide which method in the design should receive priority, how to implement it, and when to integrate them to answer the research questions (Ivankova et al., 2006).

In this study, the quantitative data will be captured first followed by the qualitative data (Creswell & Plano Clark, 2011). The researcher will start with the quantitative data, analyze it, and use the findings to develop the qualitative data, which will consist of interview questions derived from the information learned in the quantitative phase. The reason for using this order is that “the quantitative data and analysis provide an understanding of the research problem, while the qualitative data and analysis refine and explain those results by exploring the interviewees’ views in greater depth” (Tashakkori & Teddlie, 1998, p. 82). The positive aspects of this design are its directness and openings for the exploration of the quantitative results in greater detail (Morse, 1991). The limitations are the great amount of time involved and the means to collect and analyze both types of data (Ivankova et al., 2006).

At the end of both phases, they will be integrated during the ‘meta-inference’ phase. Creswell and Plano Clark (2011) call these “conclusions or interpretations drawn from the separate quantitative and qualitative strands of a study as well as across the quantitative and qualitative strands” (p. 213). Teddlie and Tashakkori (2009) see mixed methods as “a vehicle for improving the quality of inferences that are drawn from both the quantitative and qualitative methods” (p. 88). In weaving these two phases of research
together, we can understand more regarding how and why GIS is effective, and what, if anything, can be done to improve those areas.

**Quantitative Phase**

The goal of the quantitative phase of this research is to examine whether GIS had an impact on middle school girls’ perceived attitudes and interests in science. The data was collected in the form of a pre-survey, taken before girls attended GIS, and a post-survey, taken immediately after girls attended GIS. The pre- and post-surveys were developed by the researcher and were measured on a 5-point Likert-type scale. The questions were developed from literature review on factors that had been identified as have an effect on girls and their attitudes and interests towards science. Questions were asked not only concerning each girl’s interest and attitude towards science, but also if they know what a scientist does, if they would consider taking additional science classes in high school, if science class is valuable, and about their parent’s influence towards their interest in science. The Pre/Post-Survey is in Appendix A.

The response scale for both the pre and post questions consisted of the following responses: 1 (strongly agree), 2 (agree), 3 (no opinion), 4 (disagree), and 5 (strongly disagree). The 12 survey questions were analyzed using the statistics program SPSS, and an independent samples t-test was utilized to analyze the data.

Besides the 12 survey questions, the participants were also asked to respond to two open-ended questions. The first question asked the participants why they were interested or not interested in taking high school science classes, and the other asked what a scientist does. This data was analyzed by coding and searching for patterns by the researcher (Creswell & Plano Clark, 2011).
The demographics of the participants were obtained as they enrolled. They were selected based on their agreement to attend GIS. A total of 94 participants will be used. They were all female middle school students (grades six through eight), from Knox County, Ohio, and took both the pre- and post-surveys. Participants were selected to attend GIS from their home schools by their science teachers, the teachers could have selected on the following issues: grades, behavior, and interest in science. Besides being female middle school students, each participant is from Knox County, attends one of 5 public schools, or one private, religious-based school, and received permission from their parents/guardians to attend.

There is one major limitation, however, in the quantitative phase of research when using a pre- and post-survey. Howard (1980) refers to this limitation as Response-Shift Bias. This could apply to the quantitative strand of this study. Even though girls will complete the pre-survey of their attitudes and interests towards science, once they attend GIS and fill out the post-survey, they change their perceptions of their initial feelings about science in the pre-survey. They could decide, for example, that they really did not know much about what a scientist does, but they did not realize they were so unaware until after they attended GIS. Girls could say their initial responses on the pre-survey were inaccurate. Howard (1980) said this could be because of issues like subject compliance, memory misrepresentation, or social appeal. He says the potential for this is increased when subjects are asked to provide “a pretreatment and post-treatment ratings of their levels of functioning” (p. 95).
**Qualitative Phase**

The second, qualitative phase is divided into two parts. Eight participants were chosen to be interviewed before attending the event for the first time, and then interviewed again after attending GIS. The interview participants were selected to be interviewed based on the recommendation of their home-school science teachers that was based on their interest and verbal skills. They were then asked for their consent and accepted. The home-school teacher is the one who made the introductions between the researcher and participants. The researcher traveled to each participant’s home school for the interview. Interview questions were derived from the previous quantitative surveys mentioned above. The second part of this phase is the cross sectional interviews that will take place where the researcher will interview current and past students that participated in GIS in various cohorts since 2008. Some of the participants will still be minors while a few will currently be college students. Special considerations were taken into account when interviewing adolescent females.
The first issue to be considered is the ethical issues involved with interviewing minor females. One of these is informed consent (Kvale & Brinkmann, 2009). All subjects participating in an interview must freely and voluntarily consent to be in this study. This includes informing them of their right to withdraw at any time without penalty or repercussion, and informing them what the study is about, and why they are
being interviewed. The material being asked could be of an emotional or controversial nature, and the participants need to be ready for that. This applies to all studies, but especially this study since I am interviewing minors. Besides getting their parents’ consent to interview them, each girl’s assent is also needed. This involves explaining the study to them, telling them there is no penalty for not wanting to participate, and that they may stop being interviewed at any time. This is different from consent because it is for the minors themselves, and it must be explained in language that they are familiar with and can understand.

Confidentiality is another ethical issue. This states (Kvale & Brinkmann, 2009) that private data that can identify the participants should not be disclosed. Since a study can potentially be published, a participant must agree to releasing identifiable information. Therefore, all interviewees should be aware of who will later have access to the data. This can bring about a dilemma, because the interviewer can learn of mistreatment, malpractice, child abuse, drug use, or other criminal behaviors. Kvale and Brinkmann (2009) explain how in the United States, researchers can get a certificate of confidentiality in advance from the government to protect the identity of their participants.

Another issue is consequences. Potential harm and potential benefits to the participants must be identified. The risk of harm to a participant should be the least possible (Guidelines for the Protection of Human Subjects, 1992). Kvale and Brinkmann (2009) say that from an ethical perspective, “the sum of potential benefits and importance of the knowledge gained should outweigh the risk of harm to the participant” (p. 15). The notion to carry on the study must be justified. In this study, the researcher seeks to help
each girl to clarify what she got out of the experience, and perhaps make her wonder why her attitude towards science changed in comparison to what it once was. Since they are not being asked about highly emotional issues, at least none are anticipated, risk is minimal, and the researcher will have no previous relationship with the participants.

The last ethical consideration is one of what Edgar and Fingerson (2002) call power dynamics. It should seem clear to most people that researchers have most of the power in the interview. They are the ones picking the setting, asking the questions, deciding when to go on to the next question, and announcing when the interview is over. The interviewee can easily get pictured as the one who gets subjected to a barrage of questions, has his/her answers written down, coded, analyzed, transcribed, and thought of as a non-human instrument of information. An option to restore equal power is for researchers to conduct many interviews with the same person, promoting a greater level of depth. Feminists (Reinharz, 1992) believe this will promote the empowerment of interviewees by encouraging deeper reflection and trust. This applies to this research because two interviews are being completed with the same person, so trust will be developed.

There are other ways to combat the power dynamics, and many of these ideas come from researchers who specifically interview adolescents. One is called reciprocity (Eder & Fingerson, 2002). This involves lessening the unequal power between the researcher and interviewee by helping the interviewee get something out of the interview. Taylor, Gilligan, and Sullivan (1995) interviewed a number of adolescent females, and found that just by the researcher being interested in them made the girls feel free to speak and discuss things she would not normally share with her family and friends. Some of the
girls interviewed said they had gained new insights into themselves during the interview. One said “But since the question came up, it let me know how I felt. I think that’s good. I can do this forever you know…keep on going” (p. 129). Eckert (1989) did a study that involved interviewing adolescents and found out that when the interview questions were nonjudgmental and confidential, the interviewees found the atmosphere to be safer than talking with adults they know.

**Reliability and Validity**

Reliability and validity of this study are address through various methods in each phase of the research. Validity of the quantitative survey research will be confirmed through the qualitative interviews. The qualitative data will be analyzed using a structured interview technique. Data will be analyzed by doing a preliminary coding followed by a secondary coding and then data will be examined for themes (Saldana, 2013). Research will address credibility by using rigorous techniques for data gathering, credibility of the research and philosophical paradigm.

Qualitative transparency is a critical issue for addressing areas such as reliability and validity. This will be addressed through triangulation of qualitative data sources. Research will examine the interviews for triangulation of data gathered from different sources at different times. Reliability will also be addressed through co-rater reliability of the data coding by another researcher and validity will also be examined by member checking of the interviews for intention of meaning as well as correct transcription.
Researcher’s Lens

The researcher started the program “Girls in Science Day” in 2008 in Knox County, Ohio. She has taught science for eleven years in Knox County at two different school districts, and has taught ninth through twelfth grades in the subjects of chemistry, physics, earth science, chemistry II, physical science, astronomy, and environmental science. Her experience as a female science teacher along with her classroom observations led her to detect a need for a girl-related science program in the rural area of Ohio when field trips to science days at urban areas were not financially feasible. The researcher has done extensive research on the matter of gender differences in science, and the areas mentioned in chapter 2 come up consistently in the literature.

The researcher’s experience in her undergraduate and graduate work have helped this process immensely. Her undergraduate degree is in psychology, her master’s degree is in education (curriculum and instruction), and her doctorate will be in education majoring in science education. All of these areas have given her experiences in teaching science, working with adolescent females, and interacting with them concerning education and science-related issues. Along with this, her graduate-level statistics course, qualitative research methods course (data coding and mixed-methods), and other research courses have helped strengthen her understanding of both quantitative and qualitative research methods culminating in this dissertation, which utilizes the mixed-methods approach.
Chapter 4: Results

In this chapter, each research question is broken down and answered with survey and interview responses. The quantitative results are summarized and discussed first, including a table of significance, followed by a summary of information gathered during the qualitative interviews of girls before and after they attended GIS. Immediately after this, the cross-sectional interviews are summarized, anticipating the meta-inference phase of design. Recurrence of themes are generalized and related to the research questions.

The first step of the exploratory sequential mixed methods design was to collect quantitative data and then analyzed that data to develop the pre- and post-interview questions for the qualitative stage that followed. The survey was distributed in-person to each attendee of 2013 GIS (N = 96) on the first day of the program, but only 94 post-surveys were collected so the usable response rate was 97%. Data was entered into Excel and then imported into the SPSS data analysis software.

Quantitative Results

Survey data was analyzed in accordance with the study research objectives.

Objective 1: Does “Girls in Science Day” have an effect on the participants’ perceived attitudes and interests towards science?

This objective sought to examine what impact GIS had on the participants’ attitudes and views toward science. The participants were all female, in grades six through eight (ages 12-14), who attend local schools in Knox County, Ohio. They were selected to attend GIS by their home school science teachers, who could have chosen these girls based on their interest in science or their positive behavior in class.
Demographic data was captured by the program enrollment form that had been given to each girl and her family in order to attend this program. The requirements to participate in this GIS program were as follows: that the participants were females, between the ages of 12 to 14, have a grade level from starting 6 grade to finishing 8 grade, and attend a Knox County school.

