

# **How Personal Identity, Motivation, Interest and Outside Expectations Affect the Way Science and Technology is Viewed: A Case Study of Six Middle School Girls**

**Anuja Parikh**

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*University of Pittsburgh*

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## **Abstract<sup>1</sup>**

It is generally known that girls start to lose interest in science and technology during their middle school years. This study explored the values, attitudes, and perceptions current middle school girls had about science and technology and it was hypothesized that their models of science and technology is based on personal identity, motivation and interest level, and outside influences. A qualitative study was conducted with six sixth grade girls and their science teacher. Findings show that science and technology is valued when valued by their parents and teachers, girls prefer interactive and collaborative science and technology classes, gender stereotypes still exist, and that while peer and teacher expectations are important, parents are the most influential in middle school girls' lives.

## **Introduction**

It is estimated that women make up almost half of the workforce today, yet 72 to 91 percent of all computer science, engineering, and technology degrees in the United States are held by men, while women who have jobs such secretarial or clerical work, personal services (i.e. maid, hair dresser, daycare), dental assistant, school teaching, and nursing make up 85 percent of the workforce (Hesse-Biber & Carter, 2000). A

major difference between the science and technology oriented work versus the latter service-based work is that the former occupations are considered to be of higher status, thus they have a significantly higher pay and more access and opportunities for career advancement (Hesse-Biber & Carter; NCES, 2004).

The reason for this segregation of occupations by gender can be traced back to adolescence, where it is generally known that girls start to lose interest in science and technology starting in middle school. (AAUW, 1994; Beller & Gafni, 1996; Fredricks & Eccles, 2002; Bleeker & Jacobs, 2004). Many of these studies suggest that the decrease in interest is not due to ability or effort, but is rather attributed to several factors such as negative female images shown by the media, peer pressure, parental and teacher expectations, and low self-confidence (Eccles, et al, 1993; Levine & Orenstein, 1994; Hyde & Kling, 2001; Wentzel, Caldwell, & Barry, 2004). It has also been found that if girls are encouraged during this critical period to stay involved in math and technology, they are more likely to continue to stay interested throughout high school and their adult lives (AAUW, 1994).

This study will investigate some of these causes and see if a link exists between them. This study also hopes to offer suggestions on creating an intervention program that will significantly impact the lives of middle

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<sup>1</sup> For questions or comments, contact the author at [itsanuja@yahoo.com](mailto:itsanuja@yahoo.com)

school girls so that they will view science and technology more positively.

### Context of the Study

*Click!* is an interactive game that was designed as an intervention program to get middle school aged girls interested in science and technology. Using the city as a game-board, the girls will work with friends in teams of five as “*Click!* Investigators”. College age mentors, parents, and other community leaders and members will also be involved with the girls as they try to solve a mystery about the disappearance of Roxy Robin, a teenage rock star who is also deeply interested in science. The girls will travel to various places around the city of Pittsburgh and they will gather evidence by using technology such as a laptop, a global positioning system (GPS), and a cell phone, and also by completing science experiments such as water quality testing and fingerprint analysis to unravel the case. It is expected that around 150 girls will be able to take part in this experience. This study was originally designed to be a pretest to the *Click!* game, but because of its postponement, this study will now focus primarily on how girls view science and technology so that *Click!* as an intervention program can be successful.

Since *Click!*'s purpose was to create a large impact on a small group of students, I chose to conduct a case study. I wanted to focus on directly getting to know a few members of the intended target audience rather than look at vague generalizations. While the method I used is not the most traditional in psychology research, it has been successfully used by many researchers in the social sciences who similarly wanted a more personal and in-depth approach. This method is known as *Educational Ethnography* (Windschitl & Sahl, 2002;

Berg, 2004; Chin, Bell, Munby, & Hutchinson, 2004).

### Literature Review

Science and technology has traditionally been stereotyped as male domain. A classic study conducted by Mead and Métraux in 1957 asked over 35,000 high school students to write an essay describing a scientist and the image agreed upon by almost all students portrayed the typical scientist as a man. More recent studies suggest that this stereotype still exists. A 1995 study conducted by Finson and Beaver asked junior high school students to draw a scientist. An overwhelming 83.1 percent of the portraits drawn were male. This study was repeated in 1999 by Barman. He used a younger set of students from kindergarten through grade eight, and again, a large majority of the students gender-typed the typical scientist as being male.

De Castell and Bryson and carried out a similar study where they asked 500 high school students to complete a technology survey (1996 as cited by De Castell & Bryson, 1998). They found that a large majority of the students felt that both boys and girls had equal proficiency and usage of computers. Ironically, like the previous “Draw a Scientist” studies, when the students were asked to draw two images, one of a person extremely good at using a computer and one of somebody who could never learn to use the computer, the “computer whiz” was almost always a male, while the latter was almost always female.

These discrepancies between the images and actions may occur because girls have been socialized from a young age on what society considers to be acceptable behavior (Hyde, 1996). Hesse-Biber and Carter believe it is the influences of family, school, peers, and

the media that play a strong role in shaping society's perception of how males and females should be and this is what creates the gender inequalities (2000). Having friends is another integral part in determining an adolescent female's academic achievement, and is highly correlated with good grades, higher test scores, and participation in extracurricular activities (Berndt & Keefe, 1995 as cited by Wentzel, Caldwell, & Barry, 2004). A study conducted by Wentzel, Caldwell, and Barry (2004) found that students who made a friend during their first year of middle school were able to adjust to better to school and were emotionally happier than those students who were not able to make any friends. These well adjusted students also received better grades, regardless of how smart their friend was.

Pre-school and elementary school aged boys and girls have equally high self confidence, but self-confidence increasingly drops in teenage children throughout middle school and high school, with a greater decrease in girls. Some researchers hypothesize that this phenomenon occurs in an attempt to conform to gender ideals. Wigfield and his colleagues agree and attribute this phenomenon to puberty. They suggest that as girls start to reach adolescence, their bodies begin to change due to puberty. Along with puberty, both boys and girls face major changes in their school environment such as attending a larger school, changing friends and social status, and impersonal classes that are much different than elementary school (Wigfield, et al., 1991). All of these factors contribute to how adolescents perceive the world and themselves and because of these changes, adolescents try to conform to stereotyped notions of how males and females should act (Wigfield, et al.).

It is also at this time that adolescents start labeling certain subjects as prototypically male or female and self-confidence significantly drops more in subjects that students believe the other gender is better at (Wigfield, et al.; Lee, 1998; Jacobs, et al, 2002). When academically talented high school students attending a science, math, and engineering oriented summer program were surveyed about their future career choices, Lee found career preferences were gendered. Girls expressed interest in becoming a physician, biologist, or psychologist, while boys were interested in becoming an engineer, physicist, or mathematician.

Lee's research may explain why the number of female students actually taking science or technology classes is still low (AAUW, 2000; NCES, 2004). Statistics gathered by Department of Education on U.S. high school graduates in the year 2000 confirms what Lee found. With a recent push starting in the seventies for gender equality in science classes, the difference in the number of males taking science classes verses females has been greatly reduced (NCES). However, the amount of females in upper level science classes is still low. For the class of 2000, male graduates still dominated physics classes, while the percentage of females who were likely to have taken biology and chemistry slightly outnumbered the males (NCES, 2004). While female participation has increased, the actual percentage of females taking upper level science classes is low to moderate. Most female students (93 percent) took biology. 66 percent of female students took chemistry, but only 29 percent took physics (NCES). These statistics corroborated with Lee's findings: females interested in medicine would be more likely to take biology, while a physics class would

be a lower priority for those not interested in engineering.

While the gender gap in science has decreased, the number of girls enrolled in technology classes is still low. Technology is still considered to be of male domain (Silverman & Pritchard, 1996) and in 2002, only 14 percent of girls took the advanced placement computer science test in high school (NCES, 2004). Work done by Silverman and Pritchard found that middle school girls who end up taking technology classes feel confident of doing well and even enjoy their classes, especially those that integrate hands-on and collaborative work into the curriculum (1996). Validating Bryson and de Castell's findings, recent data shows that in fact, males and females have equal access and equal use of computers. In 2001, eighty-four percent of elementary and middle school students used computers in their classroom (NCES, 2004)

Although girls use computers for emailing and word processing more often than boys (NCES), they resist using the computer at higher and more specialized levels because they find that doing programming is repetitive and boring, and most of the computer games are too violent. Girls prefer playing games that require using strategies or skills or have application to the real world. When asked if they would consider a career in computing, many girls feel the options are not very inspiring and that they would be isolated from the world, a worry that boys are not really concerned with (AAUW, 2000). AAUW also adds that the media does not help to remove these stereotypes as most of the computer savvy characters in television shows, movies, and magazines are predominantly male.

