The Effects of Design and Modeling Curriculum and Instruction on Enrollment in Eighth-grade Technology and Engineering

by

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ABSTRACT

Lack of female enrollment has been a reoccurring and high profile issue in technology education. While this is a heavily researched area, many technology education programs still suffer from a lack of female participation. This document reviews research in the area of female enrollment in technology education and compares responses to a "Seventh-grade Technology and Engineering Survey" for three sections of seventh-grade technology courses according to peer intervention and gender. The researcher seeks to develop a qualitative understanding of eighth-grade females' attitudes regarding the middle school Technology and Engineering course.

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Chapter I: Introduction

A small town in the southeastern part of Wisconsin is transforming from a farming community into a suburb of Milwaukee. The town has a population of about 8000 people. Overall, the community is very supportive of education and its schools. The middle school enrolls approximately one thousand students in grades six, seven, and eight.

Two technology and engineering courses are offered at the school. Every seventh-grade student is required to enroll in a quarter-long course that touches on technology's impacts on society. It also deals with design and modeling. This course includes environmental impacts of technology, technological and natural resource use, as well as categories of technology. As part of the design and modeling curriculum, students brainstorm, sketch, design, and build a breadboard. Students also design and build CO^2 dragsters. Eighth-grade students have the option of enrolling in a year-long elective course that includes design and modeling, robotics, and DC electricity. Of the forty-eight students enrolled in the eighth-grade course during the 2006-2007 school year, only two were female. Female enrollment in the eighth-grade course increased from two to six in the 2007-2008 school year. Curriculum updates as well as staff changes may have lead to this increase.

Previous to the 2006-2007 school year, the technology education courses offered at the middle school were very traditional. The traditional vocational curriculum focused on manual skill – for instance - on a student's ability to operate a box and pan brake, or make a square cut with a miter box. The coursework also included a limited study into flight. The middle school technology education department is transitioning from this traditional curriculum to one that focuses on engineering principles through the design process. The present engineering-based curriculum focuses on technology as the application of math, science, and design principles. In addition to curriculum revisions, this researcher began exploring other ways to improve female enrollment in elective technology education courses.

Students, especially females, come to the technology education classroom with preconceived ideas about what the class and teacher will be like (Hill, 1993). It seems that female students trudge into the technology education classroom on the first day of school, while their male counterparts race in excitedly. Researchers have found that without realizing it, some teachers send the signal that technology education is not equally appropriate for males and females (Flowers, 1998). Teachers are inclined to give male students four times more praise than female students. When female students do receive praise, it is more often about the appearance of their work than it is about the substance of the work (Welty & Puck, 2001). If technology and engineering educators fail to offer girls an equal chance to succeed, the subsequent benefits that may come from research done by women will be lost (Sanders, 2000). The middle school requires technology education classes for all seventh-grade students. Given the opportunity this required seventh-grade course presents to a technology instructor, it is very important that curriculum be constructed so that it is as free of bias as possible. This also raises the question, "Is it morally defensible to allow major differences between males and females in technology courses, knowing that technology is a major key to success in America?" (Gloeckner & Knowlton, 1995, p. 47) Such gender discrepancies must be addressed in the interest equality and opportunity for all students.

A democratic society has an obligation to ensure that all students have opportunities to succeed and fail in a wide variety of subjects and methods (Goodlad, 1994). The US Department of Labor predicts that jobs for engineers and technologists will grow at four times the national average (Shanahan, 2006). The lack of diversity in the workforce nationwide is taking an economic toll. Failure to fill jobs with women and minorities is estimated to cost science, technology, engineering, and math-related businesses and industries four billion dollars annually (Childress, 2006).

Five influences have been identified that affect a young woman's inclination to register for technology and engineering courses. They include social fit, classroom climate, curriculum and instruction, role models and mentors, and messages females receive from counselors (Welty & Puck, 2001). In response to social pressure, females tend to gravitate toward educational programs that prepare them for traditional occupations during high school, and subsequently enroll in traditional majors like elementary education or health care in college. Children make important gender role decisions based on the roles that they see women playing in society. The absence of women in the ranks of people successful in technology reinforces the misconception that the study of technology is a male endeavor (Welty & Puck, 2001).

The suburban middle school being studied suffers from a lack of female enrollment in the eighth-grade technology and engineering course. In order to increase enrollment in technology courses, one should not "fix" the females, but make the technology classroom and profession more appealing and welcoming to females (Shanahan, 2006). Female students are especially excited about courses that focus on design and problem solving (Gloeckner & Knowlton, 1995). The curriculum at the suburban middle school being studied was updated previous to the 2006-2007 school year. As indicated previously, the female enrollment in eighth-grade elective courses improved after the curriculum revision. Could other strategies be used to increase female enrollment?

This researcher has examined the resources available to technology education classroom teachers and revised technology education curriculum in an attempt to attract more female students. The use of peer-presenters promoting technology education to seventh-grade students will be examined as a feasible method of developing a more inclusive classroom during this study.

Statement of the Problem

Although all seventh-grade students are required to enroll in seventh-grade technology and engineering, and are exposed to technology education, very few elect to continue their education in technology and engineering by enrolling in the eighth-grade technology and engineering course.

Purpose of the Study

There were three purposes for this study. One purpose was to identify seventh-grade female students' responses to a technology and engineering survey with their male counterparts. The second purpose of this study was to examine the impact peer-presenters had on influencing students' attitudes toward enrollment in eighth-grade technology and engineering courses. The third purpose of this study was to develop a qualitative understanding of eighth-grade females' attitudes regarding the middle school technology and engineering courses.

Data was collected during the fourth quarter of the 2008-2009 school year from three sections of seventh-grade technology and engineering students. A *Seventh-grade Technology and Engineering Survey* was developed from the one hundred question *PATT-USA* instrument developed by Dr. Allen Bame, Dr. Marc de Vries, and Dr. William Dugger. Permission to use the survey was granted and the resulting thirty four question *Seventh-grade Technology and Engineering Survey* (see Appendix C) was administered during class time at the beginning of the quarter (pre-course) and again at the end of the quarter (post-course). Using survey responses, the attitudes of seventh-grade technology and engineering students can be compared by gender between pre-course and at post-course conditions. The attitudes of seventh-grade students were also compared according to peer-presenter interventions between pre-course and post-course levels. The researcher used survey responses to study what effect the delivery of design and modeling had on seventh-graders attitudes toward technology. A focus group made up of eleven female eighth-grade technology and engineering students answered sixteen questions related to the middle school's technology and engineering courses (See Appendix D). The responses to these questions aided this researcher in understanding the reasons behind the lack of female enrollment in the eighth-grade technology and engineering course at the middle school being studied.

Research Questions

Research questions fall under five broad areas. These include demographic information, attitudes toward technology, impacts of peer intervention, impacts of gender and viewpoints from 8th grade females. The following research questions will guide this study.

Questions regarding peer interventions:

1. Does the use of peer presenters impact students' perceptions of parents' use of technology in the workplace?
2. Do seventh-grade students' attitudes toward technology and engineering education change after completing a seventh-grade design and modeling course?
3. Does a students' gender play a role in students' consideration of technology careers?
4. Do peer presenters play a role in students' consideration of technology careers?
5. Do peer presenters influence students' attitudes toward technology?
6. Do peer interventions influence students' attitudes toward male/female aptitude with technology?

7. Do peer interventions impact students' attitudes toward technology courses in the school curriculum?

Questions regarding gender:

1. Does gender impact students' perceptions of parents' use of technology in the workplace?
2. Does gender play a role in students' consideration of technology careers?
3. Does gender influence students' attitudes toward technology?
4. Does gender influence students' attitudes toward male/female aptitude with technology?
5. Does gender impact students' attitudes toward technology courses in the school curriculum?
6. What do current female 8th grade technology and engineering students view as positive and negative aspects of this middle school's technology and engineering coursework and facilities?

Justification of the Study

This study is justified for five reasons.

The middle school being studied has historically had a proportionally low number of female students enrolling in *Eighth-Grade Technology and Engineering.* The technology and engineering profession needs to keep female students interested, even after they have taken exploratory courses (Childress, 2006). A loss in female enrollment at the middle level will undoubtedly lead to loss of female technology professionals, and result, as researched by Childress, in the decreased economic viability of our nation.

Second, most male students feel that design and technology classes will be useful in their future employment, while only one quarter of female students feel that design and technology classes will be useful to them in their future employment (McCarthy & Moss, 1994). The results of this study will be used to widen the instructor's understanding of female perceptions and understandings in technology and engineering education.

Third, the job market in the United States is becoming exponentially technologically based. According to the Information Technology Association of America there are over 800,000 technical jobs open in America (Sanders, 2000). The U.S. Department of Labor predicts that jobs for engineers and technologists will grow at four times the national average (Shanahan, 2006). By excluding female students from technology and engineering education, we are also excluding any future advancement that may be made because of their work in the field.

A democratic society has the obligation to ensure that all students have the opportunity to succeed and/or fail in a wide range of disciplines (Goodlad, 1994). Students should not be denied their right to an educational opportunity simply because of perceived values that they are not welcome. Many female students view technology and engineering classrooms as dirty environments, and not at all feminine. Technology education classrooms are viewed as a dumping ground for students that do not succeed in regular classrooms. Often female students are intimidated by the remoteness of the technology education facilities or by the comments they receive from male students (Gloeckner & Knowlton, 1995). By evaluating different types of learning activities, this researcher can help create an environment to decrease current stereotypes of technology education.

Finally, this study focuses on the design and modeling unit of seventh-grade technology and engineering. Studies show that female students can be especially excited about courses that focus on design and problem solving (Gloeckner & Knowlton, 1995). Research also shows that female students learn well when the teacher's methods involve cooperation, consensus building, and hands-on opportunities (Childress, 2006).

Limitations of the Study

The limitations of this study are as follows:

1. The population being surveyed is seventh-grade students at a Midwestern suburban middle school. The conclusions that are drawn in this study may not accurately assess the opinions and perceptions of students outside of this school.
2. Participants in this study were students assigned to technology and engineering courses during the third quarter of the 2008 – 2009 school year at the middle school being studied. The students that returned permission slips were the participants of the study.
3. Participants in the study may not complete the survey honestly. Social pressure must be factored into account when evaluating the results.
4. Participants in the study may not fill out the survey completely. A number of factors may affect the completeness of the survey. Students may not completely understand the questions, may not be interested in providing complete answers, or may not see the importance of completing the instrument.
5. The time of day may affect the quality of the responses given on the survey. Factors include amount of sleep students have received and the proximity to breakfast or lunch. School schedules are forcing students to lose sleep and to perform academically when they are at their worst (Hansen, et AL, 2005). Studies show that

higher glucose levels can boost concentration and conversely, low glucose levels can detract from concentration (Sinderbrand, 2002).

6. Data collection procedures were bound by the rules and regulations of the school district where the research occurred. In order to protect student privacy, no data identifying individual students was taken.
7. The sample pool of fifty students is small, and may lead to faulty tests of significance. Items that did not reach statistical significance, but still may be beneficial in an educational setting were indicated.

Assumptions of the Study

This study assumes that:

1. Study participants put forth an honest effort when completing the survey.
2. Students' survey answers were not influenced by forces outside of the technology and engineering curriculum such as parents, guidance counselors, peers, and other teachers.

Definition of Terms

A number of terms are referred to in this study. Their definitions are as follows.