The pre- and post-survey were comprised of 12 questions with a likert-type response scale that asked participants to choose their level of agreement for each statement. The Likert-type scale ranged from (1) strongly agreeing to (5) strongly disagreeing. Participants completed the pre-test at registration in the morning and then completed the post-test late in the afternoon that same day. An independent t-test was used to analyze the data due to an inability to match the identity of the pre-test with the post-test. The statement with the highest level of agreement on the pre-test was “science is valuable” with a mean of 1.75 (SD = .795) and the statement with the lowest level of agreement was mean score for the pre-test was “at times it seems that my science teachers pays more attention to the boys in the science classroom than the girls” with a mean of 3.72 (SD = 1.237). Table 4.1 shows the means and standard deviation of all questions for both the pre- and post-survey. This table also includes the results of the t-test analysis between the pre- and post-test.
Table 4.1 Results of the survey that examined the attitudes and perceptions of Girls in Science Day. Statistically Significant Results of Surveys administered to participants of the Girls in Science Day in Knox County, OH

<table>
<thead>
<tr>
<th>Question</th>
<th>Pre-Test</th>
<th></th>
<th>Post-Test</th>
<th></th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>sd</td>
<td>Mean</td>
<td>sd</td>
<td></td>
</tr>
<tr>
<td>I am very interested in science.</td>
<td>2.03</td>
<td>0.774</td>
<td>1.76</td>
<td>0.729</td>
<td>0.012</td>
</tr>
<tr>
<td>I think about having a career in a science-related field.</td>
<td>2.53</td>
<td>1.142</td>
<td>2.22</td>
<td>1.156</td>
<td></td>
</tr>
<tr>
<td>I would consider taking additional science courses in high school.</td>
<td>2.08</td>
<td>0.777</td>
<td>1.85</td>
<td>0.939</td>
<td></td>
</tr>
<tr>
<td>I believe I could be a scientist.</td>
<td>2.97</td>
<td>1.200</td>
<td>2.35</td>
<td>1.055</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>I have good science skills.</td>
<td>2.41</td>
<td>0.878</td>
<td>2.07</td>
<td>0.858</td>
<td>0.009</td>
</tr>
<tr>
<td>I know what a scientist does.</td>
<td>2.32</td>
<td>0.912</td>
<td>1.82</td>
<td>0.829</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Many females are interested in science.</td>
<td>2.33</td>
<td>0.854</td>
<td>1.73</td>
<td>0.882</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Science class is valuable.</td>
<td>1.75</td>
<td>0.795</td>
<td>1.68</td>
<td>0.793</td>
<td></td>
</tr>
<tr>
<td>My friends don’t like science very much.</td>
<td>2.86</td>
<td>0.958</td>
<td>2.99</td>
<td>1.021</td>
<td></td>
</tr>
<tr>
<td>My friends’ attitudes toward science do influence me.</td>
<td>3.61</td>
<td>0.966</td>
<td>3.54</td>
<td>1.064</td>
<td></td>
</tr>
<tr>
<td>My parents are happy about my interest in science.</td>
<td>2.11</td>
<td>0.832</td>
<td>2.13</td>
<td>0.975</td>
<td></td>
</tr>
<tr>
<td>At times, it seems like my science teacher pays more attention to the boys in my science class than the girls.</td>
<td>3.72</td>
<td>1.237</td>
<td>3.83</td>
<td>1.151</td>
<td></td>
</tr>
</tbody>
</table>

Note. N = 94 Scale is based on the following: 1= strongly agree, 2 = agree, 3 = neutral, 4 = disagree, and 5 = strongly disagree. A-t-test and p=0.05

Five statements were found to be statistically significant from the pre- to post-survey score. The first question that showed a statistically significant difference was “I am very interested in science” went from a mean of 2.03 (SD = 0.774) on the pre-survey (agree) to 1.76 (strongly agree) on the post survey (SD = 0.729). “I believe I could be a
scientist” went from 2.97 (neutral) on the pre-survey ($SD = 1.200$) to 2.35 (agree) on the post-survey ($SD = 1.055$). Another statistically significant question was “I have good science skills” that went from 2.41 (agree) on the pre-survey ($SD = 0.878$) to 2.07 (agree) on the post-survey ($SD = 0.858$). “I know what a scientist does” went from 2.32 (agree) on the pre-survey ($SD = 0.912$) to 1.82 (agree) on the post-survey ($SD = 0.829$). The last significant statistic was “Many females are interested in science,” which went from 2.33 (agree) on the pre-survey ($SD = 0.854$) to 1.73 (agree) on the post-survey ($SD = 0.882$).

The remaining four questions did not differ statistically from the pre- to post-test on the survey. “I think about having a career in a science-related field” went from 2.53 on the pre-survey ($SD = 1.142$) to 2.22 on the post-survey ($SD = 1.156$). The others seem to follow this trend. “I would consider taking additional science classes in high school” went from 2.08 on the pre-survey ($SD = 0.777$) to 1.85 on the post-survey ($SD = 0.939$). “Science class is valuable” went from 1.75 on the pre-survey ($SD = 0.795$) to 1.68 on the post-survey ($SD = 0.793$). “My friends’ attitudes toward science do influence me” went from 3.61 on the pre-survey ($SD = 0.966$) to 3.54 on the post-survey ($SD = 1.064$). For all of these statements, even though they were not statistically significant, the trend indicates that the participants are choosing more positive choices.

There were three statements that did not fit this category. “My friends don’t like science very much” went from 2.86 on the pre-survey ($SD = 0.958$) to 2.99 on the post-survey ($SD = 1.021$). “My parents are happy about my interest in science” went from 2.11 on the pre-survey ($SD = 0.832$) to 2.13 on the post-survey ($SD = 0.975$). Also, “At times, it seems like my science teacher pays more attention to the boys in my science
class than the girls” went from 3.72 on the pre-survey ($SD = 1.237$) to 3.83 on the post-survey ($SD = 1.151$). These scores, again though not statistically significant, did indicate that overall the response of the participants were learning toward disagreement.

**Qualitative Results**

Objective 2: How does “Girls in Science Day” affect girls’ attitudes and interests towards science?

Since the first objective was to examine that GIS had on participants views and interest in science as examined through a pre and post survey the second objective was to probe each participants view on participating in GIS day prior to the experience and after the experience. Interviews were conducted with eight participants who were purposefully chosen for this study. Interviews allowed the research to capture how this program might have contributed to a change in their attitudes and interest in science. The semi-structured interview questions for the pre-program-interview were developed by the researcher through her extensive review of the literature regarding science day results for girls. The review of the literature indicated that some girls who attended these day long sessions had changes in their views and attitudes because of single - gender environment and hands-on learning. The post program interview questions evolved through an examination of the literature, quantitative results and the initial analysis of the pre-program interview. Pre and post program interview questions are located in Appendix A. Pre and post program - interview data was gathered through semi-structured interviews and is presented below in a composite of each interviewee. Each participant’s name has been changed to protect their identity.
Addison.

Introduction and influences. Addison is in the sixth grade at the largest middle school in Knox County. She has two little sisters and one brother who is still quite young (four months old at time of interview). Her mother works at a fast food restaurant and just returned from maternity leave. She does not ask Addison about her science class, but she does encourage her to learn about science. Her grandmother also encourages her by helping with homework and telling her learning science now will help her when she gets older. Addison does not see her father very much at this time. One of her younger sister’s is very interested in science and likes to help Addison with her projects she brings home to work on. Addison enjoys science and math because they are more interesting than most of the other subjects. She does not enjoy some of the students at her school because they can be ‘annoying.’ She does not participate in any science activities at home.

Science class. Addison enjoys doing experiments best about science, but does not enjoy doing worksheets. Her strongest memory was a presentation she made in science class that in her words, she ‘forgot her lines, but it was really funny.’ She would like to be a veterinarian when she gets older because she loves animals, but has not thought about taking any upper level science classes in high school. She does know, however, that becoming a vet will take a lot of work. She is not worried about science class for any reason and feels confident she will make good grades. She looks up to her science teacher because she encourages Addison and the class by trying to help them.

Attending GIS. This will be Addison’s first time attending GIS. She thought it would be interesting, and it was her idea to attend. From GIS she would like to get better
grades in science by paying attention and learning as much as she can. She hopes she will know a few people there and wants to learn a lot. She finds the body parts especially interesting.

Addison arrived late to GIS but found her place quickly, but she enjoyed “hanging out with a bunch of people and learning a bunch of different things about science and doing a bunch of different projects.” She enjoyed the chemistry workshop the most because students got to experiment with dry ice and liked the physics workshop the least because making the cars in there got frustrating and the cars kept falling apart. Her favorite workshop was the biology where students got to do blood typing with simulated blood. She thought the workshop leaders were very nice and really patient and imagined it would be stressful for them to manage work and family at the same time.

**Results.** Addison is now more interested in taking upper level science classes in high school. This was primarily because while the students were eating lunch, workshop leaders formed a panel and discussed what classes they took when they went through school and how they had fun doing it. She is still interested in becoming a vet, and she is interested in all the organs and cells of the body.

When she got back to her home school, Addison suggested a few activities they did at GIS to her science teacher so they could do them at school also. She also shared the experience with her friends who did not get to attend GIS. GIS left a good impression because everybody was very nice and friendly. She would recommend going to someone else. She did not like the girls-only atmosphere, and even called it ‘sexist,’ and the reason she wanted boys to be there was because she had a lot of guy friends and wanted to be social with them.
Alexis.

Introduction and influences. Alexis is in eighth grade and attends a middle school in the more rural part of the county. She loves sports and plays volleyball, basketball, softball and is a cheerleader. She describes herself as a “pretty average normal teenager,” who is on merit roll, honor roll, has friends and hangs out with friends. Alexis’s mother asks her about science often, and it is her mother’s favorite subject. Her mother broke seven discs in her spinal cord, and is not allowed to work. She is expected to be in a wheelchair when she gets older. Her father scouts locations for cell towers and does not ask her about science. She has a younger sister who is not necessarily interested in science. Her stepmother and grandfather both encourage her in her science interest, along with her aunt who is a registered nurse. This has been a big influence on Alexis in wanting a medical career. Alexis participates in many science activities at home with her family including watching science television, reading science magazines, books, gardening, and hiking. She describes them camping and always looking for new kinds of bugs and stuff on the ground. She says they go camping like that for ‘weird reasons.’

Science class. At school, Alexis likes learning about different things that could help her in the future. She does not enjoy a lot of homework. She really likes science this year because they do an experiment weekly, and that did not happen in past years. She enjoys understanding how things work, and gave an example of why a car runs because of all the combustions chambers and knowing about that. Her strongest memory of science class was about an experiment they did together in class to test erosion on gravel and bigger rocks. Science is her favorite class and she struggles at times, but there is
nothing she dislikes about it. It bothers her that she struggles because her parents get angry if she does not have good grades because of her future plans.

Alexis wants to be a cardiothoracic surgeon and work with the heart and lungs. She became interested in this after looking at her aunt’s medical textbooks about anatomy and other things, and she thought the most interesting part was the heart and lungs. It should be noted she also thought about being a neurosurgeon, but decided against this because people cannot live without brains, whereas if there was something wrong with their hearts they could be hooked up to machines to keep them alive. She said she would not like to be the reason somebody couldn’t fully function and feels that cardiothoracic surgery is safer than neurosurgery. To this end, Alexis wants to take physics and anatomy in high school so she will understand all of the body parts and how everything works. She would like to take physics because she enjoys “The Big Bang Theory” on television and would like to understand everything that the characters talk about.

Her goals in high school classes are to maintain her grades in all classes, but especially geometry, trigonometry and science classes. She is nervous that she could flunk a test and get behind, get stuck in that class, and not have enough credits to graduate. She looks up to her aunt, the nurse, because she is intelligent, and knows how to take care of children, and can really help Alexis.

**Attending GIS.** This is Alexis’s first time attending GIS. Her teacher asked if she would like to go, and she thought it sounded like a fun experience. Alexis hopes to get a better understanding of certain parts of science and meet new people and learn new things. She would like to meet new people who can help her with science or she could help them if they did not understand something. She is looking forward to the
experiments and workshops at GIS and hopes there will be something that has to do with medicine there. She doubts there will be any other people there will want to be surgeons because most people she has talked to who want to be scientists do not want to be surgeons. She said she would like to know there are other people who are her age interested in these types of careers and “I’m not like crazy for wanting to do it.”

Results. After GIS, Alexis said what stood out about her day was winning the essay contest held each year, and her favorite activity was doing the blood typing because she would need that in the future. The workshop she enjoyed least was the water testing because it just wasn’t her thing. She liked the workshop leaders because they were helpful and insightful and if you needed help they would readily help you. Alexis was encouraged when she heard them talk about how they balanced work and family life because she wants to have children, “I absolutely adore children,” and hearing their stories made her feel more confident she could balance work and family when she was an adult. She is now more interested in taking upper level science classes after hearing the workshop leaders discuss what classes they took.

Many things stood out to her about GIS, and in fact, when she got back to her home school, her science class talked about GIS for twenty minutes about what they did and what they enjoyed. Even her English class talked about the day once they heard about how she won the essay contest. The day made a great impression on her because she could meet new people who want to work in the science field as well. She did not think there were going to be that many girls as interested in science as she was so she was glad to see it wasn’t just her that was interested in science. She has even already recommended GIS to younger students. She liked the girls-only atmosphere because she says “all of the
boys in my grade are idiots.” She said they usually sit in the back of the room playing with their iphones and ipads and yelling and throwing things at each other. She said it takes a lot of time for the teacher to get them quiet, and at GIS, no one was doing “stupid stuff.”