Studies have shown that girls who have a mentor, teacher, or parent who takes an

interest in their schooling are more likely to take higher level technology and science classes, (Jacobs, et al., 2002; Eccles, et al., 1993) and while friends do influence adolescents, it is family and school that are most important in determining interests, future goals and self-esteem (AAUW, 1994; Wenzel, 1998). Conversely, students who have poor relationships with adults are more prone to doing badly in school (Wenzel, 1998). Parent perceptions are also important in determining whether middle school aged girls would go into a physical science or computing career. A longitudinal study was initially conducted on seventh grade girls. When looking at their career choices twelve years later, it was found that the mothers who did not believe that their daughters had the capacity to go into a science or computing career were 66 percent less likely to do so than those mothers who had a belief that their daughters were high achieving (Bleeker & Jacobs, 2004).

Teachers also play a special role for students, especially adolescents. Many girls think of their teachers as role models, and over half of high school girls aspire to become one (AAUW, 1994). Additionally, those girls who find that their science or technology teachers are unsupportive of the students or indifferent to the subject they are teaching will be more likely to think about discontinuing from future science and technology courses (Lee, 2002).

From the conclusions made from the examples above, I hypothesize that middle school aged girls' models of science and technology is based on three factors (a) personal identity; (b) motivation and interest level; and (c) influences of outside expectations such as parents, teachers, friends, and the media. I also hypothesize that girls will view science and technology positively only if science and technology is

valued by the girls themselves, and their outside influences.

For example, if parents feel science is useless, this will cause the adolescent girl to look negatively on science. Conversely, if the parents feel science is essential to understanding life, girls will look more positively on science.

### **Specific Aims**

1. Explore the values, attitudes, and perceptions current middle school girls have about science and technology.
2. Examine if personal identity, motivation, interest level, and outside expectations affect girls interests in science and technology.

### **Method**

#### ***Participants***

Seven female subjects participated in this study. The first participant was a forty year old Caucasian female. She was also a middle school teacher who taught general science to the subsequent six subjects. The next six participants were sixth graders who were all between the ages of 11 and 13. More specifically, two girls were 13, two girls were 12, and two girls were 11. Three of the students were Caucasian, two were African American, and one was of mixed race (half Caucasian/half African American). All of the students attended the same public school in Pittsburgh and all were taking a mandatory general science class that focused on environmental science and physics as part their general requirement. The students were recruited by their teacher who offered extra credit in return for their participation. The students were also given a free meal at the restaurant

where the interviews took place as compensation for their time.

I used a convenience and a volunteer sample to find participants and the only criterion for participation was that the student be a sixth grade female in the above stated teacher's class. Of all the eligible students, six volunteered to participate after obtaining parental consent. While many stated their desire to participate, the main reason for refusal was time constraints as all interviews were conducted after school. In compliance with the "Ethical Principles of Psychologists and Code of Conduct", all ethical codes were adhered to in the administration of this study and the names of all the participants were changed to maintain confidentiality (American Psychological Association, 2001).

#### ***Background of the School<sup>2</sup>***

The middle school contains grades sixth through eighth and is located within the boundaries of Pittsburgh proper. It is a neighborhood school and average class size is 27 students. At 22 students, the science teacher's average class size was smaller than the school's average. Of the two sixth grade general science classes I observed, both classes had a slightly higher ratio of girls to boys, and while the classes were considered to be for students with learning disabilities (also known as learning support students), about half of the students were average students with no actual disabilities.

Built within the last four years, the girls' school is a modern facility compared to most city schools. The *No Child Left Behind Act*, recently created by President Bush, allows any child to attend this school if his or her own school is failing, and both the teacher and the school offer many

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<sup>2</sup> Most of this information came from the interview with the teacher, Mrs. Smith.

resources to help the students succeed. One such club is the *Homework Club* where students can get extra help after school. The teacher also gives extra credit opportunities through extracurricular participation in science activities, through positive reinforcement of the material by having a review day every Monday, and by giving parents easy access for communication with the teacher. Nevertheless, very few parents actually ever call or email routinely.

*I really encourage the parents to call me. I always try to explain to them that I have over a hundred students and they have a few or one child, and if they want to email me on a regular basis, they can do that, especially if they are concerned with the progress, but few take me up on it. I often wonder if it's because parents are involved in their own lives, or are just so busy and tired. I think it's that. I don't think parents don't care. It's really hard to juggle a full time job and family life (Mrs. Smith).*

Almost all of the students who attend this middle school come from a lower to lower middle class background, and many of the students receive a free or reduced lunch. Although the school is predominantly White, there are some African American students and some students of other cultures also. In fact, my subject pool contained a much higher ratio of Caucasians to African Americans as according to the school's website, the actual proportion of White students to Black students is 82.8 percent to 13.6 percent. Parental and guardian occupations of the participants include service sector jobs like the navy, truck driving, and hairdressing. During their interview, some participants even stated that their family had been living in Pittsburgh for several generations.

### ***The Teacher's Role in the Click! Project.***

A convenience sample was used to recruit the teacher for this study because she was easily accessible and eager to help. Some potential but unintentional biases may exist, because the teacher is also an employee of the *Click!* Project. Another reason I chose to work with this teacher was because of the types of students she had in her class. Her students were less likely to have as many opportunities and motivations to excel in science and technology than those students of a higher economic status. The teacher was compensated for her time through her regular salary paid by *Click!* Her commitment to this project counted as regular work hours.

### ***The Author's Role in the Click! Project.***

Also as an employee of the *Click!* Project and co-coordinator of creating science and technology curriculum for the *Click!* game, some unintentional author biases may exist.

### ***Materials***

Provided in Appendices 1 through 4 are the surveys that were used to interview the girls and the teacher. Seven measures were used so that girls could be examined using several perspectives. The measures included two open ended interviews, one closed ended questionnaire, a drawing task, a teacher interview, a classroom observation, and an informal observation.

*Open Ended Interview I: Science and Technology.* The first interview session included open-ended interview questions on issues such as personal identity with respect to science and technology, the girls' mental models of science and technology both inside and outside of school, interests and motivations on science and technology, and how these interests and motivations played a role in determining a science identity. This interview is located in Appendix 1.

*Closed Ended Questionnaire.* During the first interview session, a closed ended questionnaire was also used. This questionnaire consisted of multiple-choice, true/false, short answer, and rated questions. The questionnaire contained many of the same issues as the first open-ended interview questions but focused especially on attitudes about science and technology, how teacher and parent expectations shaped how the girls' viewed science and technology, and how girls rated peers and extracurricular activities in relation to science and technology. This questionnaire can be seen in Appendix 2.

*Open Ended Interview II: Outside Expectations.* The purpose of the second interview session was to question the girls more in depth about where their ideas concerning science and technology came from. This interview especially focused on issues outside of school, such as pop culture and hobbies, and how it related to science and technology. There were also some questions that concentrated on personal and classroom identity while other questions clarified some confusing answers given by the girls in the first interview. This interview is located in Appendix 3.

*Drawing Task.* Another part of the second interview session included a task where the girls were asked to draw two people based on specific instructions. This was an exercise to examine gender differences.

*Teacher Interview.* The first part of the teacher interview was designed to get an outside viewpoint about the girls. It asked questions to find out about the background of the population I was studying along, the background of the teacher, the perceptions she holds about teaching, personal identity, science and technology, student and parent interactions, and how she maintains her

classroom environment. I was also looking to find out if there was any link between student motivations, interests, and values with teacher expectations and values. This was investigated by examining how the teacher viewed the student's identity through both social groups and level of academic participation, along the teacher's beliefs on student achievement levels and ability. Appendix 4 contains the teacher interview.

*Classroom Observation.* Observations took place over the course of two class periods on a Friday afternoon in the middle school science teacher's classroom. The students were making group presentations to two women on the educational staff of a lake they had visited the week before. Their task was to explain the model of the lake they had redesigned to make it more visitor friendly. After each group presented, the students, teacher, and the classroom guests were given an opportunity to ask questions or make comments about their presentation. The first classroom observation was 50 minutes long. The second class I observed had an unusually long class period because they were missing a school assembly to make their presentations. For the second class, the first hour consisted of presentations and the next forty minutes were spent chatting with friends, taking a bathroom break, and playing science games.

*Observation Outside of Restaurant.* As the parents were late in picking up three of the participants, a unique opportunity arose where I was able to observe them outside of a formal interview setting. All three girls were interested in using the camera, so I allowed them to film each other without instruction. I also informally interviewed one of the students using the guidelines from the second open ended interview. All three girls were in the same first class period.

### ***Procedure***

The first set of testing with the girls took place at a local family restaurant down the street from the school because I was not given permission to conduct interviews inside the middle school. I, the author, also administered all of the interviews.