Classroom Climate: The subtle look and feel of the classroom and laboratory, as well as verbal and non-verbal forms of communication between both teacher and students and students and students (Welty & Puck, 2001).

Design and Modeling: An iterative decision-making process that produces plans by which resources are converted into products or systems that meet human needs and wants or solve problems followed by the process of creating three-dimensional representations of design solutions (PLTW, 2004).

Perception: 1. To be aware of, to know, or identify by means of the senses. 2. To recognize, discern, or understand (Nichols, 2000 page 982). In the context of this study, the term "perception" also relates to ones opinions and feelings.

Self: Self is "a person's nature, character, etc." (Nichols, 2000 p. 1192)

Social Fit: Social fit refers to ones ability to find a place within a society.

Technology Education: A study of technology, which provides an opportunity for students to learn about the process and knowledge related to technology that are needed to solve problems and extend human capabilities (ITEA, 2000).

Technology and Engineering Education: The study of engineering systems and technology. The goal of engineering education is to spread technological literacy, increase student interest in technical careers and support science and math education through hands-on learning (Douglas, Iverson, & Kalyandurg, 2004).

Chapter II: Review of Literature

Introduction

"One of the philosophical premises underlying technology education is the concept that technology is a human endeavor that is performed by both males and females" (Welty & Puck, 2001).

Women are poorly represented in technological professions. They represent 46% of the total labor force, but only 22% of the science, technology, and engineering fields. Female participation in science and engineering fields ranges from 40.4% in biological sciences / engineering to 5.1% in mechanical engineering (Sanders, 2000). This disproportion of females to males in technological endeavors can be traced back to gender gaps in education (Sanders, 2000).

The key to increasing female enrollment in technology education courses is not to change the females, but to make the technology education environment a more welcoming place for female students. It is important for female students to feel that they are in an environment with "other people like me" when they enter the technology education classroom or laboratory (Shanahan, 2006).

In order for technology education to attract female students, it must set itself apart from the dirty "men's work" of industrial arts and create a culture that encourages and ensures diversity. One must be critical of one's own technology education program and evaluate what artifacts the program is developing. Is the program developing artifacts that are conducive to female enrollment, or is it perpetuating a stereotypical "shop" (Liedtke, 1995)?

Curriculum that is engaging for males can be intimidating or uninteresting for female students. Females prefer to work in areas that "make a difference." For instance, are students solving the problem of "dropping a bomb from a plane, or are they dropping a care package from a plane" (Shanahan, 2000)? Women tend to view technology as a tool to facilitate cooperation and collaboration, whereas men view technology as a tool to gain control over their physical environment (Welty & Puck, 2001). This is substantiated given that biotechnology is the most gender equitable engineering field – noted earlier as 40.4% female involvement.

Roadblocks in Female Enrollment

Through the research of Welty and Puck (2001), five factors have been identified that stunt female enrollment in technology education courses. They include sense of social fit, classroom climate, curriculum and instruction, role models and mentors, and messages that females receive from guidance counselors.

The fact that there is a high proportion of female students who experience difficulty with technology related subjects may be credited to the way they approach a problem-solving activity. Females tend to focus on the aesthetic virtues of a design or project. Males, conversely, focus on considerations dealing with the manufacturing of a technology or product. Female students tend to look at a process globally, whereas males focus on one step at a time. Ninety-seven percent of technology educators are male (Welty & Puck, 2001). A male teacher may only recognize male learning styles. These differences in learning styles can lead an instructor to view the female students as lacking confidence or proficiency (Ginns, Stein, & McRobbie, 2003).

Female students tend to follow classroom rules or wait their turn to contribute to classroom discussions, whereas male students tent to blurt out answers spontaneously. In a technology education classroom, this attitude can cause female students to be drowned out or intimidated to the point of no longer enrolling in technology education classes. Females are likely to wait their turn for assistance in a laboratory setting, while males aggressively cut in line or shout questions from across the room (Welty & Puck, 2001).

Female students view the technology education classroom environment as dirty and unfeminine (Gloeckner & Knowlton, 1995). The male dominated classroom is a put off for some female students (Childress, 2006). Childress noted that technology education curriculum and facilities are perceived to be based on male interests.

Stereotypes about which career choices are appropriate for women are still abundant in middle and high schools, where there are few female technology education instructors, and few females enrolled in technology education courses. Middle school students lack knowledge of technological careers and are often unaware of what technology education courses are available to them. In some instances, students do not fully know what is meant by the terms technology education and vocational education (Silverman & Prichard, 1993).

The lack of flexibility in course scheduling can represent another hurdle in enticing female participation in technology education. Often "college bound" students have little room in their schedules to enroll in elective courses, or the elective courses that they enroll in are in foreign language or the arts as mandated by college entry requirements (Silverman & Prichard, 1993). Technology education is often viewed as a study outside of the core curriculum. This viewpoint can discourage students from enrolling (Welty & Puck, 2001).

Females tend to shy away from careers in engineering because they see those fields as solitary rather than social careers. To make women more interested in these fields, they need to be made more aware that engineering is a social endeavor that includes working with and helping people (Industrial Engineer, 2005). Females see work in terms of service professions.

They tend to overlook the opportunities that technological fields offer (Silverman & Prichard, 1993).

As noted in the statistics in the introduction to this chapter, females represent a small minority of workers in technological fields. Due to this minority of workers, there is a minority of role models to motivate young females to pursuing a career in technology (Sanders, 2000).

Differences between Male and Female Students

Young males are encouraged to interact with toys that simulate modern technologies – guns, cars, etc. - young females are encouraged to play with toys that represent domestic scenarios – dolls, play kitchens, etc. (Welty & Puck, 2001). Males receive more math and science related toys than females do. Females rate themselves much lower than males in technological ability, and are less likely to use computers outside of school. Female students are five times less likely to consider a career in a technological field (Sadker & Zittleman, 2005).

Technology teachers can counteract this phenomenon by building up a female's self confidence (Flowers, 1998). In order to build up a female's technical confidence, or perceived ability using technology, one must be prepared to first build her technical competence. As students begin to work on a technology exercise, females will often step back, not having the technical competence to know where to begin, while many of the males seem to intuitively know what to do with tools and how to perform processes (Shanahan, 2006). Females view technology education curriculum differently from males, and tend to use problem-solving as a means of helping others (Childress, 2006).

While males jump into a role and compete with each other for the attention and admiration of their peers and the instructor, females prefer to be in a group with others and tend to wait to be invited or encouraged to participate (Shanahan, 2006). "Females learn well when the teacher's methods require cooperation, consensus building, and hands on opportunity" (Childress, 2006). "Adolescent females form very strong social bonds with female peers. They tend to prefer activities that provide them opportunities to work together" (Welty & Puck, 2001 p. 8). The secret to female enrollment is to make the classroom one that the larger group wants to join (Shanahan, 2006).

Possible Solutions

Flowers (1998), a researcher in technology education, mailed a survey to all female members of the International Technology Education Association asking the question, "What should be done to improve the enrollment and retention of females in technology education in secondary schools?" The responses fell into three categories: changing the school, helping students, and improving awareness of technology education (Flowers, 1998). Flowers suggested a movement away from a male bias technology education curriculum by eliminating the "shop" mentality. He also suggested that up-to-date curriculum is more interesting to female students. Design and problem solving curriculum is more appealing to female students when compared with traditional woods and metals-based instruction.

A technology educator should stress the roles that technology plays in everyday life, and make sure that curriculum allows young people to make sense of our technological infrastructure (Welty & Puck, 2001). "Because females connect with their world through social and linguistic interaction, it is important for teachers to understand how their verbal and nonverbal behaviors can create a chilly classroom environment for females" (Welty & Puck 2001 p. 11). The researcher has made it a point to stress the social implications of technology in lessons as well as give both male and female learning styles equal weight in instruction.

Female students may be discouraged from enrolling in technology education courses because they are unfamiliar with the language being used in course descriptions. Female students are especially excited about courses focused on design and problem solving, and course descriptions written to reflect that may entice more female students to enroll (Gloeckner & Knowlton, 1995). The design of curriculum and instruction to deliberately reach out to females is a part of the answer (Childress, 2006). Curriculum re-writing at the middle school has been implemented with these changes in mind.

Some researchers have suggested single-gender classes. Classes targeting only female students may empower those students in ways not possible in mixed-gender classes (Flowers, 1998). These gender specific classrooms can be used to bridge the gap in technological proficiency between male and female students, and lead to a more equitable classroom when the sexes are mixed in later courses (Wood, 2000). Another strategy is to group female students together within mixed gender classes thereby allowing them to support one another's achievements in a safe environment. This grouping allows females to become confident in their use of technology, and will make them more likely to participate with male students in the future (Welty & Puck, 2001).

A lack of female enrollment in high school technology education courses reverts back to a lack of understanding of technology education in middle school. As stated earlier, many middle school students are unsure of the meaning of technology education or vocational education. Middle school tours of high school technology education classrooms and laboratories can lead to a more complete understanding of the field (Silverman & Prichard, 1993). According to Ginns, Stein, & Mc Robbie, (p. 319)

> Prolonged participation in open-ended technology programs or projects, where increasing autonomy is fostered by the teacher, is effective in creating an environment conducive to immersing female students in the knowledge, practices, and culture of technology and may help to ensure that female students are not disadvantaged.

Sadker and Zittleman (2005) suggested a number of strategies to shorten the gender gap apparent in many technology education classrooms and laboratories. First, eliminate teacher bias. "Teachers call on males more often than females, wait longer for males' answers, and provide more precise feedback to males" (Sadker & Zittleman, 2005 p. 29). Secondly, males attribute success to ability and failure to bad luck. Females attribute success to good luck and failure to inability. Technology educators must set high standards for both genders. Third, teachers encourage males to persist with difficult problems, while they give female students the answers. Females should be encouraged to work through problems on their own. Fourth, eliminate stereotypes. Students impose stereotypes upon certain types of academic endeavors. Females tend to avoid technology education classes because of the perception of the class as "boys stuff."

It is important to expose students to female technologists who can act as role models. Seeing successful women in technology-based professions implies to female students that technology is not for males alone (Welty & Puck, 2001).

Summary

A review of literature has shown that the roots of gender inequity in technology education come from a number of different areas. The first is an overall stereotype that technology is a pursuit of men and not women. This view not only discourages female students themselves from pursuing technology education, but also it discourages peers and adults from encouraging female enrollment in technology education.

Male and female students learn differently. Curriculum and methods involved in technology education are geared toward the male student. Ninety-seven percent of technology educators are male (Welty & Puck, 2001). Teachers tend to teach in the way that they learn best. A field dominated by male educators will often best teach toward male students.

Gender equity research specific to technology education has shown the following consistencies:

1. Female role models play a large role in female students' interest in pursuing technology related coursework.
2. Female and male students learn differently.
3. The perception of a dirty classroom environment discourages female enrollment in technology education.
4. Many female students view technology education as a "boys only" endeavor.
5. Activities that are high technology or based in creative problem-solving are more appealing to female students than traditional wood or metal curriculum.

During the 2006 – 2007 school year, technology education curriculum was revised at the middle school being studied. Classes went from a focus on industrial arts to a design and problem solving focus. The new technology and engineering curriculum is designed to attract both male and female students.

Chapter III: Methodology

Introduction

This chapter includes an outline of sample selection, instrumentation, research procedures, and data analysis.