Elizabeth.

Introduction and influences. Elizabeth is in the seventh grade and loves science. It is her favorite subject and very interesting to her. She wants to be a nurse to study more about science. Her mother works at a department store and asks her about science class a lot. She likes to hear Elizabeth talking about science class and the different things they are learning about. Her dad asks her about science but not as much as her mom does. He likes the engineering field of science more and works at a local window factory. Her older brother likes doing experiments in science class as well. Her mother greatly encourages Elizabeth to get into the nursing field because she says it’s a good job opportunity, and her brother wants her to become a chemist because it would be ‘cool’ to work with all of the chemicals. She really likes her science teacher and the class because they get to do a lot of projects right now, like making an edible rock out of various kinds of cake. She does not like having no recess time or time to go outside to play. At home, she enjoys watching the Discovery Channel, watching television shows where people go out into the wilderness and survive for a period of time, and other nature-oriented shows.

Science class. Elizabeth likes science class this year because last year they did not get to do many projects. This year they have a lot more hands-on activities. She says she is a tactile person and her science teacher gave them a quiz at the beginning of the year to see which learning style they were. Based on this, Elizabeth sometimes gets to choose
what type of assignment she will do, whether it’s a report, project, or other things. She clearly enjoys the projects most of all, and her strongest memory is when they did the edible rock assignment and everybody brought in cakes and other foods and they got to eat the rocks after it was over.

Elizabeth wants to be a nurse who takes care of babies, and she has thought about taking chemistry and physics in high school because she thinks she would be really interested in that because she has heard it is such a hands-on experience. She is looking forward to getting to choose what classes she takes in high school and is not nervous about any science class for any reason because it is so interesting to her. She looks up to her science teacher who helps and encourages her and describes her as her ‘science role model.’

**Attending GIS.** This is Elizabeth’s first year attending GIS. She hopes to learn more about science and have fun because she just likes science. It was her idea to attend the event and she hopes to learn about science, specifically about science games or projects or something they could do in science class besides paperwork. She hopes she will get to help other kids and help herself learn more about science and is very excited to attend and have fun. She hopes there are students out there that are as interested in science as she is.

**Results.** After attending GIS, she said it was really fun doing all of the activities. The chemistry workshop was her favorite because they got to do a ‘cool’ experiment with different kinds of milk and detergent and food coloring and it was exciting to see how the different particles separated. This really stood out about her day, and she least enjoyed the blood typing, so now she is thinking about going to college to become a biochemist.
She thought the workshop leaders were very nice and enthusiastic about doing what they were doing and she had a lot of fun building the cars in the physics workshop. She thought the workshop leaders put their family first more than their career and said it was ‘cool’ they could do both of them at the same time.

She is more interested now in taking upper level science classes in high school, and she would like to take most of the classes the workshop leaders talked about taking including chemistry, physics, and anatomy. She thinks she could have a science career and mentioned teaching chemistry or biology for high school students. When she went back to her home school, she talked to her teacher about letting her class do some of the things they did in the chemistry workshop, and also shared what she learned with her brother and her mother. She has never typed blood in her school classroom, so that was new to her.

GIS left a good impression and she has recommended it to others. She said that is all she and her friends talked about for three days after she got back. She liked the girls-only atmosphere because girls can get along and work hard together and she says a lot of people can’t see that in girls. People think girls just talk all the time. She says she probably would have been fine with boys there because she pays attention and doesn’t really get distracted easily.

Felisha.

Introduction and influences. Felisha is in the seventh grade and describes herself as “not like most girly girls.” When asked what a girly girl is, and if she likes science, she said she doesn’t mind getting dirty and likes to skateboard. She really likes science and school and plays sports such as softball and soccer. She does not particularly enjoy math
because it is kind of boring unless you are doing a project. Sometimes her mother will help her with science with giving her ideas of what to do for projects and her dad really likes science as well. She said he likes to go out and discover things and when she was in fifth grade they made a weather instrument and her dad helped her build it out of wood and plastic. He makes car parts for a living. She has one younger brother and no one in her family has a science-related job of any sort. Her grandmother and her parents, and really her whole family know about her interest in science and have encouraged her by helping with projects and homework. At home, she gardens a lot with her grandfather and reads science magazines.

Science class. In science class, Felisha likes it when they do projects. She likes this because you get to see what people think about science, you get to do things, and it helps you get involved with the subject. She really remembers her past projects. She said it was harder to come from fifth grade to sixth grade because you had to do more projects, pay attention more, take notes, and you didn’t have as much time to finish everything. She eventually got used to this and is fine now. Her strongest memory of science was building the weather instrument with her dad, and then having her class going outside to test the weather instruments. In the future, she is interested in working in a crime lab, because she watches a lot of criminal movies, so she thinks she would like being in the lab and testing fingerprints, or finding DNA samples. She likes how you can find out a lot of information with such tiny evidence. Besides this, she would be interested in becoming a doctor or a veterinarian so she could help people. She says she has always wanted to help people, and is very sensitive to when people get hurt. She would also like to take upper level science classes in the future, though she is not sure
which ones. Her goals for high school include being in a lot of advanced classes. She is not nervous about taking any science classes because she always studies hard and she knows her family will help her if she needs it.

**Attending GIS.** This is Felisha’s first year attending GIS. She had a friend that went last year and heard how much fun it was so she wanted to go very badly this year. She hopes to get memories and have fun and learn new things at GIS. She also would like to see how many other girls there are who like science like she does, though she is pretty sure that a lot of girls would like science. She hopes she will have a good time being around other girls that like what she does and she’ll get to learn things she hasn’t learned yet.

**Results.** After attending GIS, Felisha reported that she had a lot of fun, learned a lot of ‘cool’ stuff, and met other girls that liked science, too. The chemistry workshop stood out to her, but she also enjoyed the blood typing workshop because she could see how the agents react and find what blood type a person has. She liked the workshop leaders because they all wanted to do something else in high school, but then they found out how they liked science, and now they all love their job now. She liked hearing how they balanced their lives between work and family and she liked how one of them said she could work all day, then go home and play video games with her son. Felisha is now more interested in taking upper level science classes in high school because when you are up close, you get to see how things react, and how doing experiments can cause you to come up with new ideas. She told her parents all about GIS and what she did, and she actually tried some of the activities at home with her dad and her younger brother. She
said they haven’t gotten to do any experiments in her science class at school yet, like they got to do at GIS and haven’t done a lot of hands-on activities.

She said GIS left a good impression on her because she likes to hang out with girls without guys around and it was different because you get to see how other girls like science and girls act differently when boys are around because they are afraid to be themselves. She also really liked the lunch time because she could see her friends and they could talk about what they did in the morning and what they would do in the afternoon.

Fiona.

Introduction and influences. Fiona is in the seventh grade and math and science are her two favorite subjects because she finds it easier to understand what she’s learning in those subjects. She does not enjoy social studies. Fiona’s mom asks her a lot of questions about science. She is a biologist and works at a local college in Knox County. Fiona’s dad likes science, but not as much as her mom does. He is a doctor and works at the local urgent care center. Fiona has a younger sister who does not like science as much as Fiona. She says no one has encouraged her directly, but that she has encouraged herself by looking up information about science in her spare time when she was interested in what the class was learning. At home, Fiona watches science television shows and documentaries.

Science class. Fiona says science class is entertaining and her favorite thing she’s learned about so far is the periodic table of elements and progression. Her strongest memory of science class was recently when she had to write a poem about what she understood about the periodic table of elements. She says it was ‘pretty ridiculous.’ She
says it was this way because her group was easily sidetracked. Fiona would like to become a scientist in the chemical field, and would like to end up working in a lab and/or a university. She has not thought of taking upper level science classes in high school, and has no goals for her high school classes. She is not nervous about science class in any way because she turns in all of her homework and gets good grades on all of the tests. She looks up to Albert Einstein because he invented $E = mc^2$, and that is very famous in science.

**Attending GIS.** This is Fiona’s first year attending GIS. It was her idea to go, and she wants to learn more about science. She hopes to gain more information about science and understand it a little better, although she understands it now. Her mother is one of the workshop leaders and Fiona is looking forward to working with her mother there.

**Results.** After attending GIS, what stood out to her was the number of girls that were there. She felt there were a lot of girl who were just as enthusiastic about science as she was, and she liked that as she did not think there were that many. She enjoyed the chemistry workshop the most, and talked about making the designs on the little cards with the dye and experiment, and she liked it because she likes chemistry. The physics workshop was her least favorite because it took a while to build the cars.

Fiona liked how the workshop leaders were enthusiastic about what they did, and not bored, and they balance work and family well by spending time at/with both. Fiona has the same interest in taking upper level science classes, and now especially chemistry. She thinks she would be a good scientist because she likes to learn about science and there is a lot to learn about science. When she went back to her home school, what stayed with Fiona about GIS the chemistry experiment because it was fun and there were lots of
messes. She shared what she learned with her parents and her sister. She said in her science classroom, they don’t do experiments, they usually just do worksheets and open up science textbooks, but at GIS, they didn’t open up books, but learned first-hand, and she thinks that was a better way to learn it.

GIS left a good impression on her because it made her more enthusiastic about science and it was just all about science. Fiona would recommend GIS to someone if they like science, and even if they didn’t, they might feel better about it. But she thinks if someone doesn’t want to go, she shouldn’t have to.

Kaitlyn.

Introduction and influences. Kaitlyn is in the seventh grade. She loves sports and plays softball, basketball, and volleyball. She says “Sports is like my whole life.” Science is also her favorite subject. Her mother does not like science or ask about science class, and teaches at the district preschool. Her father doesn’t, either, and is a mortician. She has an older brother who likes science, although he wants to go into sports management. She says her teacher has encouraged her a lot in science because she explains things thoroughly to Kaitlyn and keeps her going at it. At home, Kaitlyn likes to watch science on television about earth, outer space, and plants, and likes to hike and stops to look at the plants.

Science class. Kaitlyn enjoys getting to interact with her friends at school, and that it is challenging, but not too challenging. She does not like it that she does not get to go outside and play. She really likes science class and how they get to do hands-on projects. Last year she went to a different school, and they didn’t do many activities and didn’t learn about things that interested her, like astronomy. Besides the hands-on
projects, she likes being able to get up and move around the classroom and learn. She says she can learn by pictures, and can’t really do a worksheet unless it is explained to her, and there is something she can touch and see how it works. Her strongest memory of science class is an experiment she did putting a thermometer in water and putting that in a black baggie and measuring the changes in temperature.

When she gets older, Kaitlyn would like to go into sports management, teach science in preschool, or teach science in the seventh grade. She would like to teach children how to play sports and how to be a great all-star, and if she were a science teacher she could arrange the labs and make it lots of fun. She would like to take upper level science classes in the future, like chemistry, anatomy, and physics, because she would like more education about that. In high school, she would like to be in upper level science and math classes, and is not worried about science class for any reason. Kaitlyn looks up to her science teacher because she makes it fun and she makes the material understandable for her and makes Kaitlyn feel that she believes in her.

**Attending GIS.** This is Kaitlyn’s first year attending GIS. She would like to learn more about science and see how many other girls are interested in science. At first, she did not want to attend GIS because she didn’t think her friends were going, but then she found out one of them was attending, so she came. She did not want to not know anyone there. At GIS, she hopes to learn more about science and astronomy, and is looking forward to having a good time.

**Results.** After attending GIS, Kaitlyn really liked the chemistry workshop where she got to do experiments with dry ice, and she didn’t have a least favorite activity, though the water testing workshop was not her favorite. She liked how the workshop
leaders explained things well and connected with her. She also liked how they have a family, too, so they can connect with mothers who balance work and family. She said some people say that girls who are in science don’t have families, and now she sees how that is not true. Attending GIS made her more interested in taking upper level classes in high school such as chemistry and astronomy. She also liked building the car and making it move in physics.

When she got back to her home school, Kaitlyn remembered how fun science can be doing hands-on activities and doing all the chemistry so she can stay interested in science throughout her school career. She shared what she learned with her parents and her friends. GIS left a good impression because it was so much fun doing hands-on projects. Usually in school she just watches somebody do experiments. She would recommend GIS to someone else because of the fun and so other people could have a science career. She also said she could focus better without the boys there. Boys are very distracting because they will do something funny, everyone will laugh, and then she can’t concentrate. So the girls understand and don’t try to make everyone laugh. She said she felt more comfortable without the boys present, because they are looking over her shoulder during assignments and that’s ‘freaky’ to her.