Interviews were done in pairs and all pairs were friends because preliminary testing done by other members of the *Click!* team found that middle school aged girls felt more comfortable talking about their experiences when they were with a friend compared to when they were by themselves. Each interview took on average about one and a half hours and consisted of several parts. The first ten minutes were spent on introductions and engaging in small talk to allow the girls to feel comfortable conversing with someone they had just met for the first time. Food was also ordered at this time. This conversation was not recorded. After the informal conversation, I began the open ended interview on science and technology. Except for two girls who refused to be videotaped, the open ended interview was recorded with a video camera. While the interview questions were strictly followed, I did allow some room for additional probing if the given answer was too vague. After the interview, the girls completed a seven paged closed ended questionnaire. The questionnaire took about twenty minutes to finish and was completed by circling the preferred response. I also did not record the girls filling out the questionnaire. For all parts of the interview session, I allowed questions and feedback to occur.

This study originally started out as a baseline pretest to the *Click!* game, so the first questionnaire and survey was geared more towards how much the girls understood about the concepts of technology

and science, where their motivations and interests lay within that field, and how much support they feel they receive from their parents and teachers. When the game became indefinitely postponed, I decided to use a case study approach to get a more holistic point of view. Using this qualitative approach can lead to a “greater depth of understanding” compared to a quantitative approach especially through the process of *triangulation*, or looking at several angles to understand the whole (Berg, 2004). My own strategy of triangulation was to interview the students’ teacher and to do unobtrusive observations to supplement the first person accounts.

The second interview was created to get a deeper understanding on the girls’ identity and where they might get ideas about science and technology outside of the school setting. As before, the interviews were done in the same family restaurant and in the same pairs as the first interview. Each interview took about an hour to complete. This interview was much less formal and while a set of questions did exist, they were used more as a guideline rather than in a rigid format. Some questions were not asked if they did not seem relevant, and interesting ideas were probed further. The first pair of girls was audio-taped as they did not feel comfortable in front of a video camera. Due to a lack of extra help, I allowed the second pair of girls to interview themselves with the first open ended interview questions, while I questioned the first pair of girls with the second interview questions.

Following the interviews, I asked the girls to participate in a drawing task, which was completed in about ten minutes. I provided them with instructions and a set of colored pencils and plain graphite pencils. They were given directions to draw two separate

pictures. The directions for the first picture stated, "Picture a person who is a computer expert. Draw your impression of a 'computer whiz'. Give your whiz a name. How old is your whiz? The second set of instructions stated, "Picture a person who just can't learn to use computers. Draw your impression of a 'computer whizzn't'. Give your whizzn't a name. How old is your whizzn't?" This study was originally created by Bryson & de Castell for high school students (1998). When the students were surveyed, no differences were found in the skill level or use of computers between girls and boys, yet there was a huge difference in the people that they drew. In two types of pictures, the "whiz" was almost always a boy with glasses who looked socially inept. The "whizzn't" usually was an extremely feminized girl. The purpose of replicating this drawing task with the girls was to see if these stereotypical notions of "computer whizzes" and "whizzn'ts" still exist, because my first interview with the girls found that they both used and felt comfortable with a computer.

The parents were asked to pick up their children at a certain time, so after the interviews, I waited with them outside of the restaurant. Of the four girls, three of the parents were over thirty minutes late, so the girls asked if they could explore the video camera as they were quite fascinated with it. I agreed and let them communicate however they wanted. This was a rare opportunity because without a formal environment, all three girls let go of all their inhibitions. The two girls who had originally been shy in front of the camera suddenly wanted to videotape each other. After some time when the girls began to get restless, I intervened and asked them questions about their identity with respect to science and technology in the school setting. Some examples of these questions included, "What

was your science teacher like last year" and "What were your favorite and least favorite things about your science class last year". During the last fifteen minutes, I able to partially conduct the second open ended interview on outside expectations with one of the second set of girls who had participated in the self interview. Although her partner had already left, another classmate and friend kept her company.

Due to time constraints and the availability of the participants, not all of the girls were able to finish all of the interview sets. Table 1 gives an exact listing of what methods were used in interviewing all of the girls.

The teacher interview was conducted at her home. The total interview time was about an hour and a half, and was recorded entirely on video. Questions were asked without much deviation from the interview sheet.

After all of the interviews were complete, the last step was a classroom observation. Keeping in mind of what the students and teacher had said about each other, I looked for how the students interacted with each other and the teacher. I also looked for meaningful classroom discussion and participation levels.

## Findings

Since almost all of the interviews were conducted in pairs of two, I have decided to keep my case studies in pairs of two also. Each pair of case studies is also divided by specific aims. These aims have been shortened into two subheadings, (a) personality and outside influences; and (b) ideas about science and technology. This is because although all of the girls are friends, they all come from different backgrounds, and also have distinct personalities and ideas

about what math and science means to them. The three pairs of girls I will present in the findings are Sarah and Chantal, Vanessa and Moesha, and Allison and Chloe.

### *Sarah and Chantal*

Sarah and Chantal were the first girls interviewed. Both at thirteen years old, they were the oldest of all the subjects, and were also diagnosed by the school as having a learning disability. The first round of interviews with these girls was conducted individually, but due to the proximity of their seating arrangement being so close together, they would constantly interrupt each other with their own input and ideas. I eventually allowed this disruption to occur because I found that interviewing each girl separately elicited blank faces and shoulder shrugs for some of the tougher questions. Permitting the girls to answer during each other's interviews allowed them to feel more comfortable as it took them off the spot, and this increased the likelihood of them giving me an answer.

*Personality and Outside Influences.* Chantal and Sarah felt uncomfortable about letting me videotape them, but as their trust grew, the personal information they revealed about themselves gradually increased. Without a bulky video camera in the way, conversation seemed to flow more freely. Interestingly, on the second meeting after the interview, Sarah, Chantal, and a third subject, Vanessa, all wanted to use the camera for fun. In the informal setting of the restaurant parking lot, they all videotaped each other singing and gossiping about each other. It was during this time all shyness towards the camera went away.

*Vanessa (V): Have you ever kissed a boy?*

*Chantal (C): She [Sarah] has French kissed three times! ...Yes, I have.*

*Sarah (S): Which way?*

*V: She's made out with a guy!*

*C: On the cheek.*

*V: On the cheek?*

*C: I rolled over as I kissed him on top of him.*

*C & S: Whoa! Too much information!*

*V: Now you.*

*S: I've French kissed more than two times.*

For Sarah especially, boys seemed to dominate the conversation over everything else and it was almost to a point where it became distracting. Sarah was the only one in the group who admitted to having a steady boyfriend, and she seemed to hold him at the utmost regard. She was very protective of him when the other girls made fun of his small size or his supposed unattractiveness. The threats by Sarah's friends were fine because she knew they were made in fun and giggles ensued after each mean-spirited comment. If anyone else ridiculed her boyfriend, Sarah would become angry. Sarah showed an extreme disliking to one particular classmate in her school who would especially torment her boyfriend. The classmate was explained as being a "punk" or a teen that seemed to get in trouble with the authority figures, dressed in controversial clothing, and relished in being full of angst.

*S (to C): Don't make fun of [my boyfriend] or I'll sock you in the face just like I'll sock that orange headed freak for grabbing his neck at school... She punched my boy in the mouth and the school will be a swimming pool of redness.*

Sarah's boyfriend seemed to be her one anchor of someone she could always trust, since her relationship with her parents was very tumultuous. During an interview with

her science teacher, Mrs. Smith commented that she was both shocked and surprised to see Sarah's "nasty" and negative behavior towards her parents at the school's annual Open House, especially because she didn't seem to behave the same way during school. I was able to see several instances of these off-putting feelings towards her parents during my interview also. The following statements took place in the parking lot after the interview. She along with Vanessa and Chantal, who were going home together, were waiting for their parents to come pick them up. Although both sets of parents were already twenty minutes late, Sarah was the only one overly antsy about the situation.

*I'll walk to freakin' Jim's [Sarah's boyfriend] house. I'll walk into his house without asking...Where is Granpap or whoever is coming to pick me up? ...Someone better come pick me up or I'm going to have a little hissy-fit!*

Several minutes pass, and Sarah finally calls her mother. After reaching her, she hangs up and comments about the outcome of the phone call in a snide voice.

*Retard! My mom is like, "Where are you!" I'm like, "Where do you think! It's Tuesday. [Name of Restaurant]." She's like "OHHHHHH"! Retard!*

Chantal spoke much less about her family than Sarah, but seemed to have a close relationship with her mother. Chantal felt most comfortable going to her mother for help in science and technology and seemed to have a lot of respect for her family whenever she spoke about them. In this regard, Sarah and Chantal were total opposites.