Sample Selection

This study was conducted during the fourth quarter of the 2008-2009 school year at a suburban middle school in southeastern Wisconsin. It consisted of a quantitative portion and a qualitative portion.

The subjects in the quantitative portion of this study were seventh-grade students enrolled in "Seventh-grade Gateway to Technology and Engineering." Seventy-seven fourth-quarter, *Seventh-Grade Gateway to Technology and Engineering* students, were asked to volunteer in this study and their parents were contacted for permission. Appendix A provides an example of the parent permission letter. Fourth quarter students represented twenty-five percent of the total population of seventh-grade students at the middle school. Fifty students returned permission slips and participated in the study which represented sixteen percent of the total seventh-grade population. *Seventh-grade Gateway to Technology and Engineering* is a required course, and students are placed into sections based on the district's class scheduling processes. Fourth-quarter seventh-grade students were divided into three sections: section one serving as a control group, section five which had a female peer-presenter come to speak, and section six which had a male peer-presenter come to speak. Seven male students and ten female students participated in the study in section one, nine male students and ten female students participated in section five, and six male and eight female students participated in section six.

The thirteen students asked to participate in the qualitative portion of the study were eighth-grade female students enrolled in the elective *Eighth-grade Technology and Engineering* course. This part of the study focused on their views of the technology and engineering course and their views on *Eighth-grade Technology and Engineering* facilities. These students were asked to volunteer in this study because they had enrolled in an elective technology and engineering course. Appendix B provides an example of the letter to parents of the potential participants' asking for permission for their daughters' participation. Eleven of the thirteen students returned their permission slips and participated in the study. This researcher hoped to gain eighth-grade females' opinion on technology and engineering curriculum and facilities at the middle school being studied.

Instrumentation

The instrument used in the quantitative portion of this study, a *Seventh-grade Technology and Engineering Survey,* was adapted from the Pupils' Attitude Towards Technology (PATT) USA Instrument developed by Dr. Allen Bame, Associate Professor of Technology Education at Virginia Tech; Dr Marc de Vries, Professor at Eindhoven University in the Netherlands, and Dr. William E. Dugger, Jr., Professor of Technology Education at Virginia Tech as a guide. The researcher obtained the 100 question PATT instrument from the International Technology Education Association website (http://www.iteaconnect.org/Conference/PATT/PATTSI/PATTSurveyInstrument.pdf). The PATT instrument was chosen because it was designed for middle level students, and it has been validated within the United States. Twenty eight survey items were taken directly from the PATT, while six others were developed to meet the specific needs of this study. Survey questions one through twenty-nine deal with students' experiences with and attitudes toward technology and are direct references to the PATT instrument. Survey questions thirty through thirty-four deal with technology and engineering enrollment at the middle school and are original. Appendix C provides an example of the revised survey titled *Seventh-grade Technology and Engineering Survey* used in this study. Questions thirty through thirty-four in the revised survey, developed by the researcher, were used to obtain information about students' feelings specific to the middle school being studied.

Procedures

The *Seventh-grade Technology and Engineering Survey* was administered on two occasions to three separate course sections of seventh-grade students by the researcher during the fourth quarter of the 2008-2009 school year. The pre-course *"Seventh-grade Technology and Engineering Survey"* survey was first administered on the fifth day of the fourth quarter before instruction in design and modeling had occurred. The design and modeling course was taught to all three sections of seventh-graders. Section one had no special treatment, and acted as a control group. During the eighth week of the quarter, peer-presenters spoke to the two seventh-grade treatment groups. Section five received a fifteen minute presentation about eighth-grade technology and engineering by three female eighth-grade technology and engineering students and is referred to as the female presenter (FP) group. Section six received a fifteen minute presentation about eighth-grade technology and engineering from three male eighth-grade technology and engineering students and is referred to as the male presenter (MP) group. The student presenters showed the same Power Point presentation about their latest design and modeling project to the fifth and sixth hour classes. After the presentation, students in the seventh-grade classes were given an opportunity to ask questions. A second identical modified "Seventh-grade Technology and Engineering Survey" was administered to the three seventh-grade sections two days before the end of the quarter to all three sections to obtain post-course survey data.

The qualitative portion of this research was completed during lunch hour in the sixth week of the fourth quarter. All eleven eighth-grade female students met with the researcher in the technology and engineering laboratory. The thirty foot by forty foot laboratory was quiet and empty, although class was being conducted in the adjoining classroom. The group met around a large rectangular table, which held all eleven participants as well as the researcher so participants and the researcher could see each other. The group was asked a question by the researcher, and after discussion, each student was given a chance to individually add an opinion. Appendix D contains focus group questions.

Data Analysis

Data was analyzed using the computerized statistics program "The Statistical Program for Social Sciences" (SPSS) version 16. Data concerning seventh-grade students' attitudes toward technology and engineering was compiled using an analysis of variance test (ANOVA). Data concerning the differences between male and female opinions on technology and engineering was assessed using a t-test. Focus group data was analyzed qualitatively by the researcher and will be presented in narrative form.

Limitations of the Study

There are several limitations to this study. This study was conducted at only one school. The results of this study may not apply to other technology and engineering programs. The sample pool of fifty students is small, and may lead to faulty tests of significance.

Chapter IV: Results

Introduction

Chapter four discusses the demographic information pertaining to this study's participants and addresses the research questions posed.

Demographic Information

Fifty seventh-grade students participated in this study. Twenty-two male students and twenty eight female students chose to participate. The participants represent sixty-five percent of the sample and sixteen percent of the total seventh-grade population.

The seventh-grade study participants completing the *Seventh-grade Technology and Engineering Survey* came from three different class periods. Period one was the control group, and included ten females, and seven males. Period five was one treatment group and it received a presentation by eighth-grade female peer-presenters. It will be referred to as the FP (female presenters) group throughout this study. This class period had a sample of ten female students and nine male students. Sixth period was the second treatment group and it received a presentation by eighth-grade male student presenters. It will be referred to as the MP (male presenters) group throughout this study. This class period contained eight female students and six male students.

Responses to Research Questions

Demographic. Three survey questions were used to determine if male and female students had similar experiences with technology. They were:

5. Do you play with technical toys like Tinkertoys, Erector set, or Lego at home?
6. Is there a technical workshop at your home?
7. Do you have brothers or sisters that are interested in technology?

Survey question five asks, “Do you play with technical toys like Tinkertoys, Erector set, or LEGO at home?” Seventeen female students answered no (61%), they do not play with technical toys, while eleven answered yes (39%), they do play with technical toys. Eight male students answered no (37%), they do not play with technical toys, while fourteen male students answered yes (63%), they do play with technical toys. A Pearson Chi-square test returned a value of 2.922, and resulted in non-statistically significant data (2 sided asymp. Significance =.87). There is an 87% probability that a similar number of males and females play with technical toys

Survey question six asked students, “Is there a technical workshop at your home?” Eight female students answered no (28%), that there is no technical workshop in their home, and twenty answered yes (72%), there is a technical workshop in their home. Thirteen male students stated that there is no (59%), technical workshop at their home, and nine stated that there is a workshop at their home (31%). The Pearson Chi-square test returned a value of 4.711 and resulted in a statistically significant difference between groups (asymp. Significance = .03). There is a 97% probability that more female students have a technical workshop at their home than their male counterparts.

Survey question seven asked students, “do you have brothers or sisters that are interested in technology?” Nineteen female students stated that they have a sibling that is interested in technology (67%), and nine female students stated that they do not have a sibling who is interested in technology (33%). Thirteen male students stated that they have a sibling who is interested in technology (59%), and nine male students indicated that they do not have a sibling that is interested in technology (41%). A Pearson chi square test returned a value of .411 and did not result in a statistically significant difference (asymp. significance = .522).

Perceptions of parent's use of technology. Two questions were asked at the beginning of the *Seventh-grade Technology and Engineering Survey* during both pre-course and post-course conditions to determine if students' perceptions of parents' use of technology in the workplace changed after exposure to peer presentations in the classroom. The survey questions addressing the first research question asked:

2. If your mother has a job, how much does it have to do with technology?
3. If your father has a job, how much does it have to do with technology?

Question number two asks study participants to describe to what degree their mother's job involved technology. Students were able to rate this item on a four-point scale with 1= nothing at the low end, 2 = little, 3 = much, and 4=very much. Results for student responses are shown in Table 1.

Table 1. *How much mother's job is tied to technology, by group*

Group	Number	Mean	Std. Deviation	95% Confidence Int. Lower	Upper
Control-pre	17	2.47	0.94	1.99	2.96
Control-post	17	2.54	0.87	2.08	2.98
FP-pre	19	2.21	1.08	1.69	2.73
FP-post	19	2.89	1.2	2.32	3.47
MP-pre	14	2.43	0.85	1.94	2.92
MP-post	14	2.79	1.05	2.18	3.39
Comb. Pre	50	2.36	0.96	2.09	2.63
Comb. Post	50	2.74	1.05	2.44	3.04

N = 50

In the control group, participants' mean score for their mother's job being tied to technology increased from pre-course to post-course while the standard deviation decreased. The lower limit for the 95% confidence interval increased from pre-course to post-course by .07 points while the upper limit remained relatively constant. The standard deviation between pre-course and post-course responses increased for the female-peer and male-peer group. It should also be noted that scores in the lower bound for a 95% confidence interval in the female-peer group increased by 0.62 points and in the group with the male-peer intervention it increased by 0.24 points from pre-course to post-course. The upper bound for a 95% confidence interval in the female-peer group increased by 0.74 points and in the male-peer group increased by 0.47 points from pre-course to post-course. It can be noted that an increase of 0.74 points is quite large due to the fact that student responses are being measured on a scale of one to four. Students scored how much their mother's job was tied to technology higher after they completed the seventh-grade technology and engineering course than they did prior to completing the course. Although students exposed to peer presentations increased at a higher rate, students exposed to the female-peer intervention showed the greatest increase in both the upper limit and lower limit mean score. The lower limit increased 0.63 points and the upper limit increased 0.74 points. Students in the control group showed a minimal increase.

Question number three asks students how much their father's job deals with technology. Results for student responses are shown in Table 2. Pre-course to post-course standard deviation for the control group decreases 0.32 points. The range of the confidence interval decreases as the lower limit of the 95% confidence interval increases 0.22 points, while the upper limit decreases 0.11 points. The female-peer group shows a decrease in standard deviation from pre-course to post-course of 0.25, while the lower interval of the 95% confidence interval increases 0.7 points, and the upper limit increases 0.46 points. The male-peer group shows a minimal increase in standard deviation from pre-course to post-course of 0.03 points. The 95% confidence interval's lower bound increases by 0.41 points and the upper bound increases by 0.45 points. The mean score for all student responses indicating how much a father's job deals with technology increased from pre-course to post-course. Control group mean increased .06 points from 3.12 points to 3.18 points. The female-peer group's mean increased 0.58 points from 3.05 to 3.63. The male-peer group's mean increased .43 points from 3.07 to 3.5.

Table 2. *How much a father's job is tied to technology, by group*

Group	Number	Mean	Std. Deviation	95% Confidence Int. Lower	Upper
Control-pre	17	3.12	1.05	2.58	3.66
Control-post	17	3.18	.73	2.8	3.55
FP-pre	19	3.05	.85	2.64	3.46
FP-post	19	3.63	.6	3.34	3.92
MP-pre	14	3.07	.73	2.65	3.49
MP-post	14	3.5	.76	3.06	3.94
Comb. Pre	50	3.08	.88	2.83	3.33
Comb. Post	50	3.44	.71	3.24	3.64

N=50

Attitudes toward technology and engineering courses. The second study question examines students' attitudes toward technology and engineering education courses relative to their experiences in class. It asks, "Do seventh-grade students' attitudes toward technology and engineering education change after completing a seventh-grade design and modeling course"?