Kristy.

Introduction and influences. Kristy is 13 years old and in the seventh grade. She plays volleyball and basketball, but she is ‘not into science that much,’ but she knows she will need it later. She has a sister who is in ninth grade, and a brother who is in third grade. Her mother asks about her grades in science, but not how she likes science. Her mother teaches journalism at a local university. Her father teaches government and
history in high school and does not ask about science at all. Her sister hates science but her brother enjoys it sometimes. No one has really encouraged her in science, and she does not participate in science activities at home.

**Science class.** Kristy likes to read and write, but she doesn’t like to do activities for English class, however, just on her own. At times she enjoys math, but if it gets difficult she will get frustrated. She also enjoys social studies. She does not enjoy math because as a seventh grader she takes an eighth grade math class, and it can be difficult, and science and social studies can be boring at times. She does enjoy health and medicine. She has done a lot of projects in science class this year and she enjoys that because she has several friends that she works with, and she enjoys the projects themselves. By projects, she means anything from skits, acting out interviews, and dance moves representing waves. She thinks she learns it better that way. In the past years, she has enjoyed science, especially in the fifth grade, where she remembers a lot of the material they learned, and they had quizzes daily, but in sixth grade, she does not remember much. In science class, she enjoys small group discussion with her friends. She says they discuss topics thoroughly, then move on to a topic not related to it, so she enjoys the social aspect of science, too. She does not enjoy watching movies in science class. Her strongest memory of science was doing projects like making up a song with dance moves about electromagnetic waves.

In the future, Kristy would like to be a novelist or an oncologist. She would like to do that because she really likes to write, and because being an oncologist she would get to help people with cancer. She has thought about taking anatomy in high school since it’s about the body structure, but that is all. Her goals for high school are to make all A’s
and be valedictorian if possible. She is not worried about science class for any reason because she pays attention, tries hard, and keeps her grades up. She admires doctors in general because they had to go to medical school and learn a lot to help people.

**Attending GIS.** This is Kristy’s first year attending GIS. She was selected to go by her teacher, but she thought it would be a good experience for herself because she doesn’t normally like science much. She hopes to see a lot of activities dealing with health at GIS and how the body works. She is curious to see how the other girls react to these topics, especially her friends. She is looking forward to learning a lot and doing activities with her friends. She hopes to expand her knowledge on science and become more interested in the science field. She says if she is more interested she will try harder at the subject.

**Results.** After attending GIS, Kristy was surprised at how many other girls were there, and was glad she went. The chemistry workshop was her favorite and stood out the most to her because she got to experiment with food coloring, shaving cream, and milk, and her least favorite was the water testing because it was boring. She liked the workshop leaders because they were helpful and nice and did not make you feel stupid for asking questions. This is different from some of the teachers at her home school. She liked how the workshop leaders balanced career and family life because they found a way to meld them together. She is now more interested in taking upper level science classes in high school, especially anatomy and chemistry. She liked the way the workshop leaders were very sincere and open and loved their subject matter.

What stayed with her about GIS after she went back to her home school was the way everyone almost seemed like family. They were very nice, treated you really well,
and wanted you to learn their subject. She thought it was more fun than her home school with just the atmosphere and interaction. She did not think there would be that many girls who had that same purpose in mind. She also liked the girls-only atmosphere because nobody was unhappy being there, but came with the mindset of just getting to work. She said boys can be stupid and annoying and she was glad they were not there. GIS left a good impression because it changed her mind about science. Shen she went, she really did not want to go, but afterwards she was glad she attended. She would recommend GIS to somebody else, even if they did not like science much because it might help them enjoy science more.

Reese.

Introduction and influences. This is Reese’s first year attending school in Knox County, and she is 1 in the seventh grade. She plays soccer and basketball and her favorite subjects are English, because it’s easy for her, and science, because she finds it interesting. She enjoys being with her friends at school and learning new things and does not enjoy math. Her mother is the school psychologist for the district Reese attends, and checks with her about her science grades, but not about what she does in science. Her father likes science more and checks her grades a lot also. He works making tests such as OAA’s, etc. Reese has two sisters in college who are not majoring in science, and a brother. He encourages her in science because he is taking upper level science courses right now and enjoys them. He talks to Reese about it and she watches him while he is studying. At home, she watches science and history television shows.

Science class. Reese has science first thing in the morning, so even though she is tired, she enjoys parts of it very much. In the past, she went to a bigger school where they
had higher standards so it could be confusing but still interested her. In science class this year, what she enjoys most is doing labs, and she does not enjoy topics such as pH because that is not interesting to her. Her strongest memory of science was when they did labs with rocks, testing color, hardness, and texture, and she found that very interesting.

In the future, Reese would like to do something with the history of science. She likes archaeology, construction, and would like to play college soccer. She likes archaeology because she thinks history is interesting, too, and she likes to learn about the past. She is interested in taking upper level science classes in the future due to her parents’ encouragement, and would like to take upper level math classes, AP classes, and be a post-secondary student and attend college while in high school. She is not nervous about science class for any reason and looks up to her science teacher because she is a ‘smart lady.’

**Attending GIS.** This is Reese’s first year attending GIS. She thinks she will enjoy it, along with trying something new. It was her idea to attend, and she hopes to get a look at different careers and see if they interest her. She is looking forward to learning new things because she doesn’t think she knows a lot about science now. She hopes to have a good time and find out about careers that she didn’t know about and could possibly do one day.

**Results.** After attending GIS, the chemistry workshop was her favorite and it stood out because they could make different things in class. The blood typing was her least favorite because she could not move around in class that much. She liked the workshop presenters because they had a lot of good answers to her questions and she wouldn’t have to ask them over again. She thinks they manage to keep up with their
career and family life. Reese has the same interest in taking upper level science classes now, but after attending GIS, she knows which classes she would like to take like chemistry. What stayed with her about GIS was the chemistry lab, and she still thinks of it today. She shared what she learned with her science teacher and parents and told them she got something out of it. They do not usually do activities like blood typing in her school classroom. GIS left a good impression because she learned a lot of things and it helped her figure out what she liked and what she didn’t like in science. She also thought it was fun because she got to see people from different schools she usually didn’t get to see. It did surprise her how many girls were interested in science. She would recommend GIS to students who were interested in science, but she would encourage the ones that weren’t interested to go as well. It would help them learn what parts of science interest them.

Reese said without the boys around GIS was more laid back, and girls are less judging about things, so they are more willing to take chances than boys. She said at this age, boys are thinking they should be playing sports and are tough and not thinking about their education much.
Figure 4.1 Pre-Interview Themes
Figure 4.2 Post-Interview Themes
Objective 3: Explore the long-term effect that participating in “Girls in Science Day” could have on the participants’ decision to continue in science courses or in the field of science.

For this phase of the research, cross-sectional interviews were conducted with eight past participants of GIS. Participants for this section of the data collection had participated in GIS from the following years: 2008, 2009, 2011, 2013. Two participants from each year were purposefully chosen for this study. They were chosen based on ease of contact and agreement to participate in the research. Since the researcher of this study had developed and was the program coordinator for each of these years she felt comfortable in these individuals due to her knowledge of these participants. Each individual interview in presented below and the names have been replaced by pseudonym to protect identify. Summaries of the results of these interviews follow.

**Aidan.**

**Introduction.** Aidan is 18 and will be attending college as a freshman for the 2014-2015 school year. She attended the GIS cohort from 2009 as a middle school student. She describes herself as “academically-based” and one of her favorite things about school is her science classes. In her free time, she reads and plays various musical instruments such as the piano, French horn, and ukulele. Since attending GIS, she has taken 9th grade science, biology, anatomy, chemistry, and physics. She participates in her classes a lot by answering questions and helping other students. For a career, she would like to be involved in some sort of mathematical research, so she is thinking about getting a master’s degree or PhD in math so she can become a college professor and be involved in education and research.
Memories. She has many strong memories of science class that mainly involve her teachers. She says the way they express their ideas were the most memorable parts, such as crazy antics, singing, and toys. She says teachers weren’t just giving them the material, but they were actually involved and wanted them to enjoy science.

GIS. She remembers a bit about GIS. She really remembers the competition they engaged in after their lunch break. Each group was given a big pile of ‘junk’ including such items as straws, pipe cleaners, tape and pennies, and were asked to construct the longest bridge they could that could withhold a certain amount of weight. She really enjoyed the teamwork involved and putting together the different pieces of the bridge. She describes it as a positive experience that was fun, and that included dissecting a cow’s eye, and making patterns with food coloring, paper, and shaving cream. At the end of it, each team won a little bag of prizes for their efforts. Again, it was the teamwork she enjoyed, as well as seeing new science ideas she had not seen in school.

Effects. Since Aidan already enjoyed science so much, it did not have a big impact on her that way, but she saw other students growing to like science more throughout the day. At the time, as a middle school student, she did not realize that women were not portrayed as impactful as men have been, but as she has gotten older, she has understood that women have not always had a place in science, but seeing women in science and having them explain why they love it so much is eye-opening. She had strong memories of GIS for two years after attending. For a while after GIS, she thought more about a career in science, and went to the library and looked at different books on different sciences and looking for careers she could do as she got older, but her passion
was split between science and mathematics, and probably a little more toward mathematics.

When asked what could have made GIS more memorable for a longer time, Aidan had some ideas. She said the event was not really followed up on once she went back to her home school. Her teacher did not mention it, no activities were done, and it was just forgotten. She said if there would have been some follow-up after the event, she should have found her passion for it again. To combat this, she said girls should be allowed to go multiple years in a row, and that would cause them to have stronger memories. Also, once she got back to her school, if they could have had special days in her science class just for girls or a special activity for girls, that would have helped.

Her teachers encouraged her interest after GIS, and were very supportive. They were usually enthusiastic about what they were doing in class, and encouraged her to come to class to do “some really cool stuff.” She said she would have felt more encouraged if she had more options of different science classes available to take. She said since she comes from a smaller school, she did not get to take as much science as she should have wanted to, and because her schedule was so full, she could not even take all of the ones she did want to try.

Ali.

Introduction. Ali is a high school senior and is 17 years old. She likes to run track and hang out with her friends. She attended GIS when she was in middle school in 2011. Since attending GIS she has taken unified science (9th grade science), biology, anatomy, and chemistry. She feels biology and chemistry were very hands-on classes with labs. She describes science as her favorite subject and says she participates a lot in her science
classes by being involved in class discussions, answering questions, and participating in the class activities they do such as labs and dissections. She likes science a lot and how each class she has taken is very different. For a career, at first Ali wanted to be a pediatrician, but now she would like to go into pharmacy and work with children.

**Memories.** Her strongest memory in science was her chemistry class because the whole class got in on the discussions, and it was not just one person answering all of the questions. Ali was used to only a few people participating in class, so this was a welcome change.

**GIS.** Ali has some memories of GIS. She knows it had a theme of forensic science, and they went around the school, which was like a crime scene, and did forensics labs. She viewed it as a positive experience, and even went to a forensics summer camp based on that event. She liked it because it was completely different than anything she had learned about in school.

**Effects.** GIS made an impact on Ali about how much she liked science class. She also felt good because it was an event where the girls were recognized. At her school, Ali sometimes feels like it’s always about the boys, whether it is sports or academic, and this was something different than anything they had done before and gave girls some attention. Ali felt that academically, girls usually try harder than boys with their school work, so often they are not recognized for their achievements. GIS also made an impression on Ali about how she viewed women in science. She said that in school they learned about science achievements, but not who made them, so she was unaware of how much the history of science did not include women. After attending she thought it was great that women were getting recognized for their relevant work.
GIS encouraged Ali to take more science classes when she had the opportunity. The more she took different subjects, the more she realized there were a lot of different avenues you could pursue. Besides going to forensics camp during the summer, the next year she went to a pharmacy camp. She still has memories of GIS, and is happy it is still going on and people are still participating in it. She said they had never had anything like that at her school before. She really thought about a forensics career after GIS, and then she changed her mind about that and wants to go into pharmacy. She said to continue making GIS a memorable event, and that girls who participate one year should keep on going the next years.