Through an interview with the teacher, Mrs. Smith felt Chantal was popular in her class

and had a wonderful sense of humor, while Sarah seemed to have trouble maintaining good interpersonal relationships with the other students. Chantal was considered to be a very conscientious student and worked hard to retain her A in the class, even with the learning disability. In contrast, Sarah was only slightly above average with her C+ and had lower than outstanding citizenship marks (the grade received for good behavior).

Classroom observations gave a slightly different picture. During observations, I sat in the back, directly behind Sarah and Chantal. Both Sarah and Chantal seemed interested in the projects that were being presented, but of the two, Sarah was the only one who participated in class discussions. Chantal felt much shyer about participating and even felt a little anxious when it was her turn to present with her group. Both girls did not talk in their group presentations, but Chantal was the quieter of the two, and stood behind all her group members during her presentation. With regards to low citizenship grades, Chantal was quiet and attentive during the class period, but Sarah was very talkative and whispered through the duration of the class with her seatmate. Interestingly, all her whisperings had to do with constructive comments about the presentations rather than off subject topics.

*Ideas about Science and Technology.* While grades and behavior can only partially predict interest in a course, directly asking the girls about their interest in science brought about an unpredicted response. Both girls considered science to be their favorite class. For Chantal, it was her favorite class because it was easy, but for Sarah, the hands-on aspect, such as working with chemicals, made the class interesting. Defining science and technology was especially hard for Sarah and Chantal.

Science was compared to chemicals or topics recently covered in class, such as shadows, but it was hard for them to give unique or many examples.

*I (Interviewer): Name a way you use science in your house.*

*C: If you put hot [dry] ice into sinks, it makes them smoke.*

*I: What about outside your house?*

*C: We do science experiments at church.*

*I: What about technology? Name a way you use technology in your house?*

*C: I don't know...*

Since both girls enjoyed science class at school, the importance of science was given a very high rating, while technology was found to be extremely boring. This was because they really did not know what the word technology meant. Both girls planned to take science classes in the future, because it was fun, interesting, and easy. Although the girls did not want to take technology classes, the negative rating may change in the future because I was told that the girls' first school-based technology class did not occur until next semester.

During the interview, Sarah let me know that her dad had suggested that she join a technology track program in high school, but she became repulsed after her dad joked that she would have to dissect a frog. This was because her pet was a frog.

*S: My dad really wants me to join 'Technology in High School'...*

*I: Will you join 'Technology in High School'?*

*S: No. I don't want to dissect no frog. I'll probably throw it at the teacher.*

*I: What is one thing you could never do?*

*S: I can't dissect animals or frogs. I can't do anything to frogs that harms them or kills them.*

This statement was mentioned after I asked the girls if they could be surgeons. Compared to all of the other subjects interviewed, Sarah and Chantal's goal was the most science oriented and high aspiring. Both Sarah and Chantal wanted to be doctors, specifically pediatricians because they liked children, although Chantal's career goal also included being a nanny like her sister.

While the word "technology" was confusing to the girls, technology still played a large role in Sarah and Chantal's life. For Sarah, while technology and the use of computers were considered to be boring, she ironically spent a significant amount of time on the computer chatting, surfing the internet, and playing games. Since she didn't own a computer, she went to her aunt's house on the weekends and used it about two or three hours a week. Sarah's family also owned three cell phones – one for games, one for long distance calls, and one for local calls. While about half of her classmates owned cell phones, the quantity of phones that she had was much greater than her classmates, who only had 1 or none.

Chantal was a self-labeled "computer nerd". She claimed she spent the most time on her computer and she used it every day for up to 6 hours a day for playing games and surfing on Yahoo.com. As part of her extracurricular activities, she even took computer classes outside of school. All of the girls, including Sarah and Chantal, enjoyed playing arcade, card, or strategy games such as chess or solitaire.

*C: I love computers. Every time I go to my aunt's house, I'm the first one to get to a computer.*

Using a computer and being good at it did not constitute being a nerd. For all five girls, being nerdy was based off of looks, not intelligence. The ideal person was someone who was both smart and pretty. In fact, when questioned, all of them preferred to be smarter than good looking.

*S: When we were in 5<sup>th</sup> grade, our teacher, who we had... there were these computer people who came in, and they didn't fix our computer, and he went, "Those people are computer nerds", and we were like, "Yeah they are".*

*I: They were computer nerds because they didn't fix the computer?*

*C: Cause they're smart.*

*S: No, they had glasses on.*

*I: Were they smart though?*

*S: No, they looked like nerds.*

*I: Were they guys or girls?*

*S: They were guys.*

Gender differences were definitely in place for Sarah and Chantal, as well as for all six participants. When asked to give examples of the smartest people in their school, or in the media, unconsciously all of the examples were boys. This especially can be seen in Figures 1 and 2 where all of the smart "whizzes" are males with glasses, while the "whizzn'ts", or the people who can never learn anything, are overdressed very feminine-looking females. For Sarah and Chantal, having science as their favorite subject and enjoying the use of computers already put them one step ahead of their female classmates. As for Sarah, even though her grade may be at a C+, as her science teacher mentioned, "I sometimes wonder what interest level they have, but...it's interesting that these are the girls who volunteered to [participate in these extra-curricular science activities]".

### **Allison and Chloe**

Chloe's parents came thirty minutes early to pick both girls up, so they were not able to do the picture task or finish the second interview. Both girls were the quietest and most reserved of the group and politely waited for each other to finish talking before answering the questions.

*Personality and Outside Influences.* Allison and Chloe maintained the closest bond in the group compared to any of the other girls. Both of their parents had been family friends for as long as they could remember and the bonds went as far as joint family vacations. Both girls also were the youngest of the group at 11 years old and were part of separate class from the first three girls. Both girls were also very well rounded in their lives and still maintained good grades. Their science teacher considered them "mature beyond years".

*T (Teacher): All have A's in science and seem very conscientious and care about their grades...[they] are very motivated in just about everything they undertake.*

Both interviews and observation of them in their classroom also showed that they were confident, enormously focused, and attentive students who took a great interest in their surroundings and the people around them. When I observed their classroom, students were making presentations about a lake they had visited during a recent field trip. Their assignment was to build a model of the lake and redesign the area to make the lake friendlier to both visitors and the environment. Students were permitted and even encouraged to ask questions or make comments about the presentations, and at the beginning, Allison was the only one to do so. After each presentation, she raised her hand, and commented on what she liked best about the presenters model.

*A (Allison): I like the Lego people.  
[For presentation one]*

*A: I like the way you designed the  
park area. [For presentation two]*

*A: I like how you used sparkles for  
the grass. [For presentation three]*

She only had positive comments and by the end of the class, while the other students found her comments amusing, they also began to follow her example by giving encouraging comments to presenters too. She seemed to be one of the most popular among her classmates. During their class break, both genders were divided in the classroom. The boys went to the back of the classroom and made fun of objects outside of the window, while the girls stood at the front of the classroom observing the models with their teacher. Allison's position was in the middle of the classroom with another female friend, and she was the only one confident enough to interact with both the girls and boys in her class.

Chloe similarly tried to help her classmates out in times of need. During her group presentation, one group member had not contributed at all because of her shyness. After each member, except the shy classmate, took turns stating what they had learned from doing the project, Chloe first whispered to the classmate, "[Classmate's name], you're supposed to say something". When the classmate emitted no response, Chloe took it upon herself to speak out and tell Mrs. Smith, "She has something to say. [Her favorite part] was nature."

Although doing well in school seemed important to the girls, sports dominated their interest over anything else. Chloe seemed to be the sportier of the two and participated in ballet, tap, and jazz, along with softball, swimming, and karate. Downtime included playing football, kickball, and 'hide and go

seek' with her neighborhood friends. Allison, along with playing softball and soccer, did modeling at the local mall as well. She also played football for fun with the other boys on her street.

*A: (Need to check quote) There is a  
field across from my house. (All the  
boys are on her street, so she plays  
football, and is one of the best  
people. She doesn't mind playing  
with the boys because they are nice  
to her and she gets a touchdown  
every time because they are afraid to  
tackle her.)*

She wistfully mentioned wanting to participate in gymnastics and cheerleading but could not, due to time constraints.

Friendships as well as family played a large role in these girls' lives as both were intertwined in determining personal interests and motivations. Parents were considered to be role models as well as a source of inspiration as both Chloe and Allison looked up to them in obtaining homework help and determining career choices. Ultimately, it was the teacher over anyone else who fostered the girls' interest in science, while interest in technology was predetermined by stereotypes from the media and examples of boys rather than girls were still the first to come to mind when asked what qualities made up a really smart person.