Questions number four, thirty-three and thirty-four of the "Seventh-grade Technology and Engineering Survey" examines the likelihood that students will continue to take technology courses.

Survey question number four asks students if they were excited to participate in technology and engineering class. The results of the student surveys are shown in Table 3. The mean of the control group decreased .24 points from pre-course to post-course, the standard deviation increased .28 points. The control group's upper bound of the 95% confidence interval showed a modest decrease of .1 point, where the lower bound showed a larger decrease of .37

points. The female-peer group shows a decrease in mean of .27 points from pre-course to post-course while the standard deviation increases .06 points. The female-peer group's 95% confidence interval's lower bound decreases by .29 points and the upper bound decreases by .24 points from pre-course to post-course. The male-peer group shows a .42 point decrease in mean from pre-course to post-course as well as a .3 point increase in standard deviation. The lower limit of the 95% confidence ratio decreased .07 points while the upper limit increased .45 points from pre-course to post-course. Each group showed a decreasing mean from pre-course to post-course that they were excited to participate in technology and engineering class. The male-peer group showed the largest decrease in mean, .43 points; the female-peer group showed the second largest decrease in mean, .27 points; and the control group showed the smallest decrease in mean, .24 points. All sections also showed an increase in standard deviation. The male-peer group's standard deviation increased .3 points, the control group's standard deviation increased .28 points, and the female-peer group's increased .05 points.

Table 3. *Excitement to participate in technology and engineering, by group*

				95% Confidence Int.	
Group	Number	Mean	Std. Deviation	Lower	Upper
Control-pre	17	3.24	.66	2.89	3.58
Control-post	17	3	.94	2.52	3.48
FP-pre	19	3.74	.56	3.47	4.01
FP-post	19	3.47	.61	3.18	3.77
MP-pre	14	3.57	.65	2.65	3.49
MP-post	14	3.14	.95	2.59	3.94
Comb. Pre	50	3.52	.65	3.34	3.7
Comb. Post	50	3.20	.84	2.98	3.46

N = 50

Table four describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions.

Pre-course "Seventh-grade Technology and Engineering Survey" data indicates that all groups agree with the statement that technology and engineering seems like an exciting eighth-grade elective. The male-peer group has the highest mean score at 4.64, the female-peer group has a mean score of 4.11, and the control group has the lowest mean score at 4.00. Pre-course data did not show any statistically significant differences (F test 1.59; Sig. = 0.22) between groups.

Table 4. *Technology and engineering as an exciting eighth-grade elective, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	4	1.37	3.3	4.7	CvsF-.11
19	FP	4.11	.99	3.63	4.58	CvsM-.64
14	MP	4.64	.63	4.28	5.01	FvsM-.53
		F test 1.59	Sig. = 0.22			
Post-course						
17	Ctrl	3.65	1.12	3.07	4.22	CvsF-.63
19	FP	4.28	1.02	3.77	4.78	CvsM-.49
14	MP	4.14	1.23	3.43	4.85	FvsM .14
		F test 1.59	Sig. = 0.23			

N = 50

DF:		
	Between groups	2
	Within group	47
	Total	49

Post-course survey data also indicated that all groups feel that eighth-grade technology and engineering seems like an exciting elective. The female-peer group had the highest mean score at 4.28, the male-peer group had a mean score of 4.14, and the control group had the lowest mean score at 3.65. Post-course "Seventh-grade Technology and Engineering Survey" data showed no statistical significance (F test 1.59 Sig. = .23). Peer presentations did not impact students' decisions to enroll in an eighth-grade technology course at a level reaching statistical significance.

Table five describes male and female students responses to survey question thirty-three, "Technology and engineering seems like an exciting eighth-grade elective," for the pre-course and the post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course "Seventh-grade Technology and Engineering Survey". There was no statistically significant difference in scores for females (M =3.79, SD=1.13) and males [M=4.44, SD=0.69; t(48)=-3.6, p=0.00]. The effect size is large, as 21.1% of the variance in the responses to the statement, "Technology and engineering seems like an exciting eighth-grade elective" is explained by gender in the pre-course survey.

Table 5.*Technology and engineering as an exciting elective, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	3.79	1.13	-3.59
22	male	4.44	.69	
	DF = 45.34	Significance (2-tailed) = 0.00		
Post-course				
28	female	3.57	1.14	-3.59
22	male	4.62	.81	
	DF = 47	Significance (2-tailed) = 0.00		

N=50

An independent samples t-test was also used to compare scores for males and females on the post-course "Seventh-grade Technology and Engineering Survey". There was a statistically significant difference in scores for females (M=3.57, SD=1.14) and males [M=4.62, SD=0.81; t(48)=-3.6, p=0.00]. The effect size is large, as 21.1% of the variance in the post-course statement "Technology and engineering seems like an exciting eighth-grade elective," is explained by gender.

Table six describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions. Pre-course data indicates that all groups agree with the statement that they will enroll in eighth-grade technology and engineering. The male-peer group has the highest mean score at 3.79, and the control group has the lowest mean score at 3.12. The female-peer group's mean score is 3.26.

Table 6. *I will enroll in eighth-grade technology and engineering, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	3.12	1.41	2.39	3.84	CvsF-.14
19	FP	3.26	1.66	2.46	4.06	CvsM-.67
14	MP	3.79	1.37	3	4.58	FvsM-.53
		F test 0.83	Sig. = 0.45			
Post-course						
17	Ctrl	3.35	1.37	2.65	4.06	CvsF-.32
19	FP	3.67	1.28	3.03	4.3	CvsM-.15
14	MP	3.5	1.23	3.14	4.21	FvsM .17
		F test 0.26	Sig. = 0.78			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

Pre-course data does not show any statistically significant (F test 0.83; Sig. = 0.45) differences.

Post-course data also indicates that all groups agree with the statement that they will enroll in eighth-grade technology and engineering. The female-peer group has the highest mean score at 3.67, and the control group has the lowest mean score at 3.35. The male-peer group's mean score is 3.5. Post-course data shows no statistically significant (F test 0.26; Sig. = 0.78) differences between the control group, the male-peer group, and the female-peer group. Gender did not impact students' decision to enroll in eighth-grade technology courses at a statistically significant level.

Table seven shows student responses to survey statement thirty-four, "I will enroll in eighth-grade technology and engineering," for the pre-course and the post-course surveys.

Table 7. *I will enroll in eighth-grade technology and engineering, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	2.86	1.35	-2.88
22	male	4	1.45	
	DF = 48	Significance (2-tailed) = .01		
Post-course				
28	female	3.07	1.18	-3.00
22	male	4.1	1.18	
	DF = 47	Significance (2-tailed) = 0.00		

N=50

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was a statistically significant difference in scores for females (M

=2.86, SD=1.35) and males [M=4.00, SD=1.45; t(48)=-2.88, p=0.01]. The effect size is large, as 14.7% of the variance in the responses to the statement, "I will enroll in eighth-grade technology and engineering," is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was a statistically significant difference in scores for females (M=3.07, SD=1.18) and males [M=4.10, SD=1.18; t(48)=-3.00, p=0.00]. The effect size is large, as 15.7% of the variance in the post-course statement "I will enroll in eighth-grade technology and engineering," is explained by gender.

Research question three explores whether student gender plays a role in students' consideration of technology careers? Question eight of the "Seventh-grade Technology and Engineering Survey" asks, "Would you consider a job in technology when you grow up?" Results sorted by gender, are shown in Table 8. Four male students in the pre-course survey indicated that they would not consider a job in a technical field (18%), while eighteen males indicated that they would consider a job in a technical field (82%). Pre-course data indicates that fifteen female students would not consider a job in a technology field (53%), while thirteen females would consider a job in a technology field (47%). There is a statistically significant difference (asymp. Significance =.010) between the number of male participants considering a job in technology and the number of female participants that would consider a job in technology when completing the pre-course survey.

Post-course data shows that all twenty two male students would consider a job in a technology field (100%). Data also shows an increase in the number of females who would consider a job in technology to seventeen (60%), and a decrease in the number of females who would not consider a job in a technical field to eleven (40%). Post-course data is statistically significant (asymp. Significance =.01). A Pearson Chi square returned a value of 11.081, indicating that males would more likely consider a job in technology than would females when completing the post-course survey. In both cases, males are more likely to consider a job in technology than females at a rate that is statistically significant.

Table 8. *Consideration of a job in a technology field, by gender*

Group	No	Yes	Pearson Chi-Square	Asymp. Sig.
Pre-course				
Male	4	18		
Female	15	13		
Total	19	31	6.549	.010
Post-course				
Male	0	22		
Female	11	17		
Total	11	39	11.081	.001

N = 50

Research question four explores whether peer presenters play a role in students' consideration of technology careers? Data pertaining to the result of survey question number eight, "Would you consider a job in technology when you grow up," sorted by section, is shown in Table 9. Pre-course control group data shows seven students who would not consider a job in technology (41%), and ten students who would consider a job in technology (59%). Pre-course data for the group with the female peer intervention shows seven students who would not consider a job in technology (37%), and twelve students who would consider a job in technology (63%). The pre-course for the group with the male peer intervention shows that nine students would consider a job in technology (64%), and five would not (36%). The asymptotic significance (.944) indicates that over 94% of the responses are due to chance and there is not a difference between the three groups at the beginning of the course.

For the control group, post-course data is similar to pre-course data indicating that eight students would not consider a job in technology (47%), and nine students would consider a job in technology (53%). The female-peer group's post-course data shows an increase in students who would consider a job in technology from twelve of nineteen (63%) in pre-course data to seventeen of nineteen (89%) in post-course data. The male-peer group also shows an increase in the number of students who would consider a job in technology from pre-course to post-course data. Post-course data shows that thirteen students would consider a job in a technology field (93%), and only one would not (7%). Statistically significant post-course Pearson Chi-square data returns a result of 9.479 with only 0.9% of the difference due to chance. This is a statistically significant difference between the groups. Students exposed to either male or female peer interventions were more likely to indicate they would consider a technology-related career at a higher rate than students that did not have any peer interventions.

Table 9. *Consideration of a job in a technology field, by group*

Group	No	Yes	Pearson Chi-Square	Asymp. Sig.
Pre-course				
Control	7	10		
Female-peer	7	12		
Male-peer	5	9		
Total	19	31	.115	.944
Post-course				
Control	8	9		
Female-peer	2	17		
Male-peer	1	13		
Total	11	39	9.479	.009

N = 50

Responses when given peer-presentations. Research question number five investigates if peer presenters influence students' attitudes toward technology? Seventh-grade students' attitudes toward technology were assessed using the following survey statements:

11. Technology makes peoples' lives better.

12. You have to be smart to study technology.

17. The world would be a better place without technology.

18. You need to be good at math and science to study technology.

19. I think machines are boring

21. You have to use tools to study technology.

22. Working with your hands is part of technology.

23. Design is an important part of technology.

24. When I think of technology I mainly think of woodworking.

25. Using different materials is an important part of technology.

26. Technology is found only in industry.

27. Technology helps people more often than it hurts them.

Survey participants evaluated the above items using a five point Likert scale in which five represented agreement, four represented tending to agree, three represented neutrality, two represented tending to disagree, and one represented disagreement.