Many teachers have encouraged Ali’s interest in science since attending GIS. They do this by going out of their way to help students and explain terminology to them, and go beyond what the lesson is. Going to the summer science camps encouraged her interest also, along with teachers ‘pushing’ her. Science is still her favorite subject and she is still trying to learn as much as she can about it, and will encourage her children to take science classes in the future.

Cassidy.

Introduction. Cassidy is a sophomore in high school this year, is 15 years old and plays sports. For fun, she likes to play softball, volleyball, and read. Since attending GIS in middle school, Cassidy has taken seventh grade science, eighth grade science, unified science (required ninth grade science class), and is taking honors biology this year. She describes her science classes as ‘hands-on’ and says she participates in them a lot by answering questions, helping others, and “pretty much knowing the answer.” When she
goes to college, she wants to study to become a first or second grade teacher, and she would like to coach sports while she teaches.

**Memories.** Cassidy’s strongest memory of science is talking about physical and chemical changes each year in her science classes. She says this sticks out a lot because that section comes very easily for her.

**GIS.** Since she attended GIS relatively recently, Cassidy still has several strong memories of it. She remembers the girls were split into groups and went to different workshops. In one of them, they learned about the different layers of soil by taking cupcakes and splitting them into different colors. Another one was about the population, and she considers it a very positive experience because she had a lot of fun.

**Effects.** At first when she decided to attend GIS, Cassidy was not very interested in science, and then after the day was over, she realized “Oh, yeah, I really do like science.” She didn’t realize there were so many different things you could do with it, and it could be so hands-on. It also impacted how she views women in science. She now knows that women can make just as much of an influence as a man can, and it really influenced her into signing up for honors biology this year as opposed to general biology.

She still remembers GIS strongly today, and knowing that women have made many discoveries in science, too, made the biggest influence on her. She took honors biology because she wanted to push herself, and thinks she needs more of a push in science class. She didn’t think more about a career in science after GIS but that was primarily because she already had her mind so set on what she wanted to do. To improve the effects of GIS, Cassidy says girls should start attending the program at a younger age,
and keep on attending every year. She said this way she thinks more girls will become interested in science.

After GIS, her ninth grade science teacher really encouraged her interest in the field. She did this by making the subject fun and enjoyable and using hands-on activities to demonstrate the points she was trying to make. She said to make a greater impact, home schools should “push” science on their students a little more. By this, she means being around science more with classwork and hands-on work as opposed to doing things out of the book. She said it needs to be made more interesting so that kids want to be pay attention and be into it more.

Cassidy still enjoys science today. This is because everything is always changing and she wants to know how. She wants her children to learn about science because there are so many different things to it and so much to learn. So she thinks it would be smart to maybe push more science onto them.

**Courtney.**

*Introduction.* Courtney will be a sophomore in college for the 2014-2015 school year, and is 19 years old. She is majoring in visual arts with a focus on photography and minoring in art history. For fun she likes music, especially singing, playing piano, and besides that she is interested in crafts and reading. Since she attended GIS in 2008 as a middle school student, she has taken the 9th grade required science course, 10th grade biology, and physics. Also, in college she has taken chemistry. She feels her high school classes were more hands-on than her college classes, which were primarily lecture-based, and she liked the variety of activities she did in her high school science classes. She participated in class by doing her ‘job’ in each lab activity or playing the class game they
played in class. Courtney enjoyed the science classes she took in high school, but her college chemistry class was much harder, but she enjoys the math components of science. She would like to pursue a master’s degree and PhD in art history and then teach at a college level. She is interested in this because she grew up around art as her dad was an artist and her mother ‘dabbles’ in it. She also describes herself as a history buff, and sees art history as the perfect combination between the two of them.

**Memories.** Courtney’s strongest memory of science comes from her younger years. Her mother would buy her science kits to do in the summer to keep her active. She also liked the little science experiments and demonstrations she did in science class. These memories mainly come from elementary school. She says that once she got to middle school, science became harder for her until she reached high school where she could put the math into it. Overall, she has enjoyed her science experiences and believes science and technology are very important and relevant things to learn about.

**GIS.** Courtney recalls GIS somewhat since it occurred so long ago for her. She remembers a bunch of different stations and different classrooms that all had themes. The one she remembers most was dealt with toy cars and roller coasters. She does know they talked a lot about specific women in science and their impact on the world. She says it was definitely a positive experience and was fun to be around other girls her age and seeing them have a good experience about science, even though it can be thought of as difficult. She enjoyed seeing how science can be used in real world applications, too. She saw that science wasn’t all “black and white” and everything that you learn in class from a textbook, but more than that. It actually impacts the world you are in, so it let her see science as everything around her. She said GIS changed how she viewed women in
science because she did not have a really strong viewpoint either way about the subject until she attended GIS, but after attending, realized that most of the science accomplishments she has studied in school have been about men.

**Effects.** GIS made an impact on Courtney. For example, she says GIS inspired her to take more science classes in school, because in middle school, she really did not enjoy science that much. The older she got, the more she did enjoy it, and it became more interesting to her after GIS. She had strong memories of GIS for two years, or at least through high school where she remembered going there and everything she learned from it. She liked the fact that girls were being pushed together and learning about science, and that women can have an impact on science, too. She thought briefly about a career in medicine after attending GIS, but she has always been attracted to history, so having a career in science was never really in her mind. Courtney says to expand the effect of GIS, teachers should expand more into their classrooms things they learned. For example, they could have specific days where you could celebrate something about women, because not everyone gets to attend GIS. She says it is important for everyone to get a similar experience even if it is not hands-on, to see that women do have an impact so it’s not just a select few students learning everything. Girls need to know that just because you are a girl doesn’t mean you can’t have a career in science just because a lot of men are in it.

After GIS her teachers really encouraged Courtney’s interest in science. Both in middle school and high school, she could see how much they enjoyed science and how enthusiastic they were about it. She thinks she would have been more encouraged if her school had a more diverse offering of science classes. She said she would have liked versatility there and felt her options were limited in what she had to choose from
Courtney still likes science and thinks it is interesting how it affects technology, the medical field, and things that are still happening today. She likes to read articles online about science that explains how things are happening. She would definitely encourage her children to take science classes to make them more well-rounded individuals.

Kaitlyn.

Introduction. Kaitlyn is 16 years old and will be a junior in high school this year. However, unlike many traditional junior students, Kaitlyn is employing the post-secondary school option, where she will be taking two classes on a college campus near her high school. Those classes are an ethics class and an art education class, and for fun, Kaitlyn loves to participate in dance and musical theater. Since attending GIS, she has taken 9th grade required (unified) science, 10th grade honors biology, and is currently enrolled in anatomy and physiology. She feels her life science classes are very hands-on like GIS was, because they did a lot of lab activities. Kaitlyn participates in her science classes a lot by asking questions, doing her homework, and trying to get as much out of her classes as she can. She genuinely likes science to begin with so she loves learning all about it, especially how it applies to theater and dance. She is interested now in physical therapy and things that use dancing and different sports and activities involved in it. For a career, Kaitlyn really wants to do musical theater, but she also would like to keep taking science classes to possibly turn into a physical therapy career on the side to help her along with her theater activities. She says the theater is a bigger industry with fewer jobs, and since so many people try to make it in that industry, she wants to have the physical therapy side as a back up plan, or personal training, which she likes as well.
Memories. Kaitlyn’s strongest memory of science is not what one would expect to hear. She became really curious about jellyfish for no reason and researched them and wrote a report about them that was not required. She handed it to her teacher anyway, and received extra credit. She always got a lot of science kits for Christmas and she constantly asks her mother (who is a life science teacher) questions about biology, so her mother gave Kaitlyn her old biology books to read. Different things stand out to her at different times, like the jellyfish. For example, she spent half an hour once researching carnivorous plants. She wanted to know how they moved since they don’t have muscles. She gets curious because she watches documentaries on television, and reads articles, and if something strikes her, she will spend the time to find out about it.

GIS. Kaitlyn remembers GIS somewhat. She remembers they made DNA necklaces and paper airplanes. She also remembered how she got her DNA by swishing liquid around in her mouth, and they talked about cloning and genetic engineering in that workshop. She recalls it as a positive experience that exposed her to different types of science more than just what she got in her science classes. She says in classes students are mostly told “This is what it is, and here’s why it is,” but at GIS, they were shown what they could do with science knowledge once they had it. If anything, GIS made her like science class more, and also helped her narrow down which sciences she likes more than others.

Effects. Kaitlyn said GIS didn’t really affect how she viewed women in science because a lot of the media resources she uses, such as books or television portray women in the science profession. Shows such as “NCIS” have women scientists, and she watches movies where Marie Curie is referenced. GIS didn’t really motivate Kaitlyn to take more
science classes, because she was already motivated, but she did think more about a career in science after she attended it. She went home and told her mother all about it, and at that point, she wanted to be a microbiologist. She wanted to be one until the 9th grade, and before that, a botanist, and she would keep switching, but they were always based on science. Then she started doing musical theater a lot, and loved the people and performing. She says she is unsure whether she is creative enough to be a scientist and come up with her own experiments. She likes studying what other people do, though.

Kaitlyn says a great way for the positive results of GIS to continue would be for girls to attend science camps in the summer time. She says that keeps your exposure to science and keeps you learning more. Her parents greatly encourage her interest in science after attending GIS. They did this by answering her questions and listen to her explain her thinking about science topics. Also, they would get her science kits for Christmas and birthdays for her to use. Her teachers encouraged her in a general way because they are teachers and they want you to do well in their class.

Kaitlyn says her interest in science has not waned over the years, but something else has risen more – musical theater. She still loves science and thinks about it all the time. Her dance teacher influences those feelings because they study a lot of anatomy curing her dance, so that has influenced her to take anatomy and physiology this year. She will encourage her children in science because it is important and you need to know why things happen, and be able to back them up with knowledge.

Maddie.

**Introduction.** Maddie is 18 years old and will be a college freshman for the 2014-2015 school year. She is attending a university and majoring in biology that is for pre-
med majors. She likes to cheer and will be cheering at college, too. For fun, she likes to sleep, hang out with her friends, and swim. Since attending GIS, she has taken 9th grade unified science, 10th grade biology, chemistry, physics, and anatomy and physiology. She says her physics and chemistry classes were very hands-on like GIS, but anatomy was taken by independent study so it was not, and the other classes were not either. Maddie participates in science classes by answering questions, doing her work, turning it in on time, doing her labs right, and working with others during the labs. She likes science class a lot because it is fun to learn about the different things the world is made up of. After college, she would like to go on to medical school, and then specialize in pediatrics. She doesn’t want to have her own practice, but work in a hospital.

**Memories.** Maddie’s strongest memories of science were difficult to get to, but she remembers dissecting a pig in anatomy and physiology most of all. She likes dissecting things and did extra work on her specimen, taking out every organ and naming it with her partner.

**GIS.** Maddie’s memories of GIS were more vivid. She remembers doing a project with food coloring and shaving cream where you make a design on the note card, scrape off the shaving cream, and have a really nice design on the card. They also worked with tuning forks and talked about music. She definitely remembers it as a positive experience and she had a lot of fun. She also liked that the day was not stressful like science class can be when you have to study or take tests. After GIS, Maddie looked at science in a more fun way rather than it just being information and you have to know it. She says it helped her to look at science as more fun, not boring, and not from a textbook. She did not think anything about being a woman in science or that it was for girls only, and at her
college, her major is mostly girls anyway. She wants to be a pediatrician because she likes anatomy, and her mother wanted her to go into obstetrics, but she likes children a lot, so she chose to go into pediatrics. GIS did motivate her to take upper level science classes some, but she would have taken them anyway because of her career goals. She had strong memories of GIS for a year. She said that GIS helped her understand what her chemistry and physics classes would be about, because she had some prior experience with them. She thought more about a science career after attending because she had so much fun and thought it would be fun to do that for the rest of her life.

**Effects.** Maddie says people need to talk a lot more to middle school girls about what careers are available in science, because before attending GIS, she had no idea there were so many opportunities. So more career exposure and what each career entails would be great. She says to sustain the effects of GIS, girls’ home schools needs to get involved and have activities and talk about the event more. Maddie says her teachers supported her interest in science, but her mother really ‘pushed’ her by talking about science and always having an ‘A’ in science. She still likes science a lot, and will encourage her children to take science classes if it interests them. She will support whatever they decide for a career.