Both considered themselves to be "really good with computers" but both were impressed when an aunt could type with both hands or when "Kim Possible", a Disney character could set up a website on the computer "all by herself". They didn't have easy computer access, so they usually used either the library or a relative's computer, and preferred spending their time outdoors rather than with a computer.

Teachers, family, and friends seem to play a large role in their lives. The girls did not seem shy in asking for help, and had people they felt they could go to for support. Teachers were very important to Chloe and Allison, because to them, a class was interesting based on the teacher's personality. The girls also had many siblings and Chloe especially seemed to be very close to her twin sister. Both girls' parents took an active role in spending time with their children, and this was done especially through sports. Chloe mentioned that her grandfather had been playing baseball since he was ten, so he would spend a lot of time teaching her and helping her improve her skills. Her mother was her softball coach for three years, and her sister taught her acrobatics during their free time. Allison and her brother both play soccer together with her father, and she ends up playing and practicing a lot because her father's best friend is her soccer coach. Allison spends time with her mother and grandmother when cooking, a hobby they like to do often. Allison's mother also takes an active interest in her modeling career.

*Ideas about Science and Technology.* Science was not Allison and Chloe's favorite subject, but they did seem to enjoy the class. According to the teacher, both had an A in the class, but they thought their grade range was slightly lower and both estimated that they would receive between an A and a B. They understood ways science could be used outside of school, but sometimes made the examples seem experimental by relating most of their instances to chemicals.

*I: Tell me what you think of when I say the word science to you?*

*A: Chemicals, beakers, vials, and using more information to get the right thing. If you are making*

*chemicals, you have to use the right information to get [the product].*

*I: Can you name a way you use science in your house?*

*A: Making cool-aid. You have to mix the powder, water, sugar, and put it in the fridge. Then drink.*

*C (Chloe): Food. Like chemicals, you have to measure and mix ingredients when you make food.*

While like Chantal and Sarah, science was viewed as interesting, Allison and Chloe found technology to be just as appealing. They could also easily describe the definition of technology by relating it to computers. Allison and Chloe considered themselves to be good at using the computer, and they even gave several examples of how they taught others to use it too. Most of the tasks they did on the computer consisted of writing papers and researching for school, but they would also play both online and offline games, talk to friends on AOL, and download songs onto CD's. The lack of access to a computer was the only thing that seemed to deter the girls from learning more about it. Allison had a computer at home, but it didn't include internet access. Chloe's family did not own a computer, so she had to travel to her grandmother's house to use one.

When asked what they thought about science and technology, they answered that both were important and necessary in helping to better the world and their career choices, but they did not plan to choose that route when deciding their own careers. Allison's career choice was acting, while Chloe wanted to be a hairdresser. Similar to Chantal, choosing a career that someone in the family already had seemed important, as that goal appeared to be a lot more attainable and practical than other careers.

*I: Have you talked to your parents about what you want to do?*

*C: We were talking about it to my older sister because it will come up soon for her. At first, I wanted to help autistic kids...but I changed my mind because I don't want to go far away for college and be away from my parents, so I chose hair dresser because that is a good job, and I'm good at hair because I've watched my grandma and aunt do it. You don't go to college, you go to school. If I had to, I'd go to college for autistic kids...*

*I: Are your parents okay with you not going to college?*

*C: Dad wanted me to go to college. He wanted all his kids to go to college because it's a better education, but he said whatever is best for you. You could go to school for whatever you want.*

Allison's career goal was to become an actress because she enjoys expressing her drama. Her mother seemed okay with her career choice also, and Allison mentioned that she could then support her mother from the money she makes from being on television shows or movies. She also did not expect to go to college and instead hoped that modeling would help her with her acting.

### ***Vanessa and Moesha***

Vanessa and Moesha were a unique pair of subjects because their interviews were not conducted in the same way as the other four participants. Vanessa and Moesha were originally recruited to participate in a separate study that would be running in the same place and time. When the interviewer running the other study cancelled at the last minute, the girls were left without anything to do. Since I had already started the second

set of my interview, I handed them a video camera and asked them to interview themselves with the first open ended interview on science and technology. Both girls were very excited at the prospect of this, and took turns interviewing each other. I was not able to personally interview Moesha, because her mother was not able to bring her back for any more interview sessions, but Vanessa very talkative, and I was able to interview her twice.

*Personality and Outside Influences.* Of the two girls, Vanessa was the most attentive, and took total control of the situation. Vanessa first had Moesha film her, while she interviewed herself, then she took charge of the video camera and both interviewed and filmed Moesha. Both girls had an easy going rapport with each other and with Sarah and Chantal.

Vanessa was very close to her family, especially her grandmother. She felt very comfortable going to her for advice, especially with homework. She seemed a little hesitant to talk about them because of family problems that were going on in her life, but she still strived to keep a positive attitude and had high self esteem. The family problems had caused her cousin, who was in the same grade at the same school, to break their friendship. Since her best friend sided with her cousin, she felt upset, but was happy to have her other friends stick up for her.

*Now I know who my true friends are. I'm not losing anything. When she [the best friend] comes crying back to me, I'll be like, "no". I think the only reason she did it is to be cool, because she doesn't really have a lot of friends. While [cousin] is still mad at me, she's using [best friend] to get back at me.*

Weekdays were designated as family time for Vanessa, while weekends were spent with friends. She also made time to meet her friends in the morning before school started.

Gender stereotypes were very strong with Vanessa. In the “Draw a Computer Whiz” task, her “computer whiz” showed very masculine traits while her “computer whizzn’t displayed strong feminine traits. Her drawing can be seen in Figure 3. She described the smartest person in her school as being male also. She labeled the smart boy as a “nerd” and she described him as a person who is constantly studying. She added that smart people don’t feel shy about asking the teacher for help. When asked about the “dumbest person”, Vanessa pointed at Sarah, but turned it into a joke when Sarah turned around. When I questioned her about her response, she whispered to me that Sarah talks everyday in class. A second person who fit into the category low intelligence was a boy who swears. When asked to describe smartness in relation to the media, Vanessa gave a different answer. Using much older adults as her role models, such as Julia Roberts and Denzel Washington, she believed they were smart because of their success. She could not relate science with respect to the media because she did not feel it was applicable, but she could relate technology because she felt computers were useful to all people.

Teacher observations added depth to the interviews with Vanessa and Moesha. The teacher described Vanessa as quiet, self-confident, and very mature. She had an A in the class and worked hard to maintain it. Moesha on the other hand was described as having a learning disorder, low self-confidence, and low interest in her class work. She was popular with her classmates but unmotivated with her schoolwork.

Moesha lately had been getting in trouble for talking in class and not taking responsibilities for her action, and thus has a C+ in the class and an unsatisfactory mark for her citizenship (behavior) grade. Moesha’s mother seemed interested in keeping up with her daughter’s progress, and was one of the few parents who kept in contact with Mrs. Smith.

Both the interview and classroom observations showed Vanessa in a different light. While she was very self-confident and mature, she was talkative, and enjoyed showing off her singing skills in front of her peers. During her class presentation, Vanessa was the main student to present all of her group’s information, and although during the question-answer session the rest of her group contributed equally, Vanessa was the most outspoken. Moesha fit the characteristics Mrs. Smith described. Her group did not take a lot of interest in the project, and Mrs. Smith and her assistant had to probe the group for more specific answers.

*Assistant Teacher(AT): Moesha, quick! What did you learn about?*

*M (Moesha): Nature.*

*AT: What else?*

*M: Me?*

*AT: Yes.*

*M: About the history of the park.*

Moesha’s contributions were not as detailed as other classmates. For example, Vanessa stated she learned that, “it can be fun to work together and put creative ideas together”, while Allison declared, “What I learned from doing the model [of the lake for the presentation] how hard it was to put together.” Moesha also showed signs of low interest throughout the class and spent much of the class period conversing with her neighbors. She later had point taken off of her citizenship grade for excessive talking.

*Ideas about Science and Technology.* Science was Vanessa's least favorite subject in school. She stated that it was because of her fifth grade science teacher who made her intensely dislike the subject. While she didn't enjoy the subject, surprisingly, Vanessa's favorite teacher was Mrs. Smith. She felt extremely comfortable going to her for help, and asserted that Mrs. Smith helped her catch up to class standards. She looked highly at Mrs. Smith and considered her to be a role model. She definitely felt that having a good teacher was critical to enjoying any school subject, and used to like science before fifth grade.

Vanessa defined science as having to do with nature and the earth. Moesha had trouble understanding what science or technology was. I unfortunately was not able to question her further. Vanessa was able to define technology in her second interview after some probing.