Table ten describes two different analyses of variance (ANOVA) between the control group, female-peer group, and male-peer group at the pre-course and post-course conditions for survey question eleven. All groups indicated that that technology made peoples' lives better. The control group's mean score for technology making people's lives better was the lowest at 4.06 while the female-peer group's mean score for making people's lives better was the highest at 4.36. The male-peer group's mean score for technology making people's lives better was 4.36. There was not a statistically significant difference (F test 1.74; Sig. = 0.19) between the control group, female-peer group and male-peer group attitude's related to technology making people's lives better in the pre-course survey.

Table 10. *Technology makes peoples' lives better, by group*

Number	Hour	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	4.06	.83	3.63	4.48	CvsF -.47
19	FP	4.53	.61	4.23	4.82	CvsM -.3
14	MP	4.36	.84	3.87	4.84	FvsM .17
		F test 1.74	Sig. = 0.19			
Post-course						
17	Ctrl	4.18	.81	3.76	4.59	CvsF -.14
19	FP	4.32	.82	3.92	4.71	CvsM -.25
14	MP	4.43	1.02	3.84	5.00	FvsM -.11
		F test 0.32	Sig. = 0.73			

N = 50

DF:		
	Between groups	2
	Within group	47
	Total	49

When the post-course survey was administered all groups indicated that that technology made peoples' lives better. The control group's mean score for technology making people's lives better was the lowest at 4.18 while the male-peer group's mean score for making people's lives better was the highest at 4.43. The female-peer group's mean score for technology making people's lives better was 4.32. There was not a statistically significant difference (F test 0.32;

Sig. = 0.73) between the control group, female-peer group and male-peer group attitude's related to technology making people's lives better in the pre-course survey

Table eleven describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question twelve. All pre-course groups indicated tended to disagree that you have to be smart to study technology. The male-peer group disagreed with that you have to be smart to study technology the most at 2.43, while the control group disagreed with the statement the least at 2.82. The female-peer group's mean score was 2.79. There was not a statistically significant difference (F test 0.49; Sig. = 0.19) between the control group, the female-peer group, and the male-peer group in pre-course "Seventh-grade Technology and Engineering Survey" data.

Table 11. *You have to be smart to study technology, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	2.82	1.29	2.16	3.48	CvsF .03
19	FP	2.79	.92	2.35	3.23	CvsM .39
14	MP	2.43	1.2	1.59	3.27	FvsM-.28
		F test 0.49	Sig. = 0.62			
Post-course						
17	Ctrl	2.65	1.22	2.02	3.28	CvsF -.46
19	FP	3.11	1.2	2.53	3.68	CvsM -.28
14	MP	2.93	1.27	2.2	3.66	FvsM .18
		F test 0.63	Sig. = 0.54			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

When the post-course "Seventh-grade Technology and Engineering Survey" was administered, the control group and the male-peer group both disagreed with the statement that one has to be smart to study technology. The control groups mean score was 2.82, while the male-peer group's score was 2.93. The female peer group showed a neutral opinion as to whether or not one has to be smart to study technology with a mean score of 3.11. Post-course "Seventh-grade Technology and Engineering Survey" data showed no statistical difference (F test 0.63; Sig. = 0.19) between the control group, male-peer group, and female-peer group.

Table twelve describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question seventeen.

Table 12. *The world would be a better place without technology, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	1.53	.87	1.08	1.98	CvsF .06
19	FP	1.47	.77	1.1	1.85	CvsM .1
14	MP	1.43	.65	1.06	1.8	FvsM .04
		F test 0.07	Sig. = 0.94			
Post-course						
17	Ctrl	1.76	.9	1.3	2.23	CvsF .13
19	FP	1.63	.83	1.23	2.03	CvsM .19
14	MP	1.57	.85	1.08	1.9	FvsM .06
		F test 0.21	Sig. = 0.81			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

Pre-course survey data indicates that all groups indicated that they did not believe that the world would be a better place without technology. The male-peer group disagreed with the statement the most with a mean score of 1.43, the female-peer group showed a mean score of 1.47, and the control group showed a mean score of 1.53. There was not a statistically significant difference (F test 0.07; Sig. = 0.94) between the pre-course groups.

Post-course data shows all groups in disagreement with the statement that the world would be a better place without technology. The male-peer group disagrees with the statement most strongly with a mean score of 1.57, the female peer group shows a mean score of 1.63, and the control group shows a mean score of 1.76. Post-course data does not show a statistically significant difference (F test 0.21 Sig. 0.81) in group responses.

Table thirteen describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question eighteen. The pre-course data shows that the control group and the female-peer group stated that they were neutral in their opinions that one had to good at math and science to study technology. The control group's mean score was 3.24 and the female-peer group's mean score was 3.37. The male-peer group tended to disagree with the statement that one has to be good at math and science to study technology, and showed a mean score of 2.79. Pre-course "Seventh-grade Technology and Engineering Survey" data shows no statistically significant difference (F test 1.42; Sig. = 0.25) between groups.

Post-course "Seventh-grade Technology and Engineering Survey" responses show all groups neutral in the opinion that one has to be good at math and science to study technology. The control group agrees with the statement the most showing a mean score of 3.41, and the female-peer group disagreeing with the statement the most, showing a mean score of 3.21. The male-peer group's mean score was 3.36. There is not a statistically significant difference (F test 0.13; Sig. 0.88) between the control group, the male-peer group, and the female-peer group in post-course "Seventh-grade Technology and Engineering Survey" data.

Table 13. *You need to be good at math and science to study technology, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	3.24	1.3	2.57	3.9	CvsF -.13
19	FP	3.37	.76	3	3.74	CvsM .45
14	MP	2.79	.89	2.27	3.3	FvsM .58
		F test 1.42	Sig. = 0.25			
Post-course						
17	Ctrl	3.41	1	2.57	3.9	CvsF .2
19	FP	3.21	1.36	3	3.74	CvsM .05
14	MP	3.36	1.34	2.27	3.3	FvsM -.15
		F test 0.13	Sig. = 0.88			

N = 50

DF:		
	Between groups	2
	Within group	47
	Total	49

Table fourteen describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question 19. The pre-course survey indicates all three groups showed disagreement with the statement that machines are boring. The control group disagreed with the statement the most showing a mean score of 1.59. The male-peer group disagreed with the statement the least with a mean score of 1.64. The female peer group's mean score was 1.63. Pre-course data shows no statistical significance (F test 0.02 Sig; 0.98) between groups.

Table 14. *I think that machines are boring, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	1.59	.71	1.22	1.95	CvsF -.04
19	FP	1.63	.96	1.17	2.09	CvsM -.05
14	MP	1.64	.93	1.11	2.18	FvsM -.01
		F test 0.02	Sig. = 0.98			
Post-course						
17	Ctrl	1.94	1.14	1.35	2.53	CvsF .57
19	FP	1.37	.5	1.13	1.61	CvsM .01
14	MP	1.93	1.14	1.27	2.59	FvsM -.56
		F test 2.11	Sig. = 0.13			

N = 50

DF:		
	Between groups	2
	Within group	47
	Total	49

Post-course data also shows all three groups in disagreement with the statement that machines are boring. The female-peer group disagrees with the statement the most with a mean score of 1.37, and the control group disagrees with the statement the least with a mean score of 1.94. The male-peer group has a mean score of 1.93. The difference between the male-peer, female-peer, and control group shows no statistical significance (F test 0.02; Sig. = 0.98).

Table fifteen describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question 21. In pre-course survey data, all groups were relatively neutral in the belief that you have to use tools to study technology. The control group's mean score was the highest at 3.29, and the female-peer group's mean score was the lowest at 3.05. The male-peer group's mean score for one having to use tools to study technology was 3.06. There was not a statistically significant difference (F test 0.72; Sig. = 0.49) between the control group, the female-peer group, and the male-peer group.

Table 15. *You have to use tools to study technology, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	3.29	1.31	2.62	3.97	CvsF .24
19	FP	3.05	1.08	2.53	3.57	CvsM .23
14	MP	3.06	1.12	2.14	3.43	FvsM-.01
		F test 0.72	Sig. = 0.49			
Post-course						
17	Ctrl	3.41	1.06	2.86	3.96	CvsF-.12
19	FP	3.53	1.12	2.98	4.07	CvsM-.23
14	MP	3.64	1.08	3.02	4.27	FvsM-.11
		F test 0.17	Sig. = 0.84			

N = 50

DF:		
	Between groups	2
	Within group	47
	Total	49

When the post-course survey was administered, the female-peer group had the highest mean score for one having to use tools to study technology with 3.64. The male-peer group had a mean score of 3.53 and the control group had a mean score of 3.41. There was not a statistically significant difference (F test 0.17; Sig. = 0.84) between the control group, the male-peer group, and the female-peer group.

Table sixteen describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question 22. All groups indicated that working with one's hands is a part of technology. The control group's mean score was the highest at 4.41, followed by the male-peer group with a mean score of 4.21, and then the female-peer group with a mean score of 4.16. Pre-course data shows no statistical significance (F test 0.72; Sig. = 0.7) between groups.

Table 16.*Working with your hands is part of technology, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	4.41	0.71	4.05	4.78	CvsF .25
19	FP	4.16	0.27	3.6	4.72	CvsM .2
14	MP	4.21	0.21	3.75	4.68	FvsM-.05
		F test 0.36	Sig. = 0.7			
Post-course						
17	Ctrl	4.24	0.83	3.81	4.66	CvsF .08
19	FP	4.16	1.12	3.62	4.7	CvsM-.19
14	MP	4.43	0.85	3.94	7.92	FvsM-.27
		F test 0.33	Sig. = 0.72			

N = 50

DF:		
	Between groups	2
	Within group	47
	Total	49

Post-course data also shows all groups indicating that working with one's hands is a part of technology. The male-peer group's mean score was the highest at 4.43, and the control group's mean score was next at 4.24. The female-peer group had the lowest mean score at 4.16. Post-course data shows no statistical significance (F test 0.33; Sig. = 0.72) between groups.

Table seventeen describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question twenty three. After the pre-course survey was administered all three groups showed agreement that design is an important part of technology. The pre-course female-peer group showed the highest mean score at 4.84. The male-peer group showed the next highest mean score at 4.57, and the control group showed the lowest mean score at 4.43. Pre-course data shows no statistical significance (F test 0.92; Sig. = 0.4) between groups.

Table 17. *Design is an important part of technology, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	4.43	1.01	4.01	5.05	CvsF-.41
19	FP	4.84	.5	4.6	5.08	CvsM-.14
14	MP	4.57	.65	4.2	4.94	FvsM .27
		F test 0.92	Sig. = 0.4			
Post-course						
17	Ctrl	4.18	1.33	3.49	4.86	CvsF-.45
19	FP	4.63	0.96	4.17	5.09	CvsM-.39
14	MP	4.57	0.76	4.13	5.01	FvsM .06
		F test 0.94	Sig. = 0.4			

N = 50

DF:		
	Between groups	2
	Within group	47
	Total	49

Post-course data shows all three groups in agreement that design is an important part of technology. The female-peer group has the highest mean score at 4.63. The male-peer group has a mean a score of 4.57, and the control group has the lowest mean score at 4.18. The difference between the post-course male-peer group, female-peer group, and control group shows no statistical significance (F test 0.94; Sig. =0.4).