**Marissa.**

**Introduction.** Marissa is 19 years old and will be a sophomore in college during the 2014-2015 school year. Her major is currently undecided but she is learning towards wildlife conservation sciences and Spanish. In her spare time, she likes to surf the Internet, watch television, read, which she describes as normal things. For fun, she likes to hang out with friends, go out to eat, and see movies. Since she participated in GIS in
2008, she has taken 9th grade science, 10th grade biology, chemistry, physics, and in college she has taken her first biological sciences class with lab. She feels her chemistry class and college biology class were very hands-on and she participates in them a lot, especially the labs. By participating, she answers questions, listens actively to the teacher, and does the actual lab with her partner doing her share of the work. In her high school classes, she answered questions, took notes, and participated in the projects they did in class. Marissa describes her science classes as ‘pretty interesting,’ and she enjoyed going to them. For a career, she would like to work at an animal sanctuary or the Environmental Protection Agency, or be a forest ranger. She would like to do that so she could be outdoors and work with animals, which she really likes. She is also thinking about becoming an actuary in the statistical mathematics profession.

Memories. Marissa’s strongest memory of science stems from home watching television shows such as “Bill Nye the Science Guy” on television. That was very informative for her. She says he was her first real introduction to science and displayed information in a very fun and educational way. She enjoyed watching it.

GIS. Marissa also remembers GIS. She remembers working with Newton’s laws and “Hot Wheels” cars, and then she dissected a clam, which was her first dissection ever. She says it was a positive experience meeting a lot of new people, and hanging out with her friends. It didn’t really change her perception of science class since she enjoyed it so much already. She knew it was an all-girl event, but she didn’t really think about it much. In fact, she never considered it until she got into college. Now she realizes there are a lot more guys in her biological classes, but that makes her feel like a pioneer. She does not mind it. She says GIS motivated her to take more science classes when she had
the choice because it made her realize even more how much she liked science. She then took the harder science classes.

**Effects.** Marissa had strong memories of GIS for about a year. She talked about it with her friends, but her teacher never mentioned it. The dissection part made the biggest influence on her, because it was the first time she had done that, but she really enjoyed it. She already had a career like zookeeper or wildlife person in mind even at that age so GIS didn’t really influence that part of her life, but did reinforce it. Those feelings about a career in science last to this day, as she still thinks about a science career.

To continue the efforts started by GIS, Marissa had some ideas. She thought girls should continue to go to GIS every year, and at their home school they could start a science club for girls. Marissa’s teachers have encouraged her in science to succeed and science class was never boring. She thought her school could have some kind of careers in science seminar, however, to open up different avenues to go into the sciences because there are a lot of professions you can have when studying science. She was not aware of how many different options there were when she was in school. Marissa still enjoys science and is still studying it. She is due to take chemistry this coming year. She will encourage her children in science because having a knowledge of our world is important because we’re living in it and we should know what is going on around us.

**Ramey.**

**Introduction.** Ramey is 16 and will be a senior in high school for the 2014-2015 academic year. For fun, she likes to read, is in the marching band, is very involved with her church, and likes to hang out with her friends and go swimming. Since attending GIS she has taken 9th grade science, 10th grade biology, and chemistry, and she feels biology
and chemistry were very hands-on. Ramey finds herself participating in science classes a lot by answering questions, doing activities, and acting things out. Science is not Ramey’s favorite subject, but she has learned a lot from her classes so she doesn’t mind studying it. When Ramey finishes school, she would like to be a missionary teacher overseas. This is something she feels like God has called her to do and she wants to serve Him.

**Memories.** Ramey’s strongest memory of science was in biology class. Whenever her class learned a new process in biology, they would always stand up and act it out with a ball or a toy. So she remembers how interactive it was. It stands out so much because they were all really engaged in it and it was hands-on.

**GIS.** Ramey remembers attending GIS. It had a forensics theme the year she went, and she went around to different stations and she remembers one distinctly where they took coffee filters and markers and they went around changing the color of the ink. She remembers it as a positive experience because it was so much fun. She got to learn about a completely new branch of science that was not studied in her school. GIS did not change her general feelings that she liked science class, but it did serve as a good reminder that it is not just a man’s world in science. Ramey doesn’t want to be a scientist, but she says some other girls would have at that time. She had already decided she was taking chemistry, and biology was a required course. She remembered GIS for two years after it had occurred.

**Effects.** Ramey had varying feelings after GIS. She said it didn’t really influence what classes she signed up for in high school because her high school did not offer that many science classes a student could choose from. A career in science crossed her mind
after attending, but she is set on becoming a teacher and that didn’t change. She thinks GIS might have been more effective if the same people could keep going back year after year, or if they could just have a day for seventh graders, eighth graders, etc. Ramey’s teachers encouraged her interest after GIS by asking what they learned, and generally. Ramey feels pretty much the same about science now, though she appreciates it more. She sees the impact it has on society and will encourage her children in science because it is important to our world and to understand how things work.
Figure 4.3 Themes from Cross-Sectional Interviews

**Coding and Diagrams**

Saldana says a code is “most often a word of short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion
of language-based or visual data (Saldana, 2013, p. 3). The data here are all of the interview transcripts. After having these made, I manually first-cycle coded the pre-interview of each participant, looking for recurring themes and patterns in how the girls were answering the questions, and what those answers pointed to. In doing this type of coding I chose descriptive coding because it is very appropriate for beginning qualitative researchers learning how to code, and I was summarizing a nouns in short words or phrases (Saldana, 2013). Based on this, I came up with several first cycle codes that were mentioned several times in the different transcripts of the pre-interviews.

After this was complete, I used Saldana’s (2013) ideas about what to do after first-cycle coding. I used his “code-mapping” literature and made lists of the current codes I had, then categorized them according to different main themes I found, including the importance of grades, the social aspect of GIS, that the girls want to learn new things, labs, experiment, and project, wanting to help people, and doing science activities at home. Once I had these initial codes in place I went back and second-cycle coded with code landscaping, and then focus-coded. I went through each individual pre-interview and gathered information that went with each first cycle code. I then made a diagram (Figure 2) which outlines the important themes of the pre-interviews, and the points from the interviews that support them. This made the results much clearer with greater visibility.

For the post-interviews, I used the same methods, and first-cycle coded, landscaped, and then second-cycle coded. That diagram can be seen in Figure 3.

The cross-sectional longitudinal interviews were slightly different. The question I wanted to answer from those included “Was GIS effective at making you sign up for
upper level science courses when you had the chance?” I also wanted to look and see what these girls, most of whom went on to take great numbers of STEM classes in high school and college had in common, and what they did that made them successful in taking these classes.

I therefore looked again for commonalities in their actions, words, views, and plans that made them successful. Most did agree that GIS made them want to sign up for upper level science courses, but I wanted to know why, so I went about descriptive coding for answers. Once I had these first-cycle codes, I went onto landscape the codes and look for support for each code in the second-cycle codes. I then diagramed this into Figure 4.

**Recurring Themes in Pre-Interviews**

There were some recurring themes that emerged during the pre-interviews. There were several areas the girls going to attend GIS for the first time had in common. The first item that was important to all of them were their grades. They all wanted to maintain grades that would at least get them on their school’s honor roll. They also mentioned how important grades were to their parents.

Another item was that they all enjoyed doing laboratory activities, experiments, and projects in science class. They described these in many different ways. Some were actually ‘labs’ or lab activities. These seemed to be the most formal activities there were, and involved taking data, using instruments such as thermometers, plastic bags, pebbles, sand, and scales. The older (eighth grade) girls seemed to describe their science activities this way. Experiments were also in this category and had a more formal tone. Activities were very informal and included class projects such as an often-mentioned “Edible
Rock,” where students had to create different rock layers made out of cake. What linked all of these activities together was that they were all described as “hands-on.” This was different from “the textbook” and all of the girls agreed it was more fun.

Another theme that seemed to be related to most of the girls was that they had some sort of experience doing science-related activities at home. Some of these activities could be loosely linked to science but were mentioned nonetheless. They included reading science books and magazines, watching science-related television shows such as “Bill Nye” and “NCIS.” Other activities included gardening, bird watching, hiking, camping, and taking nature walks specifically looking for new items.

The girls also frequently mentioned that they enjoyed learning new things. Among these were different branches of science including astronomy and geology. Others included different career fields, but the medical field was mentioned the most frequently, which encompassed nursing, technician, and becoming a doctor. They all anticipated being able to acquire new knowledge not usually done in school before. They often used the medical field to begin talking about how they liked helping people and how they wanted to do that for a career.

Another theme that also was mentioned frequently was the social aspect of GIS. The girls interviewed wanted to have fun, do experiments with friends, and meet other people interested in science. Most of the girls interviewed felt very isolated at their schools because they were the only ones who liked science and enjoyed science class. Some were questioning whether there were other girls like that at other schools. That was something they looked forward to seeing. These can be seen in Figure 4.1.
Recurring Themes in Post-Interviews

There were also some recurring themes in the post-interviews as well. The first one was that they quickly found out they “were not the only one” interested in science. They were pleased at this, and it gave them self-confidence, and increased their self-identity. Also, after attending GIS they knew what science classes they wanted to take in high school, and they knew what chemistry entailed, and had an idea of what physics was.

Another theme was that they learned about possible careers in science. Most of them had no idea how many careers were available in science, and what a person did in each careers. This included talking about knowing about the different branches in science, and how it related to those careers.

Many of the girls interviewed shared what they did at GIS with other people. They mentioned going home and talking about it with their parents and siblings, and even attempted to replicate the experiments they saw at GIS. A couple shared what they did with their science teachers and requested to do those same activities in their science classes.

In the post-interviews, the hands-on aspect of GIS was discussed a lot. Girls enjoyed the opportunity to “get dirty.” They got very involved in the labs and projects and became more interested to try them at home. At one of the workshops they attended, the facilitator had dry ice, and they really enjoyed working with this, especially since they do not get to work with this at school.

The biggest theme in the post-interviews was about the girls-only atmosphere. They all commented on it, enjoying the ‘get to work’ atmosphere, how nobody was off
task and doing nothing, but everyone was ‘like a family’ and just got on about doing their jobs. Some said that boys were “annoying” and “immature,” while one went so far as to say that boys looked over her shoulder in science class, and wanted to see what she was doing. The boys were repeatedly seen as a bother who just wanted to sit back and do nothing in class. These can be seen in Figure 4.2.

**Recurring themes in Cross-Sectional Interviews**

The cross-sectional interviews with the young girls revealed some themes as well. Some of which were disheartening. First, all of them recall participating in science class a lot. They all answer questions, turn in their work, and do their labs. They also all had a lot of parent involvement from home. They described their parents as helping them, and in some instances ‘pushing’ them into science courses and careers. They did this by constantly checking and reminding them of their grades in science class, watching science television shows with them, and buying science kits for them to experiment with when school was not in session. All had fond memories of instances like these.

Unfortunately, after GIS, little was heard about this program or ones like it again. It was not followed up on back at their home schools, and only existed as memories soon after. Their home teachers did no activities for girls or promoted girls in science careers or class in any way, nor did they contact GIS for follow-up activities. Also, girls were not accentuated in science class in any way, nor did the schools have activities for girls at school like science clubs or field trips. At this point, it was suggested to have GIS for ‘repeats’ who had attended it before to keep the momentum going, but that was not done, either.
Many of the things these ladies remember from GIS were things that were not typically done in their schools. They did practical science that was organized around possible science careers that was hardly ever mentioned in school. Also, they did activities that were ‘not from the textbook’ and so did not do worksheets or read, but got out of their seats and did activities and labs. They also said they remember how GIS lets girls be recognized for science, when that does not ordinarily happen. A few mentioned that their schools need to emphasize more about the possible science careers available for boys and girls. Some said they had no idea about what all they could do until they got to college.
Chapter 5: Summary, Conclusions, and Recommendations

In this chapter, the results from the previous chapter are analyzed and each research question from chapter one is answered, according to the pre-interviews, post-interviews, and cross-sectional interviews. From here, the meta-inference section is analyzed, complete with sections on factors girls have control over and factors girls do not have control of about science. Implications follow with recommendations for girls, parents, and schools, with some concluding thoughts.