*I: What's the difference between science and technology?*

*V: Science is... more nature, but technology is artificial. Not fake, but I'm meaning artificial light. Like that's artificial light (points to the lights on the ceiling of the restaurant), but the sun, that's Earth's light.*

Vanessa enjoyed using the computer, but only did her homework on it because her sister constantly occupied it. Although she didn't receive the opportunity to play computer games very often, she had a lot of fun playing them. She wished she could use the computer a little more often, but did not want one of her own.

*My sister has a laptop but she can't use it yet because we don't have a cord, so then we'll get to use [the computer], but not really. Not until I'm older because I'm brave enough*

*to admit I'm not ready for it yet, because I don't know if I could take care of it. I don't have a spot to put it in because I have a lot of stuff in my room.*

Vanessa also understood the importance of science and technology, and correlated knowing math, science, and reading to having a successful job. She expressed a definite interest in going to college, but was unsure about what she wanted to do. She had thought about becoming a teacher or a musician, but she wanted to use high school as an outlet for exploring her options. She especially liked singing, and was enrolled in several singing and dance classes, but did not know if musicians attended college. She did not feel singing was a career that required science, but technology was an important aspect, especially for equipment such as microphones and lights. Moesha only mentioned wanting to become a doctor or nurse, and it was a career that she decided with her mother.

## **Discussion**

At the start of this study, I aimed to explore what ideas current middle school girls have about science and technology. I found that science was a term that was everyone could describe easily. All were able to think of ways they could use it outside of school, but many times topics were experimental based and all had to do with nature or using chemicals. All also enjoyed their science class, but only one actually specified it as being their favorite class. This is consistent with Beller and Gafni's study, who also found that girls would easily be able to compare science to experiences outside of school (1996).

Choices in careers were also in agreement with previous research (Lee, 1998). Half of

the girls wanted to be a doctor, and all were careers that were very people oriented such as teacher, entertainer, and hairdresser. All were able to think of ways that science and technology could be used in their careers, but except for medicine, the girls agreed that science and technology were of minor importance.

The reason for this may be because girls have not had an opportunity to experience science outside of a school setting. Since all of the girls assert that they enjoy science class and their teacher, *Click!* may be very helpful in persuading them to continue on in science. As an intervention program, *Click!* will need to emphasize how science can be used in everyday life and how science careers can include jobs other than a science teacher or a scientist who works with chemicals. *Click!* should also try to maximize on hands-on experiences and minimize on lecturing as classes that the girls preferred most were very creative and interactive.

Unlike science, technology was a term that still confused the girls. After some probing, only one girl was able to produce a definition of technology. One reason may be because the girls were not enrolled to take a technology class until the next semester, so they may not have come into working contact with the word. Despite the initial confusion, technology did in fact play a large role in the girls' lives. All of the girls seemed to take delight in using technological equipment such as cell phones and video cameras.

In contrast with previous research (i.e. AAUW, 2000; NCES, 2004), all six girls enjoyed playing computer games, although usage was variable. This was because girls who had a computer at home used it more often because they had easier access. I was

not able to find out how extensive the girls' technological knowledge was but it seems like they had basic computer skills such as knowing how to use a word processor or the internet rather than more specialized computing such as programming or web designing.

From the results of the drawing task and through the interview questions, gender stereotypes still exist. The smartest person the girls could think of on TV or at school was always portrayed negatively as a boy who was good at using the computer. This boy was also usually someone who preferred to be alone rather than with other people. The findings that that gender stereotypes still exist are in line with the National Center for Education Statistics (2004) and the American Association of University Women (2000).

During the *Click!* game, the term technology should be explained in a more meaningful manner to help remove the negative stigma the word presents. By associating technology with its actual components, such as the cell phone and the laptop, the word will hopefully become more meaningful and accessible to the girls. While technology equipment may have extra appeal, using the computer as a tool rather than an accessory will be important, because in concurrence with previous research, girls find that doing tasks that requires strategy or application to the real world is much more interesting than a task such learning how to take a computer apart (Silverman & Prichard, 1996; AAUW, 2000). Using technological equipment in general will be very popular with the girls, as many do not get to use them on a regular basis.

My second aim was to see if personal identity, motivation and interest level, and outside expectations such as parents,

teachers and friends all play a role in middle school girls' models of science and technology. In agreement with my hypothesis, I found that all are important in determining if the girls should be concerned about science and technology. When girls found that their teachers, parents, or friends thought science and technology was useful and interesting, they also looked at science positively, and felt it was important. When science or technology was looked at unconstructively, as in the case of Sarah's father suggesting she learn to dissect frogs when he knew that she had a pet frog, science and technology was also looked at negatively. Also as expected, I found that personal identity, motivation and interest level, and outside expectations are all interrelated and complement rather than replace each other.

Recent findings state that adolescents at the middle school level value their parents' expectations over their friends' expectations (AAUW, 1994, Wenzel, 1998). I found similar results, and the justification may be because of age. Since all six girls were not of driving age yet and friends were not in close walking distance, the girls typically were not allowed to leave their houses on a school night, and consequently evenings were usually spent with their families.

Family members, especially parents were also important as role models for their daughters. Almost of the girls who were asked said they go to their parents when they need help with either science or technology. Many aspired to gain some of the same characteristics as their mother or grandmother, participated in extracurricular sports with a family member and some even based their career choices on family values. All had discussed future career choices with their parents, and received positive verification about their decision.

Teachers also played an important role in helping to shape girls' science and technology identity. Teachers held power over whether their students would like the subject they taught based only on personality and classroom activities. If a teacher was unpleasant or rude to the students, the class that a particular teacher was teaching would automatically take on the same qualities, regardless of the actual subject matter. This result is consistent with Lee work (2002). Similarly, students enjoyed Mrs. Smith's class immensely because her students felt she was energetic and took a direct interest in her students and her science class. She made sure that everyone was given an opportunity to participate, and used hands-on experiments, science based games, and collaborative work to keep the coursework from becoming repetitive.

Friends or peers are a third factor in determining middle school girls' attitudes and values about science and technology. Friends were especially significant in school setting, and it can reasonably be assumed that this is because of the daily and constant interaction they had with each other. Although the girls did not really receive an opportunity to work together outside of school, all had formed a close knit bond with each other in school. Like previous research shows, the four girls who were doing well in school were seen as popular by the teacher, the two girls who were not doing so well, also had social or discipline problems (Wentzel, Caldwell, & Barry, 2004).

Finally, all of the girls had very high self esteems and did not feel there was something they could not do. Some just expressed worry that they could not do multiple things (i.e. be a doctor and an actress) but this was due to time constraints

rather than lack of ability. All felt with proper training, anything could be achieved.

The implications of these findings suggest that because both parents and teachers are respected and are considered to be role models, it is possible that including them in the *Click!* game will be more helpful than detrimental. Participation in *Click!* game may also give parents and teachers an outlet to discuss the positive aspects of a career in science or technology. They may provide more support when the girls are at a crossroad in deciding if they want to pursue science classes in high school or the future, since parent perceptions do determine if their child is likely to go into a science or technology career (Bleeker & Jacobs, 2004). As friends are play an important role in shaping a middle school girl's identity, *Click!* will benefit by fostering high levels of interaction with both friends and other players. Participating with friends may also keep girls motivated in a school setting, because participating in an activity outside of school may make the bonds of their friendship stronger. As a final point, because these girls still have high expectations of what they are able to achieve, *Click!* can use this opportunity to build up their interest and confidence in science and technology. If *Click!* is able make a personal impression of how valuable science and technology can be, not only to the world, but more importantly to themselves, this intervention program can be considered a success.

A future study may consider implementing a post-test evaluation of the *Click!* game to see if girls have in fact benefited from being a participant. Also future researchers who may plan on repeating this study may profit by creating a shorter and more focused closed ended questionnaire, as the answers given by all the girls were very inconsistent.