Table eighteen describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question 24. All pre-course groups showed slight disagreement with the statement that when one thinks of technology one mainly thinks of woodworking. Both the control group and the male-peer group showed the highest pre-course mean scores at 2.71. The female-peer group showed the lowest pre-course mean score at 2.32. Pre-course data shows no statistical significance (F test 0.71; Sig. = 0.5) between groups. Post-course groups also showed disagreement with the statement that when one thinks of technology one mainly thinks of woodworking.

Table 18. *When I think of technology I mainly think of woodworking, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	2.71	1.21	2.08	3.33	CvsF .39
19	FP	2.32	1.16	1.76	2.87	CvsM 0
14	MP	2.71	.99	2.14	3.29	FvsM -.39
		F test 0.71	Sig. = 0.5			
Post-course						
17	Ctrl	2.88	1.17	2.28	3.48	CvsF .41
19	FP	2.47	1.12	1.93	3.02	CvsM .17
14	MP	2.71	1.27	1.98	3.45	FvsM-.24
		F test 0.55	Sig. = 0.58			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

The post-course control group has the highest mean score at 2.81. The male peer group had a mean score of 2.71, and the female peer group had the lowest mean score at 2.47. The difference between the male-peer, female-peer, and control group shows no statistical significance (F test 0.55; Sig. = 0.58).

Table nineteen describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question twenty five. After pre-course survey administration, all three groups agreed that using different materials is an important part of technology. The control group showed the highest mean score at 4.65 while the male-peer group showed the lowest mean score at 3.86. The female-peer group's mean score was 4.42.

Table 19. *Using different materials is an important part of technology, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	4.65	0.49	4.39	4.9	CvsF .23
19	FP	4.42	0.61	4.13	4.71	CvsM .79
14	MP	3.86	0.77	3.41	4.3	FvsM .56
		F test 6.44	Sig. = 0.00			
Post-course						
17	Ctrl	4	1.17	3.4	4.6	CvsF-.42
19	FP	4.42	.96	3.96	4.88	CvsM-.36
14	MP	4.36	1.01	3.78	4.94	FvsM .06
		F test 0.80	Sig. = 0.45			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

Pre-course survey data shows a statistically significant difference (F test 6.44; Sig. = 0.00). Tukey's test shows a statistical difference in pre-course data between sections one and six, and sections five and six. The statistical difference between sections one and six is 0.00, and the statistical difference between sections five and six is 0.04.

Post-course data shows the following. The female-peer group shows the highest mean score at 4.42, while the control group shows the lowest mean score at 4.00. The male-peer group's mean score is 4.36. Post-course data shows no statistical significance (F test 0.80; Sig. = 0.45) between groups.

Table twenty describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question 26.

Table 20. *Technology is found only in industry, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	2.47	1.23	1.84	3.1	CvsF .73
19	FP	1.74	.87	1.32	2.16	CvsM .04
14	MP	2.43	1.28	1.69	3.17	FvsM-.69
		F test 2.39	Sig. = 0.1			
Post-course						
17	Ctrl	2.53	1.01	2.01	3.05	CvsF .42
19	FP	2.11	.99	1.63	2.58	CvsM .39
14	MP	2.14	1.1	1.51	2.78	FvsM -.03
		F test 0.89	Sig. = 0.42			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

Pre-course data indicates that all groups disagree with the statement that technology is found only in industry. The control group has the highest mean score at 2.47. The male-peer group's mean score is 2.43. The female-peer group has the lowest mean score at 1.74. Pre-course data shows no statistical significance (F test 2.39; Sig. = 0.1) between the control group, the female-peer group, and the male-peer group.

Post-course survey data also indicates that all groups disagree with the statement that technology is found only in industry. The control group scored the highest mean at 2.53. The male-peer group's mean score was 2.14. The female group had the lowest mean score at 2.11. Post-course data show no statistical significance (F test 0.89; Sig. = 0.42) between groups.

Table 21 describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question 27. Pre-course data indicates that all groups are in slight agreement that technology helps people more often than it hurts them. The male-peer group shows the highest mean score at 3.93. The female-peer group's mean score is 3.74, and the control group has the lowest mean score at 3.65. Pre-course data shows no statistical significance (F test 0.38; Sig. = 0.69) between groups.

Post-course data also shows all groups in agreement that technology helps people more often than it hurts them. The control group had the highest mean score at 4.06. The female-peer group's mean score was 3.95. The male-peer group's mean score was the lowest at 3.71 when asked if technology helps people more often than it hurts. Post-course "Seventh-grade Technology and Engineering Survey" data showed no statistical significance (F test 0.54; Sig. = 0.59) between groups.

Table 21. *Technology helps people more often than it hurts them, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	3.65	.93	3.17	4.13	CvsF-.09
19	FP	3.74	.87	3.32	4.16	CvsM-.28
14	MP	3.93	.92	3.4	4.46	FvsM-.19
		F test 0.38	Sig. = 0.69			
Post-course						
17	Ctrl	4.06	.9	3.6	4.52	CvsF .11
19	FP	3.95	.78	3.57	4.32	CvsM .35
14	MP	3.71	1.14	3.06	4.37	FvsM .24
		F test 0.54	Sig. = 0.59			

N = 50

DF:		
	Between groups	2
	Within group	47
	Total	49

Research question six explores whether peer interventions influence students' attitudes toward male/female aptitude with technology? Seventh-grade student's attitudes toward males' and females' ability to work with technology were assessed using the following survey statements:

9. Technology is as easy for males as it is for females.

13. Males are better at mechanical tasks than females are.

15. You need to be strong to work in a technology field.

16. Males know more about technology than females do.

28. If I knew more about designing and building things, I could be better at it.

Survey participants evaluated the above items using a five point Likert scale in which five represented agreement, four represented tending to agree, three represented neutrality, two represented tending to disagree, and one represented disagreement.

Table 22 describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question nine. Pre-course responses indicate that all groups indicated that technology is as easy for males as it is for females. The female-peer group had the highest mean score at 4.42, and the control group had the lowest mean score at 4.06. The male-peer group's mean score was 4.14.

Table 22. *Technology is as easy for males as it is for females, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	4.06	.83	3.63	4.48	CvsF-.08
19	FP	4.42	1.02	3.93	4.91	CvsM-.36
14	MP	4.14	1.23	3.43	4.85	FvsM .28
		F test 0.62	Sig. = 0.54			
Post-course						
17	Ctrl	3.76	1.39	3.05	4.48	CvsF-.56
19	FP	4.32	1.2	3.74	4.9	CvsM -.53
14	MP	4.29	1.07	3.67	4.9	FvsM .03
		F test 1.06	Sig. = 0.35			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

Pre-course "Seventh-grade Technology and Engineering Survey" data shows no statistical significance (F test 0.62; Sig. 0.54) between the control group, the male-peer group, and the female-peer group Post-course data also shows all groups indicating that technology is as easy for males as it is for females. As in the pre-course data, the female-peer group showed the highest mean score at 4.32, the male peer group showed the next highest mean score at 4.29, and the control group showed the lowest mean score at 3.76. The post-course difference between the male-peer, female-peer, and control group shows no statistical significance (F test 1.06; Sig. = 0.35).

Table 23 describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question thirteen.

Table 23. *Males are better at mechanical tasks than females are, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	2.41	1.12	1.84	2.99	CvsF .46
19	FP	1.95	1.27	1.34	2.56	CvsM .2
14	MP	2.21	1.42	1.39	3.04	FvsM-.26
		F test 0.61	Sig. = 0.55			
Post-course						
17	Ctrl	1.88	1.11	1.31	2.45	CvsF-.12
19	FP	2	1.25	1.4	2.6	CvsM-.33
14	MP	2.21	1.5	1.39	3.22	FvsM-.21
		F test 0.56	Sig. = 0.57			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

After pre-course survey administration, all groups indicate that they disagree with the statement that males are better at mechanical tasks than females are. The control group's mean score for males being better at mechanical tasks than females are was the highest at 2.41. The female-peer group's mean score was the lowest at 1.95. The male-peer group's mean score was 2.21. There was no statistically significant difference (F test 0.61; Sig. = 0.55) between the groups in pre-course data.

When the post-course "Seventh-grade Technology and Engineering Survey" was administered, all groups indicated that they disagreed with the statement that males are better at mechanical tasks than females are. The male-peer group's mean score for males being better at mechanical tasks than females are was the highest at 2.21, while the control group's mean score was the lowest at 1.88. The female-peer group's mean score was 2.00. Post-course data shows no statistically significant difference (F test 0.56; Sig. = 0.57) between the control group, female-peer group, and the male-peer group.

Table 24 describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question 15. After the pre-course survey implementation each of the three groups disagreed with the statement that one needs to be strong to work in a technology field. The control group had the highest mean score at 2.29, and the female-peer group had the lowest mean score at 1.89. The male-peer group's mean score on the statement that one needs to be strong to study technology was 1.93. Pre-course survey data shows no statistically significant difference (F test 0.98; Sig. = 0.38) between groups.

Post-course data also indicates that all groups disagree with the statement that one needs to be strong to work in a technology field. The control group's mean score is the highest at 2.82, while the female-peer group's mean score is the lowest at 2.16. The male-peer group's mean score was 2.16. There was not a statistically significant difference (F test 1.92; Sig. = 0.16) in post-course data between the control group, the male-peer group, and the female-peer group's attitudes related to one needing to be strong to work in a technology field.

It should be noted that peer intervention may make a practical difference in a classroom setting. Both groups that had peer interventions were less likely to agree with the statement that strength was needed to work in a technology field. The probability that these answers were due to chance was 16% which did not reach statistical significance.

Table 24. *You need to be strong to work in a technology field, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	2.29	0.99	1.79	2.8	CvsF .4
19	FP	1.89	0.74	1.54	2.25	CvsM .36
14	MP	1.93	1.07	1.31	2.3	FvsM-.04
		F test 0.98	Sig. = 0.38			
Post-course						
17	Ctrl	2.82	1.13	2.24	3.41	CvsF .66
19	FP	2.16	1.07	1.64	2.67	CvsM .46
14	MP	2.36	.84	1.87	2.84	FvsM -.20
		F test 1.92	Sig. = 0.16			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

Table 25 describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question 16. After pre-course survey administration, all three groups indicate that they disagree with the statement that males know more than females do. The control group has the highest mean score at 2.24, and the female-peer group has the lowest mean score at 2.05. The mean score of the male peer group is 2.14. There is no statistically significant difference (F test 0.11; Sig. = 0.89) in pre-course data.

Table 25. *Males know more about technology than females do, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	2.24	1.2	1.62	2.85	CvsF .19
19	FP	2.05	1.03	1.56	2.55	CvsM .1
14	MP	2.14	1.23	1.43	2.85	FvsM-.09
		F test 0.11	Sig. = 0.89			
Post-course						
17	Ctrl	2.24	1.25	1.59	2.88	CvsF .61
19	FP	1.63	1.03	1.17	2.09	CvsM -.33
14	MP	2.57	1.13	1.73	3.41	FvsM-.94
		F test 2.59	Sig. = 0.09			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

Post-course data shows all students in disagreement with the statement that males know more about technology than females do. The control group again has the highest mean score at

2.24. The lowest mean score is that of the female-peer group, at 1.63. The male-peer group's mean score is 2.57. There is no statistically significant difference (F test 2.59; Sig. = 0.09) between the male-peer group, the female-peer group, and the control group in post survey data. However, there may be a practical significance to the change in means from pre-course condition to post-course condition between the control group and the female-peer group as well as the male-peer group. In pre-course data the female-peer group's mean score is .19 less than the control group, and .09 less than the male peer group. In post-course data though, the female peer group's mean score is .61 lower than the control group and .94 lower than the male peer group.