The intent of this research was to investigate the impact of the effects of “Girls in Science Day” on girls’ attitudes and interest in science. By utilizing an exploratory sequential design of mixed-methods research, data was collected from current and past participants of the program. This mixed-methods style this research was based upon has two strands of data collection – the quantitative, the first qualitative, and then another qualitative strand. These strands were utilized by using the quantitative survey results to form the first qualitative strand which was the pre- and post-interview questions for the current participants of GIS. Along with this data, literature research was implemented to form the second qualitative strand for the cross-sectional study.

In the first quantitative stage, researcher-developed survey data was collected about girls’ attitudes and interests about science. In the second, qualitative phase, interview data was collected from eight current participants before and after they attended GIS. Finally, in the second qualitative stage, a cross-sectional study was completed using past participants of the GIS program from past cohorts ranging from 2008 to 2013 to find any long term effects of attending the event. Patterns and trends soon emerged, and at this
point, the meta-inferencing stage comes into play where the mixed-methods research becomes greater than the sum of its parts, forming “an overall conclusion, explanation, or understanding developed through an integration of inferences obtained from qualitative and quantitative strands” (Tashakkori & Teddlie, 2008, p. 101). Agreeing themes from both types of research are analyzed against and with each other, providing the strengths of one method to counteract the weaknesses of the other and support a stronger conclusion. The quantitative survey analysis, qualitative themes, and cross-sectional study will be analyzed together to answer the overall research questions of this study:

1. Does “Girls in Science Day” have an effect on the participants’ perceived attitudes and interests towards science?
2. How does “Girls in Science Day” affect girls’ attitudes and interests in science?
3. Explore the long-term effect that participating in “Girls in Science Day” could have on the participants’ decision to continue in science courses or in the field of science.

Is there an Effect on Attitudes and Interests?

The first objective highlights the effectiveness of the GIS program. The identical pre-and post-surveys were compared with an independent t-test, and five questions demonstrated a statistically significant increase on the Likert-type scale. The first statement that had a statistically significantly increase from the pre- to post-survey was “I am very interested in science.” The second statement that was statistically significant was “I believe I could be a good scientist.” This was telling because the first statement spoke to the girls’ interest in science, and the second spoke to their attitude. There was clearly a
statistically significant change in both, marking the effect on the girls’ attitudes and interest.

Other statistically significant statements could be labeled as confidence-boosters. The statements were: “I have good science skills,” “I know what a scientist does,” and “Many females are interested in science.” This demonstrates that GIS boosted the girls’ confidence in themselves regarding science skills, made them feel like their knowledge had increased because they knew more about what a scientist does, and showed them that they are not among an isolated few girls interested in science, but that they are part of a large group who like science. They no longer feel isolated, and this results in confidence as well.

**How did GIS Affect Attitudes and Interest?**

**The Pre-interviews.** The second objective relates to the qualitative phase of the research in the pre- and post-interviews of eight participants in the GIS program. Themes of the pre-interviews will be presented, along with themes of the post-interviews, then with meta-inference, they will be tied together.

In the pre-interviews, there were several factors that the girls had in common. One of the factors was that all of these participants did some sort of science activity at home. This ranged from watching science television shows, reading science books or magazine articles, gardening, hiking, or camping. One girl specified she did a lot of things like these, including hiking and “looking for new kinds of bugs and stuff like that on the ground.” She went on to classify this as strange behavior. “We’re just weird. We just like to go [hiking] for weird reasons.”
Another commonality was that girls who attend GIS want to learn new things. They either wanted to learn about specific areas of science like astronomy, or they wanted to learn about “cool” careers they had not heard of before. The medical field was mentioned a lot and here includes physicians, nursing, nurse practitioner, and lab worker.

Another area they had in common was enjoying their science classes, especially the hands-on activities that include laboratory work, experiments, and projects. All of the students were very vocal about specific projects/experiments they did in their classes, and went to great lengths to explain each part of it to the researcher. By far, the most important element in this section was the word “hands-on.” Each girl mentioned this term “hands-on” when referring to their science classes and enjoyable things they did there.

Making good grades was another commonality mentioned by each girl. This was of utmost importance to them, and making the honor roll, or principal’s list was mentioned several times. A telling factor in this was the fact that their parents were often associated with this comment. Their parents either had expectations for their girls to make the honor roll, or they had hoped their daughters would do pretty well. One girl said she went to GIS because she was “hoping that we’ll be able to learn a bunch of things and do better in science.” Her current grade was a B, and she was hoping to bring it up to an A.

The overall theme in the interviews was about the social aspect of participating in the GIS program. They wanted to attend GIS to meet other girls who were interested in science, and wanted to experiment with their friends. Most mentioned they wanted to “have fun” in some way or other, but others mentioned wanting to meet other girls interested in science. Alexis said she “wanted to meet new people who have a better
understanding of things who can, like, help me or who I can help them if they don’t know something about a certain topic…” No one said the word “isolation,” but several alluded to it the way Alexis did.

The themes and patterns found during the pre-interviews show an anticipation of attending GIS, with clear expectations of what they were going to find there. The girls who attended wanted to do science activities with their friends, and wanted to learn new things about science careers and the fields of science itself. They were also motivated to learn new things and to transfer that knowledge back to their home schools to apply it to their studies. They attended GIS looking for something, some adventure in science, and when you know what you are looking for, it is often easier to find it. We will see if these girls ‘found it’ looking at the post-interviews.

**The Post-interviews.** Different patterns and themes emerged from the post-interviews as well. One theme was that the girls learned about possible careers for themselves in the future. They also gained new knowledge about what each branch of science was about. They now knew what to expect when they signed up for chemistry class in the future. They had a better idea of just what physics was and encompassed. Many of them expressed interest in what science classes they wished to take at the high school level. Alexis was excited to sign up for chemistry, and Addison wanted to take anatomy. All of the girls said they were now more interested in taking upper level science classes now that they had attended GIS.

All of the girls again stressed the term “hands-on activities,” of which there were many at GIS. Reese was excited she didn’t just have to sit back and watch, but could “get dirty” while doing science. The experiments with the dry ice were the most popular and
several girls mentioned working with it, and how exciting it was because they had never experimented with it before.

Another thing the girls had in common is that all of them took the knowledge and skills that they learned in GIS, and shared it with people after they came home. Most of them shared it with their parents, but Elizabeth shared it with her science teacher, and gave her teacher detailed instructions about how they did each activity and asked if they could do it again at her school. A couple of girls also tried to replicate the activities they did at GIS at home with their parents.

Additional things the girls learned at GIS is that they are not alone in their interest of science. Fiona shared that “there were a lot of girls there who were just as enthusiastic about science as I was, and that was kind of cool.” She also admitted that this surprised her because she did not think there were that many. Alexis agreed, saying she did not think there were “gonna be that many people there who wanted to be into science because it’s not one of those things when I see people, I don’t really expect them to be into science.” She went on to say “It made me feel pretty weird. Because like when I’m in class I’ll constantly blurt out random useless knowledge I have about science and people just look at me like I’m a complete freak, so it felt nice to know there are other people there who like science and it wasn’t just me.” This day made an impact on the girls and taught them to be more confident in who they are and what they like.

The largest factor all of the girls mentioned was the girls-only atmosphere. They liked it very much. Reese said girls were “less judging about stuff like that [science] than boys are.” Alexis described the boys in her class as sitting in the back of the room playing on their ipads or iphones and throwing things at each other. She said “no one was being
stupid, doing stupid stuff, so it was nice.” Kristy said there wasn’t any “annoying stuff” that boys do, and Felisha said the girls were not afraid to be themselves. Kaitlyn felt “more comfortable” without the boys and the family-like atmosphere with the “get-to-work” attitudes was commented on several times.

**Improving GIS to have a stronger impact on girls’ attitudes and interest in science and does GIS have a long-term effect on taking upper level science courses?**

The longitudinal interviews showed some surprising results about what the girls had to say about GIS looking back at it after a few years. They still spoke very positive about the impact of GIS. The major recurring theme was that the girls did what they termed as ‘practical science’ at GIS that involved real life activities that they would be doing as a career. They said this differed from what they studied in public school because it really had to do with things they would be doing once they graduated, and especially the girls who were now in college really appreciated this.

They also said that GIS allows girls to be recognized. Ali said this does not normally happen in academics, but happens a lot in sports. She also liked it because it was “something different than anything we’ve done before.” Ali thinks that girls always try harder in school, so it is taken for granted that they excel in academics. But she said GIS “it was nice to kind of almost be rewarded and get to do something fun.”

Unfortunately, the downside of leaving GIS and going back to their home schools was that the momentum created at GIS was not followed up upon at their schools. Their home science teachers did not rise to the occasion by incorporating what these girls had learned in GIS nor did the classes expand their knowledge. It was almost as if GIS did not
exist. This was not meant to be by the creation of GIS and must be dealt with and will be in the implications.

In each cross-sectional interview, the past participant of GIS was asked if attending GIS influenced her in any way to sign up for upper level science classes in high school. It was interesting, because six girls out of eight agreed that yes, it did, but they gave numerous reasons why. Marissa said that GIS “added onto my science experience and then really made me realize, even more, how much I like science and so when I had the option of whether or not to take extra science classes in high school then I chose to. And I took the harder ones because I like science.” Maddie, on the other hands, was probably going to sign up for those classes anyway since she wants to be a pediatrician, but she said that GIS made her think that “Oh, we did this, maybe chemistry’s like that or physics is like that.” Since she had an idea of what chemistry or physics was, and she had done some activities in it, she was more willing and excited to sign up for it.

Courtney did not like science much during middle school, but the older she got the more she did enjoy it. “So I definitely think, and like I said it became more interesting to me after that [attending GIS].” Cassidy only had the option of choosing what science classes she wanted to take this year, but she chose Honors biology instead of general biology. She said “I think it influenced me of wanting to take something harder and push myself more.” Ali realized that science is not just one subject, but “Like about many branches of it there are.” She goes on to say “So I’ve tried to take as many different things [science classes] in high school as I could.”
After attending GIS, Aidan went to the library and researched different science careers. Although she ultimately chose to stay in the math field, she says about GIS “for a really long time it was very impactful on how much I liked science.”

As for the two girls who said GIS did not affect their desire to take upper level dance classes, the reasons are again mixed. Kaitlyn said she has always wanted to take upper level science classes, but it was her interest in dance that inspires her to do that, not GIS. Also, Ramey has always known she has wanted to be a missionary teacher, so science did not apply to her as much.

Meta-Inference

The themes and patterns found here are telling, and they certainly answer the objectives asked, but what about the meta-inference between the three phases of research? There are four themes that were developed from the data: two involve the girls themselves, and two more involve the girls’ schools. The researcher grouped these themes under the factors in the categories of choice with voice, and choice without voice. Choice with voice means the girls have a choice to participate, and a voice to express their desires, feelings, opinions, and attitudes. Choice without voice means that the girls may have a choice to participate but there is no room for their voice in these issues.

#1: Factors girls have a choice with voice in:
   a. Doing science activities at home
   b. Wanting to learn new things
   c. The importance of grades
   d. Enjoying the social aspect of science
   e. They have replicated the GIS experiments at home
#2: Factors girls have choice without voice in:

a. Grade expectations from parents or guardians

b. Doing science activities at home that parents buy for them

c. Parents “pushing” them

The first aspect covers factors girls do have control over. This is important because it says that even though a girl might not have home/parental support, there are still things she can do to help her interest in science along and be successful. A girl has control over watching science television shows, or replicating some experiments at school. She also may be able to go walking and look for interesting specimens. Also, she is the only one who can want to learn new things and increase her knowledge. This fuels the next factor, the self-importance of her grades. If wanting to learn new things is important for her, good grades probably are, too. It is also up to her if she enjoys the social aspects of science, including working in groups on experiments, projects, and labs. It is also somewhat under her control whether she attempts to replicate GIS experiments at home.

The factors girls have no control over are equally as interesting. It is not up to them how their parents/ guardians feel about grades, or encourage them to maintain good grades. Also, certain girls have said their parents buy them science kits from stores so they can do guided experiments by themselves at home. A girl has no control over whether her parents will obtain these kits for her or not. Parents/guardians also are involved in the next factor. Several girls, including Maddie, describe their parents as “pushing” them. This came to mean several things. “Pushing” them can mean encouraging them to get good grades, encouraging them to study science, and
encouraging them to study to get a good job. I feel this goes farther from the usual involvement and having parents who are “extra” involved is certainly out of an individual girl’s control. Also out of her control is her ability to go to extra science programs in the summers and holidays that cost money to attend. This depends on the dedication and finances of her family, which is beyond her individual control.