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**Table 1**  
*Method of Inquiry*

	Name Of Participants					
	Sarah	Chantal	Allison	Chloe	Vanessa	Moesha
1. Open Ended Interview I	X	X	X	X	X	X
2. Closed Ended Questionnaire	X	X	X	X	X	X
3. Open Ended Interview II	X	X	X	X	X	--
4. Drawing Task	X	X	--	--	X	X
5. Informal Observation	X	X	--	--	X	--
6. Classroom Observation	X	X	X	X	X	X
7. Teacher Interview	X	X	X	X	X	X

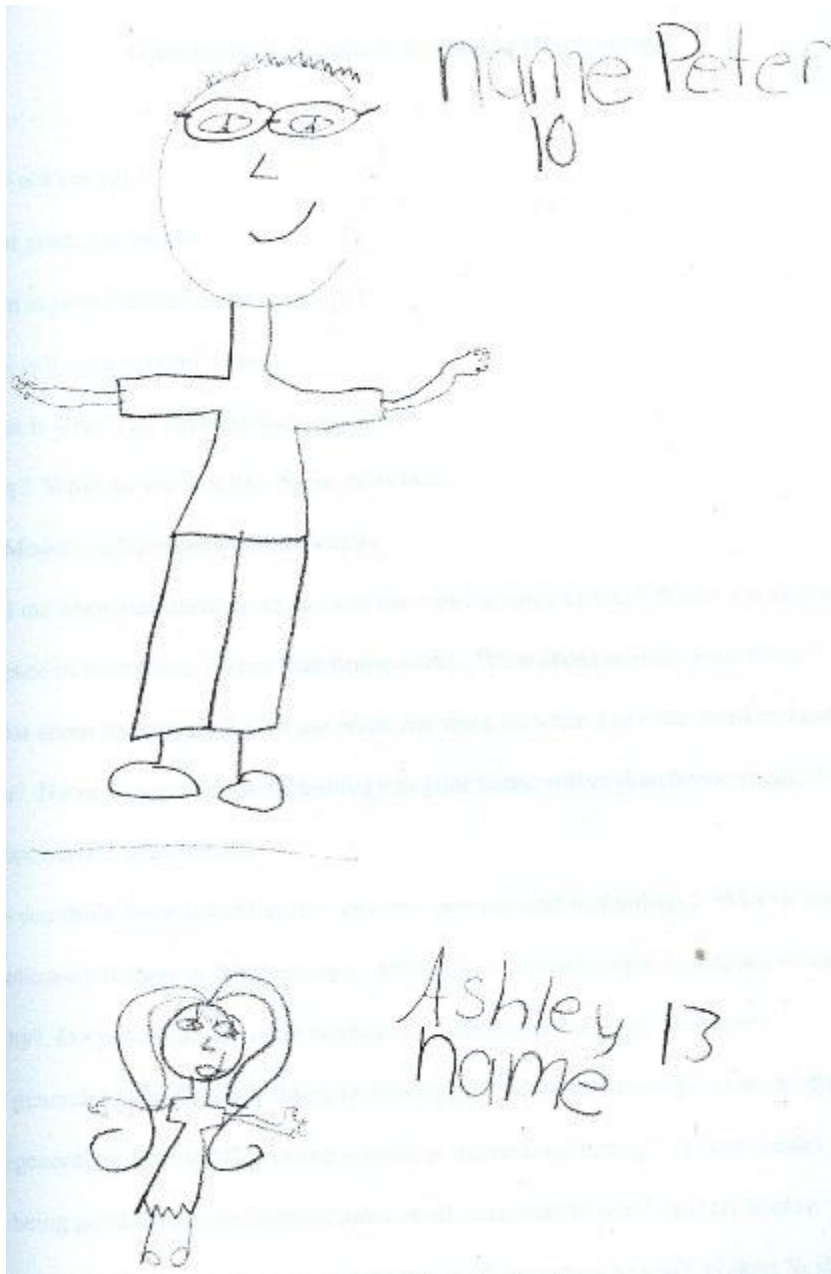
**Figure Caption**

*Figure 1.* Sarah's drawing of a "computer whiz" and a "computer whizzn't" from the Drawing Task. Female name was erased due to privacy concerns.



**Figure Caption**

Figure 2. Another example of the Computer Whiz Drawing Task. This “computer whiz” and “computer whizzn’t” was drawn by Vanessa.



**Appendix A**  
**Open Ended Interview I: Science and Technology**

**I. Warm-Up**

1. How old are you?
2. What grade are you in?
3. What is your favorite class at school?
4. Why is it your favorite class?
5. What is your least favorite class at school?
6. Why? What do you not like about this class?

**II. Mental Models of Science and Technology**

7. Tell me what you think of when I say the word science to you? Name a way you use science in your house (other than homework). What about outside your house?
8. What about technology? Tell me what you think of when I say the word technology to you? Name a way you use technology in your house (other than homework). What about outside your house?
9. Do you think there is a difference between science and technology? Why or why not? (Follow-up if there is a difference): What is your favorite topic in science or technology? Why? Do you think you need science (or technology) to study this topic?
10. In general do you find that doing technology is interesting/ boring? (Likert Scale)
11. In general do you find that doing science is interesting/ boring? (Likert Scale)
12. Is being good at science important/not at all important to you? (Likert Scale)
13. Is being good at technology important/not at all important to you? (Likert Scale)
14. Would you take science at school if you didn't have to? Why or why not?
15. Are you taking any technology classes? (If yes- would you take it if you didn't have to? If no, are you planning to take any in the future?)

**III. Outside Expectations**

16. When you need help with science, who do you usually ask?
17. When you need help with technology, who do you usually ask?
18. When science homework, papers, or exams or handed back, do you (or your classmates) compare how you did?
19. Do you work with friends when doing science homework or while studying for a test?

**IV. Computer Interests**

20. How comfortable are you using a computer? (Likert – really good/bad at it)
21. Do you have a computer at home? Who spends the most time on it?
22. How much time do you usually spend on the computer when you use it?
23. What sorts of things do you do on the computer? (Games, internet, IM, homework)
24. Do you like to play computer games? Why or why not? (If yes, what sort of games do you play?)

V. General Science Knowledge With Respect To Click!

25. Have you heard of a GPS? How comfortable are you using one? (Likert – really good/bad at it)
26. Why would fingerprints be important when solving a crime?
27. Have you ever heard of combined sewage overflow? Do you know what it is? (Follow-up): What can you tell me about water quality issues in Pittsburgh? Do you know how your toilet works?

VI. Career Aspirations

28. Have you thought about what career you eventually would like to do? Explain.
29. Do you think you'll need science in this career? If yes, how much?
30. What about technology? Do you think you'll need to use technology for this career? How much?

Thank you for answering my questions!!!

**Appendix B**  
**Closed Ended Questionnaire**

Age \_\_\_\_\_

Grade \_\_\_\_\_

- This is a survey about how you feel about different subjects and activities both inside and outside of school.
- This survey will be kept anonymous and will not be shown to your parents or teachers. Do not put your name anywhere on the survey.
- Thank you for taking this survey!

Part I. Please mark True (T) or False (F) for the following statements.

1. \_\_\_\_\_ The teacher likes science.
2. \_\_\_\_\_ The teacher tries to make science interesting.
3. \_\_\_\_\_ The teacher likes technology.
4. \_\_\_\_\_ The teacher tries to make technology interesting.
5. \_\_\_\_\_ The teacher grades our work fairly.
6. \_\_\_\_\_ My parents think science is important.
7. \_\_\_\_\_ My parents think technology is important.
8. \_\_\_\_\_ My grades are important to my parents.
9. \_\_\_\_\_ I feel comfortable going to a parent for help with science questions.
10. \_\_\_\_\_ I feel comfortable going to a parent for help with technology questions.
11. \_\_\_\_\_ I feel comfortable going to a teacher for help with science questions.
12. \_\_\_\_\_ I feel comfortable going to a teacher for help with technology questions.

Part II. Please checkmark below the answer you think fits best. Please mark only one answer per item.

If you are a girl who is really good at (see item below), is it...	More likely that other GIRLS will like you?	Doesn't Matter?	Or Less Likely that other GIRLS will like you?
English/Reading			
Math			
Science			
History/Social Studies			
Gym			
Health			
Band			
Choir			
Orchestra			
Foreign Language			
Art			
Student Government			
Cheerleading			
Woodshop/Metal Shop/Tech Classes			
Home Economics (Cooking/Sewing)			
Computer/Typing/Programming Classes			
Playing an instrument			
Sports			
Dance			
Girl Scouts			
Music			
Being the smartest			
Having smart friends			
Being the most popular			
Having popular friends			
Having clothes with labels			
How good you look			

If you are a girl who is really good at (see item below), is it...	More Likely that other BOYS will like you?	Doesn't Matter?	Or Less Likely that other BOYS will like you?
English/Reading			
Math			
Science			
History/Social Studies			
Gym			
Health			
Band			
Choir			
Orchestra			
Foreign Language			
Art			
Student Government			
Cheerleading			
Woodshop/Metal Shop/Tech Classes			
Home Economics (Cooking/Sewing)			
Computer/Typing/Programming Classes			
Playing an instrument			
Sports			
Dance			
Girl Scouts			
Music			
Being the smartest			
Having smart friends			
Being the most popular			
Having popular friends			
Having clothes with labels			
How good you look			

Please list any hobbies or activities (both outside and in school) that you do.: \_\_\_\_\_

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Part III. Please circle the answer you feel fits best.