Table 26 describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions to question 28. Pre-course results indicate that all three groups stated that they could be better at designing and building things if they knew more about it. The control group had the highest mean score at 4.29, and the male-peer group had the lowest mean score at 4.00. The female-peer group had a mean score of 4.26. There is no statistically significant difference (F test 0.41; Sig. = 0.67) in pre-course data regarding if one knew more about designing and building things, one could be better at them.

After implementation of the post-course "Seventh-grade Technology and Engineering Survey", all groups continue to indicate agreement with the statement that if one knew more about technology, one could be better at them. The control group had the highest mean score at 4.00, followed by the male-peer group at 3.79, and then the female peer group at 3.63. Post-survey data indicates no statistical significance (F test 0.38; Sig. = 0.68) in the difference between the control group, the male-peer group, and the female-peer group.

Table 26. *If I knew more about designing and building things, I could be better at them, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	4.29	.85	3.86	4.73	CvsF .03
19	FP	4.26	.73	3.91	4.62	CvsM .29
14	MP	4	1.36	3.22	4.78	FvsM .26
		F test 0.41	Sig. = 0.67			
Post-course						
17	Ctrl	4	0.87	3.55	4.45	CvsF .37
19	FP	3.63	1.46	2.93	4.34	CvsM .21
14	MP	3.79	1.37	3	4.58	FvsM-.16
		F test 0.38	Sig. = 0.68			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

The seventh research question explores whether peer interventions impact students' attitudes toward technology courses in the school curriculum. Student attitudes were evaluated using the following survey questions:

14. I would rather not have technology lessons in school.
20. Technology classes should be taken by all students.
29. Technology classes are important for all careers.

Survey participants evaluated the above items using a five point Likert scale in which five represented agreement, four represented tending to agree, three represented neutrality, two represented tending to disagree, and one represented disagreement.

Table 27 describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question 14. After pre-course survey administration, all three groups indicate that they disagree with the statement that one would rather not have technology lessons at school. The control group has the highest mean score at 1.41, while the female-peer group has the lowest mean score at 1.26. The male-peer group's mean score is 1.29. Pre-course data shows no statistically significant difference (F test 0.28; Sig. = 0.76) between groups.

In post-course data, all groups again indicate that they disagree with the statement that one would rather not have technology lessons in school. The control group shows the highest mean score at 2.18 and the female-peer group shows the lowest mean score at 1.21. The male-peer group's mean score is 1.43. Post-course data shows a statistically significant difference (F test 4.47; Sig. = 0.02). Tukey's test shows a statistically significant difference of .966 in data between the post-course control group and the post-course female-peer group. Pre-course data shows that the female-peer group's mean score is 0.15 less that the control group, and that the male-peer group's mean score is .12 less than the control group. However, the post-course "Seventh-grade Technology and Engineering Survey" data shows the female-peer group's mean score to be 0.97 less than the control group, and the male-peer group's mean score to be 0.75 less than the control group. All three groups tended to disagree with the idea that they would rather not have technology lessons in school. At the end of the course the groups that had peer presentations maintained a view disagreeing with this statement. However, the control group was less likely to disagree with this statement at the post-course survey. The difference between the groups with peer presentations and the control group reached a level of statistical significance.

Table 27. *I would rather not have technology lessons at school, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	1.41	.71	1.05	1.78	CvsF .15
19	FP	1.26	.56	.99	1.53	CvsM .12
14	MP	1.29	.61	.93	1.64	FvsM-.03
		F test 0.28	Sig. = 0.76			
Post-course						
17	Ctrl	2.18	1.24	1.54	2.81	CvsF .97
19	FP	1.21	.54	.95	1.47	CvsM .75
14	MP	1.43	1.16	.76	2.1	FvsM -.22
		F test 4.47	Sig. = 0.02			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

Table 28 describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question 20. After pre-course survey implementation, all groups indicate that technology classes should be taken by all students. The female peer group shows the highest mean score at 4.11, while the male-peer group shows the lowest mean score at 3.79. The control group's mean score was 3.82. Pre-course data indicates no statistically significant difference (F test 0.41 Sig. = 0.13) between the control group, the male-peer group, and the female-peer group.

Post-course data also indicates that all three groups are in agreement that technology classes should be taken by all students. The female peer group showed the highest mean score at

4.32, and the control group had the lowest mean score at 3.71. The male peer group had a mean score of 4.21. Post-course data showed no statistically significant difference (F test 2.17; Sig. = 0.13) between groups, however, post-course results can be seen as practically significant. In pre-course data, the female-peer group's mean is 0.29 greater than the control group, and the male-peer group's mean is .03 greater than the control group, while in post-course data, the female-peer group's mean is 0.61 greater than the control group and the male-peer group's mean is 0.50 greater than the control group.

Table 28. *Technology classes should be taken by all students, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	3.82	1.02	3.3	4.35	CvsF-.29
19	FP	4.11	.94	3.65	4.56	CvsM .03
14	MP	3.79	1.48	2.93	4.24	FvsM .32
		F test 0.41	Sig. = 0.67			
Post-course						
17	Ctrl	3.71	.99	3.2	4.21	CvsF-.61
19	FP	4.32	.82	3.92	4.71	CvsM -.50
14	MP	4.21	.98	3.65	4.78	FvsM .11
		F test 2.17	Sig. = 0.13			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

Table 29 describes two different analyses of variance (ANOVA) between the control group, female peer group, and male peer group at the pre-course and post-course conditions for question 29. Pre-course results indicate that all three groups agree with the statement that technology classes are important for all careers. The female-peer group had the highest mean score at 4.21, and the male-peer group had the lowest mean score at 3.57. The control group's mean score was 4.00. Pre-course data showed no statistically significant differences (F test 1.25 Sig. = 0.3) between groups.

Table 29. *Technology classes are important for all careers, by group*

Number	Group	Mean	Standard Deviation	Lower Bound	Upper Bound	Diff. in Mean
Pre-course						
17	Ctrl	4.00	1.12	3.43	4.57	CvsF-.21
19	FP	4.21	0.92	3.77	4.65	CvsM .43
14	MP	3.57	1.45	2.73	4.41	FvsM .64
		F test 1.25	Sig. = 0.30			
Post-course						
17	Ctrl	3.88	0.99	3.43	4.39	CvsF-.12
19	FP	4.00	0.75	3.64	4.36	CvsM .24
14	MP	3.64	1.08	3.02	4.27	FvsM .36
		F test 0.6	Sig. = 0.56			

N = 50

DF:	Between groups	2
	Within group	47
	Total	49

In post-course survey data all groups again agreed that technology classes are important for all careers. The female-peer group showed the highest mean score at 4.00, while the male-peer group showed the lowest mean score at 3.64. The control group's mean score was 3.88.

There is no statistically significant difference (F test 0.6; Sig. = 0.56) between post-course groups.

What are the differences in technology and engineering opinions among male and female students before and after completing seventh-grade technology and engineering? To help clarify data analysis, seventh-grade survey questions have placed into groups based upon the topic they address. The first group of statements studies students' attitudes toward technology and engineering using the following survey items:

11. Technology makes peoples lives better.
12. You have to be smart to study technology.
17. The world would be a better place without technology.
18. You need to be good at math and science to study technology.
19. I think machines are boring
21. You have to use tools to study technology.
22. Working with your hands is part of technology.
23. Design is an important part of technology.
24. When I think of technology I mainly think of woodworking.
25. Using different materials is an important part of technology.
26. Technology is found only in industry.
27. Technology helps people more often than it hurts them.

Table 30 shows male and female student responses to survey statement eleven, "Technology makes peoples' lives better" for the pre-course and post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey statement number eleven. There was no statistically significant difference in scores for females (M=4.25, SD=0.84) and males[M=4.41, SD=0.67; t(48)=-0.72, p=0.47]. The effect size is small, only 1.1% of the variance in the "Technology makes peoples' lives better" statement during the pre-course "Seventh-grade Technology and Engineering Survey" is explained by gender.

An independent-samples t-test was also used to compare female and male scores on the post-course "Seventh-grade Technology and Engineering Survey". There was no statistically significant difference in scores for females (M=4.2, SD=0.88) and males [M=4.41, SD=0.85; t(48)=-0.79, p=0.43] The effect size is small, only 1.3% of the variance in the statement "Technology makes people's lives better" during the post-course survey is explained by gender.

Table 30. *Technology makes people's lives better, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	4.25	0.84	-0.72
22	male	4.41	0.67	
	DF = 48	Significance (2-tailed) = 0.47		
Post-course				
28	female	4.21	0.88	-0.79
22	male	4.41	0.85	
	DF = 48	Significance (2-tailed) = 0.43		

N=50

Table 31 shows student responses to survey statement twelve, "You have to be smart to study technology" for the pre-course and the post-course surveys.

An independent samples t-test was used to compare the scores for males and females on pre-course survey statement 12. There was no statistically significant difference in scores for females (M =2.64, SD=1.03) and males [M=2.77, SD=1.41; t(48)=-0.38, p=0.71]. The effect size is small, only 0.3% of the variance in the responses to the statement, "You have to be smart to study technology" is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course "Seventh-grade Technology and Engineering Survey". There was no statistically significant difference in scores for females (M=2.82, SD=1.12) and males [M=3, SD=1.35; t(48)=-0.51, p=0.61]. The effect size is small, only 0.5% of the variance in the post-course statement "Technology makes people's lives better," is explained by gender.

Table 31. *You have to be smart to study technology, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	2.64	1.03	-0.38
22	male	2.77	1.41	
	DF = 48	Significance (2-tailed) = 0.71		
Post-course				
28	female	2.82	1.12	-0.51
22	male	3	1.35	
	DF = 48	Significance (2-tailed) = 0.61		

N=50

Table 32 illustrates student responses to survey statement seventeen, "The world would be a better place without technology" for the pre-course and post-course surveys. An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =1.57, SD=0.84) and males [M=1.36, SD=0.66; t(48)=-0.96, p=0.34]. The effect size is small, only 1.8% of the variance in the responses to the statement, "The world would be a better place without technology" is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course "Seventh-grade Technology and Engineering Survey". There was no statistically significant difference in scores for females (M=1.64, SD=0.83) and males [M=1.68, SD=0.89; t(48)=-0.16, p=0.87]. The effect size is small, only 5.3% of the variance in the post-course statement "The world would be a better place without technology," is explained by gender.

Table 32. *The world would be a better place without technology, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	1.57	.84	.96
22	male	1.36	.66	
	DF = 48	Significance (2-tailed) = 0.34		
Post-course				
28	female	1.64	.83	-0.16
22	male	1.68	.89	
	DF = 48	Significance (2-tailed) = 0.87		

N=50

Table 33 shows student responses to survey statement eighteen, "You need to be good at math and science to study technology," for the pre-course and post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M

=3, SD=1.02) and males [M=3.36, SD=1.00; t(48)=-1.26, p=0.21]. The effect size is small, only 3.2% of the variance in the responses to the statement, "You need to be good at math and science to study technology" is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course "Seventh-grade Technology and Engineering Survey". There was a statistically significant difference in scores for females (M=2.93, SD=1.27) and males [M=3.82, SD=0.96; t(48)=-2.72, p=0.01]. The effect size is moderate, as 13% of the variance in the post-course statement "You need to be good at math and science to study technology" is explained by gender.