#3: Ideas of GIS not carried back to home schools

a. Girls made suggestions to teachers for activities

b. Girls learned about possible science careers

#4: GIS was different than girls’ regular schools

a. They learned about science careers

b. Activities, not from the textbook

c. Hands-on activities

d. Practical science

e. Not alone in their interest of science

f. Atmosphere was comfortable (“like family,” “get-to-work”)

These ideas about the girls’ schools were not necessarily surprising. Girls attended GIS for a day, then they went back to school, but nothing was followed up on by their home teachers. Girls even made suggestions to teachers for activities to their teachers, and learned a lot about possible science careers. This was not mentioned at their schools, nor was having any career at all. The ideas were just dropped and remained stagnant.

One of the things the girls liked about GIS was how different it was from their home schools. They didn’t learn out of a textbook, but had engaging hands-on activities.
They learned about practical science they could use in future careers. They were not isolated in their interest of science, but there are lots of girls just like them who like science as much as they do. The atmosphere was like nothing they had felt before. There was no one discouraging them or making noise in the back of the room, or taking up the teacher’s attention, but everyone was focused in their work, and had a common goal. These things affected the girls, and made the day better. Why are they not being acted upon in their home schools?

**Implications**

The implications of this study are divided into three parts: Implications for girls, for parents, and for schools.

**Girls.** All of the girls who participated in GIS and later went onto successful careers in college have been purposefully and pointedly involved/engaged in their classes. They paid attention, turned in their work on time, participated in labs, projects, and activities, and did their part to get ahead. They also got especially involved in their classes by asking questions where they needed to, and did their jobs in their group assignments.

They also found ways to do science activities at home. Even if it was just watching television, reading articles, or taking a walk, they involved science in these activities and it stimulated their imaginations as to what they could do. They also found ways to share what happens in science class and at school with their families or guardians. They all had a ‘person’ they talked to about these things.

Girls can also find an outlet in volunteering. Alexis wants to be a doctor and volunteers in a local nursing home. Either by volunteering or job shadowing those careers
that seem exciting to you can increase your knowledge and capabilities in them. Girls can also find summer science activities or programs at community organizations close to where they live, such as the “Girls Scouts” or the “YMCA.” If there are none of these, girls can still volunteer to help science classes in the elementary school or be a science lab helper in her current science classes. Girls could learn more about science by being around the equipment, and learning how to handle the specimens.

If none of these options work for a girl, she can research science careers herself. Aidan did that after attending GIS, and her teachers were not talking about science careers in her classes. She went to the library and started looking for careers that interested her. Any girl can do the same thing and learn a lot about the career, from what education is required to what the starting pay is.

All of the girls in this study were also very conscious about their grades. Making good grades is the first step to attaining higher education and a career, and can be rewarding emotionally as well as financially later in life. Girls can make personal goals of doing well in their classes and succeeding in life later on.

**Parents.** There are many things parents can do to reinforce their daughters’ love of learning science. They need to start exposing their children to science resources, the younger age, the better. They need to take them to places such as science museums, field trips, summer programs, national parks, and also encourage them to watch science television together and bring science books and magazines into the home. Taking your children on hikes, gardening with them, bird watching or camping together can increase their daughters’ love of science.
Being involved in their daughter’s life is a theme in this section. Parents need to encourage girls to be attentive about their grades, watch them, and discuss them with them. They also need to encourage their daughters’ vocation choices, and help them research what educational requirements are needed for these jobs.

Parents can also help their daughters with homework on a daily basis, ask them how their science classes are going, and interact with them about science class. Helping with homework and projects is how many of the girls in this study became interested in science.

**Schools.** The biggest improvements to keeping girls interested in science can be made by girls’ schools. Many of the girls in the cross sectional interview studies had great ideas about how the momentum of GIS can be kept going, but the schools need to take a part in it. Schools can offer science clubs that meet periodically after school or on the weekends for girls to get involved with and to complete practical science activities. By having a place for girls-only to become involved in science, it will keep that comfortable atmosphere appreciated by so many of the girls in this study going, and make them feel confident, and reach out to learn more about science. In addition to giving girls an outlet to do science activities, this will also show them they are not alone in their love of science.

Something else that schools can offer are practical, hands-on science activities in their classes for students. Doing a few activities on obscure subjects they will probably not need in real life does not prepare students for a science career. Activities related to real careers need to be explored, to expose students to those possible science careers so
that they will want to learn more about them and understand all of the diverse range of possibilities that are out there waiting for them.

Schools can also be supportive of their teachers’ professional lives. Encouraging teachers emotionally and financially to attend professional development events that will improve their teaching techniques, expose them to the most modern methods of instruction available, and improve their content knowledge would make large strides for improving the quality of instruction to their students.

However, the biggest thing that keeps schools from starting or continuing to teach like this for careers and hands-on activities is that teachers do not have time to do this. Hands-on and vocational education needs to be emphasized in education so that students will have the opportunity to take more of a variety of courses in science. Students’ abilities need to be focused on, and improving their employable skills. Many times educators are so caught up to matching test scores with other countries that they are not preparing our students for the diversity of careers available to them, and are not teaching to their interests. We are not producing a nation of young adults ready to enter the workforce. We must fix the system so we are training people who can make a difference and change the world, which is explored in the pre-interviews. This is what is important to students these days, not their ability to compete with somebody they will never meet over memorizing information they will probably never need to know again.

Our system of education is broken and it is time to fix it. Everyone has something to do to improve the statistics of girls entering the STEM workforce, from the girls, to their parents, to their schools. It is time to put down what does not work, and pick up what does. GIS has an effect on students, it makes them want to take upper level science
courses, but we need more science activities to stimulate their interest and keep the momentum going so it has not a light effect or a weak effect, but offers a girl a strong push into the STEM workforce.
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Appendix A: Girls in Science Day 2013 Pre-Survey

Read each sentence and write the number of your choice from the options below.

1 = Strongly Agree
2 = Agree
3 = Neutral (Not sure or don’t have an opinion)
4 = Disagree
5 = Strongly Disagree

1. ____ I am very interested in science.
2. ____ I think about having a career in a science-related field.
3. ____ I would consider taking additional science courses in high school.
4. ____ I believe I could be a scientist.
5. ____ I have good science skills.
6. ____ I know what a scientist does.
7. ____ Many females are interested in science.
8. ____ Science class is valuable.
9. ____ My friends don’t like science very much.
10. ____ My friends’ attitudes toward science do influence me.
11. ____ My parents are happy about my interest in science.
12. ____ At times, it seems like my science teacher pays more attention to the boys in my science class than the girls.

13. Why are you interested or not interested in taking high school science courses?

__________________________________________________________________
__________________________________________________________________

14. What does a scientist do?

__________________________________________________________________
__________________________________________________________________
Appendix B: Girls in Science Day 2013 Post-Survey

Read each sentence and write the number of your choice from the options below.
1 = Strongly Agree
2 = Agree
3 = Neutral (Not sure or don’t have an opinion)
4 = Disagree
5 = Strongly Disagree

1. _____ I am very interested in science.
2. _____ I think about having a career in a science-related field.
3. _____ I would consider taking additional science courses in high school.
4. _____ I believe I could be a scientist.
5. _____ I have good science skills.
6. _____ I know what a scientist does.
7. _____ Many females are interested in science.
8. _____ Science class is valuable.
9. _____ My friends don’t like science very much.
10. _____ My friends’ attitudes toward science do influence me.
11. _____ My parents are happy about my interest in science.
12. _____ At times, it seems like my science teacher pays more attention to the boys in my science class than the girls.

13. Why are you interested or not interested in taking high school science courses?
______________________________________________________________________
______________________________________________________________________

14. What does a scientist do?
______________________________________________________________________
______________________________________________________________________
Appendix C: Pre-GIS Interview Questions

1. Tell me about yourself. What do you enjoy about school? What do you not enjoy? What does the word enjoy mean to you?
2. Does your mom like science or ask you about your science class?
3. Does your dad like science or ask you about your science class?
4. Do you have an older sibling who is in the field of science?
5. What are your impressions of science class this year and past years?
6. What do you enjoy most about science class? Least?
7. What is your strongest memory in science class that stands out to you the most, positive or negative?
8. What careers are you interested in pursuing? Why are you interested in those careers?
9. Have you thought about taking upper level science courses in high school (chemistry, physics, anatomy, etc.)?
11. Do you participate in any science activities at home (reading science magazines, TV shows, going bird watching, gardening, hiking, etc.)?
12. Do you have any goals for high school classes?
13. Are you worried about any particular science class or nervous about science class for any reason?
15. Why are you attending GIS?
16. Was it your idea or someone else’s?
17. What do you hope to get out of GIS?
18. What are you looking forward to about GIS?
19. What do you hope will happen at GIS?
Appendix D: Post-GIS Interview Questions

1. Tell me about your day.
2. What stands out?
3. What did you enjoy most? Least?
4. Which workshop was your favorite? Why?
5. Which workshop was your least favorite? Why?
6. What did you like about the workshop facilitators?
7. How do they balance career and family?
8. Are you interested in taking upper level science courses in high school? Why?
9. Which classes?
10. What about GIS makes you more, less, the same interest in taking upper level science classes?
11. Do you think you could have a career in a science field? Why?
12. Do you think you could be good in a science field?
13. When you went back to school, what stayed with you about GIS? Did you share the information you learned with anyone?
14. Was anything done at GIS that affected you that is not regularly done in your classroom?
15. Did GIS leave a favorable impression? Why or why not?
16. Would you recommend GIS to someone else? Why or why not?
Appendix E: Interview Questions for Longitudinal Interviews

1. Tell me about yourself. How old are you now? Are you a student? Where? What grade?
2. What do you like to do for fun?
3. What science classes have you taken in school since completing GIS? Do you feel your science classes are very hands-on like GIS was? Are you participating in your science classes a lot?
4. How do you feel about them? Why?
5. What do you want to do when you finish your schooling such as your career? Why?
6. What are your strongest memories of science (in school or out of school)? Why does this stand out so much?
7. Do you remember attending GIS? What do you remember about it?
8. Was it a positive experience? Why?
9. Did it change your feelings/perceptions about science or science class? Did it change how you view women in science?
10. Did GIS motivate you to take more science classes when you had the choice?
11. For how long did you have strong memories of GIS?
12. What about it made the biggest influence on you?
13. Did it influence what classes you signed up for in high school? College? How?
14. Did you think more about a career in science after attending GIS?
15. Did those feelings last? How long? Why didn’t they last longer?
16. After attending GIS, how could the positive results of liking science be sustained (continued) for a longer period of time?
17. Did anyone encourage your interest in science after GIS? What did they do?
18. Did your school counselor or science teacher(s) encourage you to go into the science field?
19. What else would have encouraged your interest towards science?
20. How do you feel about science now?
21. What influences those feelings?
22. When you have children, will you encourage them in science? Why or why not?
Appendix F: IRB Approval

The following research study has been approved by the Institutional Review Board at Ohio University for the period listed below. This review was conducted through an expedited review procedure as defined in the federal regulations as Category(ies):

Project Title: Girls in Science Day 2014

Primary Investigator: Carmen Sue Dixon
Co-Investigator(s):

Faculty Advisor: Kisinana Machinami
Department: Education

Rebecca Cale, AAB, CIP
Office of Research Compliance

12/10/13 Approval Date
12/9/14 Expiration Date

This approval is valid until expiration date listed above. If you wish to continue beyond expiration date, you must submit a periodic review application and obtain approval prior to continuation.

Adverse events must be reported to the IRB promptly, within 5 working days of the occurrence.

The approval remains in effect provided the study is conducted exactly as described in your application for review. Any additions or modifications to the project must be approved by the IRB (as an amendment) prior to implementation.
Appendix G: IRB Exemption

A determination has been made that the following research study is exempt from IRB review because it involves:

Category 1. research conducted in established or commonly accepted educational settings, involving normal educational practices

Project Title: Girls in Science Day 2013

Primary Investigator: Carmen Sue Dixon

Co-Investigator(s):

Advisor: Danielle Deni

Department: Education

Rebecca Cale, AAB, CIT
Office of Research Compliance

3/18/13

The approval remains in effect provided the study is conducted exactly as described in your application for review. Any additions or modifications to the project must be approved (as an amendment) prior to implementation.