1. In general, how would you compare males to females in science? (Circle one.)
  - a) Females are much better than males.
  - b) Females are a little better than males.
  - c) Females are the same as males.
  - d) Males are a little better than females.
  - e) Males are much better than females.
  
2. In general, how would you compare males to females in English? (Circle one.)
  - a) Females are much better than males.
  - b) Females are a little better than males.
  - c) Females are the same as males.
  - d) Males are a little better than females.
  - e) Males are much better than females.
  
3. In general, how would you compare males to females in technology? (Circle one.)
  - a) Females are much better than males.
  - b) Females are a little better than males.
  - c) Females are the same as males.
  - d) Males are a little better than females.
  - e) Males are much better than females.
  
4. In general, how would you compare males to females in history? (Circle one.)
  - f) Females are much better than males.
  - g) Females are a little better than males.
  - h) Males are much better than females.
  - i) Males are a little better than females.
  - j) Females are the same as males.

Part IV. Please answer the following questions. Circle the number you feel fits best.

1. How good are you at science?  
 Science is really easy. 1 2 3 4 5 6 7 Science is really hard.
  
2. How good are you at technology?  
 Technology is really easy. 1 2 3 4 5 6 7 Technology is really hard.
  
3. Compared to other girls at school, how good at science do you think you are?  
 Best 1 2 3 4 5 6 7 Worst
  
4. Compared to other boys at school, how good at science do you think you are?  
 Best 1 2 3 4 5 6 7 Worst
  
5. Compared to other girls at school, how good at technology do you think you are?  
 Best 1 2 3 4 5 6 7 Worst

6. Compared to other boys at school, how good at technology do you think you are?  
Best 1 2 3 4 5 6 7 Worst
7. How excited are you when it comes to studying science?  
A lot less than other classes 1 2 3 4 5 6 7 A lot more than other classes
8. How excited are you when it comes to studying technology?  
A lot less than other classes 1 2 3 4 5 6 7 A lot more than other classes
9. How hard do you work in science?  
A lot less than other classes 1 2 3 4 5 6 7 A lot more than other classes
10. Compared to other girls at school, how hard do you work in science class?  
A lot less than other girls 1 2 3 4 5 6 7 A lot more than other girls
11. Compared to other boys at school, how hard do you work in science class?  
A lot less than other boys 1 2 3 4 5 6 7 A lot more than other boys
12. How often do you get science homework?  
Never 1 2 3 4 5 6 7 Everyday
13. How much time do you normally spend on science homework? (Please put an X by one answer.)  
 Less than 15 minutes a day  
 15-30 minutes a day  
 30 minutes to 1 hour a day  
 More than 1 hour a day
14. What grade do you think you'll get in science class this year? \_\_\_\_\_  
*(Please answer if you are taking any technology related classes.)*
15. How hard do you work in your technology class?  
A lot less than other classes 1\_\_2\_\_3\_\_4\_\_5\_\_6\_\_7\_\_ A lot more than other classes
16. Compared to other girls at school, how hard do you work in your technology class?  
A lot less than other girls 1\_\_2\_\_3\_\_4\_\_5\_\_6\_\_7\_\_ A lot more than other girls
17. Compared to other boys at school, how hard do you work in your technology class?  
A lot less than other boys 1\_\_2\_\_3\_\_4\_\_5\_\_6\_\_7\_\_ A lot more than other boys
18. How often do you get technology homework?  
Never 1\_\_2\_\_3\_\_4\_\_5\_\_6\_\_7\_\_ Everyday

19. How much time do you normally spend on technology homework? (Please put an X by one answer.)

- Less than 15 minutes a day
- 15-30 minutes a day
- 30 minutes to 1 hour a day
- More than 1 hour a day

20. What grade do you think you'll get in your technology class this year? \_\_\_\_\_

Part V. Circle the answer you feel fits best.

1. What is the one item you couldn't head to school without?

- a) My skateboard or discman.
- b) Deodorant. Don't wanna be smelly after practice.
- c) My vintage bag or homemade lip balm.
- d) My make-up bag, a mirror, an extra outfit in case I get tired of what I'm wearing...
- e) My homework.
- f) Other

2. Which celeb do your classmates say you remind them of the most?

- a) Hilary Duff.
- b) Avril Lavigne.
- c) Serena Williams
- d) Beyonce
- e) Phoebe from Friends

3. Would you rather be better looking or smarter?

- a) Better looking
- b) Smarter
- c) Neither

## Appendix C

### Open Ended Interview II: Outside Expectations

#### I. Warm-up

1. Is there anyone you wish you could be like? It can be a mix and match of different people. What qualities would this person have?
2. What type of person would you never want to be like?
3. What is the most fun thing you have ever done?

#### II. The Media and Science/Technology

4. Do you have any favorite TV shows? Favorite Singers? Movies?
5. Why do you like these singers/stars?
6. How old are they?
7. What are their personalities like?
8. Which star/singer/actress do you think you are most like?
9. How smart do you think they are?
10. Do you think they like science?
11. Are they/could they ever be good at science? (If no, why do you think that is?)
12. Do you think they were good at science when they were in school?
13. Do you think they ever use a computer? If yes, how often?
14. What do you think they use it for?
15. Who's the smartest TV character you can think of? What are they like?
16. Do you know people like that at school?
17. What qualities does a person who's really good at science have?
18. Describe a really smart person.
19. Would you rather be smarter or better looking? Why?

#### III. Self-Perceptions about Ability

20. Last time you said that you wanted to become[insert occupation here]. Do you think something could keep you from becoming one?
21. Have you talked to parents about what you want to do?
22. Do you think there are any career that you think you could never do?
23. What types of things are you really good at? What types of things are you really bad at?
24. Do you think there is anything you are so bad at doing, you good never be good at it, no matter how hard you tried?

#### IV. Classroom and Teacher Perceptions

25. What did you do or learn about today in [Mrs. Smith's] class?
26. Why do you think she was teaching that?
27. What is the most fun or interesting thing you've done in [Mrs. Smith's] class so far? What about the most boring thing?
28. How does [Mrs. Smith] make class interesting?
29. Do you remember anything about last year's science class? What made that class interesting or boring?
30. What do you think [Mrs. Smith] does when she goes home?

## **Appendix D**

### **Teacher Interview**

#### **I. Background of the Teacher and School**

1. What is your approximate age?
2. What is your background?
3. What did you do before coming to Brashear?
4. Why did you choose to work with middle school aged students?
5. What brought you to Brashear Middle School??
6. What type of school is Brashear? How would you describe its demographics?
7. Are there any unique characteristics that you like about the school?
8. If you could would there anything you would change about the school?
9. How long have you been working here at Brashear Middle School?
10. What type of science do you teach?
11. Is it any different that your own personal interests in science? If yes, what type of science appeals to you?
12. How did your own science interests develop?
13. Do you communicate with any of your students outside of the classroom?
14. What about their parents?
15. How important do you feel are parents' role in education?
16. How much active effort would you say parents actually put in?
17. Does any collaboration take place with the other teachers? How much? (This includes both in designing coursework and in general.)
18. What would you say your typical teaching style is?
19. Is this style typical of most teachers here at Brashear?

#### **II. Classroom Environment**

20. How much of what a student learns about science in your class depends more on a student's natural ability than on your own teaching strategies? (Eccles)
21. How are assignments graded? Are all grades based on a letter grade or point system or is any credit give based on participation?
22. How often, if ever, is group work encouraged?
23. How much homework do you usually assign? Are assignments expected to be completed unaccompanied?

#### **III. Use of Computers and Technology in the Classroom**

24. Do you think there is a difference between science and technology?
25. What would you define the term technology as?
26. How much technology do you use on average in your classroom?
27. On a scale of 1 (being excellent) and 7 (being poor), how comfortable are you using a computer?
28. How often do you use a computer?
29. What do you use your computer for?
30. Do you ever play or have you ever played computer games?
31. Do you ever incorporate the use of computers into your coursework?

IV. The Girls

32. How would you describe the six girls I interviewed this week?
33. Can you tell me anything about their background?
34. What social group would you place them in, if any? (I.e. popular, sporty, nerdy)
35. You mentioned previously that they were part of “Learning support groups”. Can you explain this in a little more detail?
36. Do you think the participation in this group affects their ability in any way to perform in class?
37. How would compare these girls I just interviewed to the other girls in this class? What about compared to the boys? And how about compared to students in other classes? (This includes both performance and in general.)
38. How often do they typically participate in class (same/less/more than other students)?
39. What level would you say the girls participate at? (I.e. Are the questions they ask meaningful to classroom discussion?)
40. Compared to other children, how much innate ability or talent do you think each of these girls have in science?
41. How well do you think these girls will do next year?
42. How likely do you think it is that these girls will take science classes in the future, even when they don’t have to?