Table 33. *You need to be good at math and science to study technology, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	3	1.02	-1.26
22	male	3.36	1	
	DF = 48	Significance (2-tailed) = 0.21		
Post-course				
28	female	2.93	1.27	-2.72
22	male	3.82	0.96	
	DF = 48	Significance (2-tailed) = 0.01		

N = 50

Table 34 shows student responses to survey statement nineteen, "I think machines are boring," for the pre-course and post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was a statistically significant difference in scores for females (M =1.86, SD=1.01) and males [M=1.32, SD=0.48; t(48)=2.31, p=0.02]. The effect size is moderate, as 10.0% of the variance in the responses to the statement, "I think machines are boring" is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course "Seventh-grade Technology and Engineering Survey". There was no statistically significant difference in scores for females (M=1.89, SD=1.13) and males [M=1.50, SD=0.67; t(48)=1.14, p=0.16]. The effect size is small, only 4.1% of the variance in the post-course statement "I think machines are boring." is explained by gender.

Table 34. *Independent sample t-test: I think machines are boring, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	1.86	1.01	2.31
22	male	1.32	.48	
	DF = 40.36	Significance (2-tailed) = .02		
Post-course				
28	female	1.89	1.13	1.44
22	male	1.5	0.67	
	DF = 48	Significance (2-tailed) = 0.16		

N = 50

Table 35 shows student responses to survey statement twenty-one, "You have to use tools to study technology," for the pre-course and post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =2.82, SD=1.16) and males [M=3.36, SD=1.14; t(48)=-1.66, p=0.1]. The effect size is small, only 5.4% of the variance in the responses to the statement, "You have to use tools to study technology," is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course "Seventh-grade Technology and Engineering Survey". There was no statistically significant difference in scores for females (M=3.36, SD=1.16) and males [M=3.73, SD=0.94; t(48)=-1.22, p=0.23]. The effect size is small, only 3.0% of the variance in the post-course statement "You have to use tools to study technology," is explained by gender.

Table 35. *You have to use tools to study technology, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	2.82	1.16	-1.66
22	male	3.36	1.14	
	DF = 48	Significance (2-tailed) = 0.1		
Post-course				
28	female	3.36	1.16	-1.22
22	male	3.73	.94	
	DF = 48	Significance (2-tailed) = 0.23		

N = 50

Table 36 displays student responses to survey question twenty two, "Working with your hands is part of technology," for the pre-course and the post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =4.29, SD=0.71) and males [M=4.23, SD=1.15; t(48)=0.22, p=0.83]. The effect size is small, only 0.1% of the variance in the responses to the statement, "Working with your hands is part of technology," is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course "Seventh-grade Technology and Engineering Survey". There was no statistically significant difference in scores for females (M=4.43, SD=0.88) and males [M=4.05, SD=1; t(48)=1.44, p=0.16]. The effect size is small, only 4.1% of the variance in the post-course statement "Working with your hands is part of technology" is explained by gender.

Table 36. *Working with your hands is a part of technology, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	4.29	0.71	.22
22	male	4.23	1.15	
	DF = 48	Significance (2-tailed) = 0.83		
Post-course				
28	female	4.43	.88	1.44
22	male	4.05	1	
	DF = 48	Significance (2-tailed) = 0.16		

N=50

Table 37 illustrates student responses to survey statement twenty-three, "Design is an important part of technology," for the pre-course and post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =4.57, SD=0.92) and males [M=4.77, SD=0.43; t(48)=-0.95, p=0.35]. The effect size is small, only 1.8% of the variance in the responses to the statement, "Design is an important part of technology," is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=4.61, SD=0.83) and males [M=4.27, SD=1.28; t(48)=1.12, p=0.3]. The effect size is small, only 2.5% of the variance in the post-course statement "Design is an important part of technology" is explained by gender.

Table 37. *Design is an important part of technology, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	4.57	.92	-.95
22	male	4.77	.43	
	DF = 48	Significance (2-tailed) = 0.35		
Post-course				
28	female	4.61	.83	1.12
22	male	4.27	1.28	
	DF = 34.32	Significance (2-tailed) = 0.3		

N=50

Table 38 displays the results of survey statement twenty-four, "When I think of technology I mainly think of woodworking," for the pre-course and post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =2.57, SD=1.2) and males [M=2.55, SD=1.06; t(48)=0.08, p=0.94]. The effect size is small, only 1.3% of the variance in the responses to the statement, "When I think of technology I mainly think of woodworking," is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=2.98, SD=1.13) and males [M=2.41, SD=1.18; t(48)=1.47, p=0.15]. The effect size is small, only 4.3% of the variance in the post-course statement "When I think of technology I mainly think of woodworking," is explained by gender.

Table 38. *When I think of technology I mainly think of woodworking, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	2.57	1.2	.08
22	male	2.55	1.06	
	DF = 48	Significance (2-tailed) = 0.94		
Post-course				
28	female	2.98	1.13	1.47
22	male	2.41	1.18	
	DF = 48	Significance (2-tailed) = 0.15		

N=50

Table 39 shows student responses to survey statement twenty-five, "Using different materials is an important part of technology," for the pre-course and the post-course surveys.

An independent samples t-test was used to compare the scores for males and females for pre-course data. There was no statistically significant difference in scores for females (M =4.32, SD=0.72) and males [M=4.36, SD=0.66; t(48)=-0.21, p=0.83]. The effect size is small, only 0.1% of the variance in the responses to the statement, "Using different materials is an important part of technology" is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=4.21, SD=1.03) and males [M=4.32, SD=1.09; t(48)=-.035, p=0.73]. The effect size is small, only 0.3% of the variance in the post-course statement "Using different materials is an important part of technology" is explained by gender.

Table 39. *Using different materials is an important part of technology, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	4.32	.72	-.21
22	male	4.36	.66	
	DF = 48	Significance (2-tailed) = 0.83		
Post-course				
28	female	4.21	1.03	-.35
22	male	4.32	1.09	
	DF = 48	Significance (2-tailed) = 0.73		

N=50

Table 40 represents student responses to survey statement twenty-six, "Technology is found only in industry," for the pre-course and post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =2.25, SD=1.21) and males [M=2.09, SD=1.11; t(48)=0.48, p=0.63]. The effect size is small, only 0.5% of the variance in the responses to the statement, "Technology is found only in industry," is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course "Seventh-grade Technology and Engineering Survey". There was no statistically significant difference in scores for females (M=2.21, SD=0.88) and males [M=2.32, SD=1.21; t(48)=-0.35, p=0.74]. The effect size is small, only 0.3% of the variance in the post-course statement "Technology is found only in industry," is explained by gender.

Table 40. *Technology is found only in industry, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	2.25	1.21	.48
22	male	2.09	1.11	
	DF = 48	Significance (2-tailed) = 0.63		
Post-course				
28	female	2.21	.88	-.35
22	male	2.32	1.21	
	DF = 36.97	Significance (2-tailed) = 0.74		

N=50

Table 41 represents student responses to survey statement twenty-seven, "Technology helps people more often than it hurts them."

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was a statistically significant difference in scores for females (M =3.54, SD=0.74) and males [M=4.05, SD=1.00; t(48)=-2.07, p=0.04]. The effect size is moderate, as 8.2% of the variance in the responses to the statement, "Technology helps people more often than it hurts them" is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=3.89, SD=0.79) and males [M=3.95, SD=1.09; t(48)=-0.23, p=0.82]. The effect size is small, only 0.1% of the variance in the post-course statement "Technology helps people more often than it hurts them" is explained by gender.

Table 41. *Technology helps people more often than it hurts them, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	3.54	.74	-2.07
22	male	4.05	1	
	DF = 48	Significance (2-tailed) = 0.04		
Post-course				
28	female	3.89	.79	-.23
22	male	3.95	1.09	
	DF = 48	Significance (2-tailed) = 0.82		

N=50

The following survey questions illustrate student's opinions toward technology's place in education:

14. I would rather not have technology lessons in school.

20. Technology classes should be taken by all students.

29. Technology classes are important for all careers.

Table 42 shows student responses to survey statement ten, "I would rather not have technology lessons at school," for the pre-course and post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was a statistically significant difference in scores for females (M =1.54, SD=0.74) and males [M=1.05, SD=0.21; t(48)=2.99, p=0.00]. The effect size is large, as 15.7% of the variance in the responses to the statement, "I would rather not have technology lessons at school," is explained by gender in the pre-course survey.

Table 42. *I would rather not have technology lessons at school, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	1.54	.74	2.99
22	male	1.05	.21	
	DF = 32.48	Significance (2-tailed) = 0.00		
Post-course				
28	female	1.54	.92	-.48
22	male	1.68	1.25	
	DF = 48	Significance (2-tailed) = 0.64		

N = 50

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=1.54, SD=0.92) and males [M=1.68, SD=1.25; t(48)=-0.48, p=0.64]. The effect size is small, only 0.5% of the variance in the post-course statement "I would rather not have technology lessons at school," is explained by gender.

Table 43 represents student responses to survey statement twenty, "Technology classes should be taken by all students."

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =3.75, SD=1.04) and males [M=4.14, SD=1.21; t(48)=-1.22, p=0.23]. The effect size is small, only 3.0% of the variance in the responses to the statement, "Technology classes should be taken by all students," is explained by gender in the pre-course survey.

Table 43. *Technology classes should be taken by all students, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	3.75	1.04	-1.22
22	male	4.14	1.21	
	DF = 48	Significance (2-tailed) = .23		
Post-course				
28	female	3.86	.97	-1.94
22	male	4.36	.85	
	DF = 48	Significance (2-tailed) = 0.06		

N=50

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=3.86, SD=0.97) and males [M=4.36, SD=0.85; t(48)=-1.94, p=0.06]. The effect size is moderate, as 7.3% of the variance in the post-course statement "Technology classes should be taken by all students," is explained by gender.

Table 44 indicates student responses to survey statement twenty-nine, "Technology classes are important for all careers." An independent samples t-test was used to compare the scores for males and females on the pre-course "Seventh-grade Technology and Engineering Survey". There was no statistically significant difference in scores for females (M =3.82, SD=1.09) and males [M=4.14, SD=1.25; t(48)=-0.95, p=0.35]. The effect size is small, only 1.8% of the variance in the responses to the statement, "Technology classes are important for all careers," is explained by gender in the pre-course survey.

Table 44. *Technology classes are important for all careers, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	3.82	1.09	-.95
22	male	4.14	1.25	
	DF = 48	Significance (2-tailed) = .35		
Post-course				
28	female	3.86	.85	-.02
22	male	3.86	1.04	
	DF = 48	Significance (2-tailed) = 0.98		

N=50

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=3.86, SD=0.85) and males [M=3.86, SD=1.04; t(48)=-0.02, p=0.98]. The effect size is small, as less than 0.1% of the variance in the post-course statement "Technology classes are important for all careers," is explained by gender.

The following survey statements concern students' opinions about male and female roles in technology:

9. Technology is as easy for males as it is for females.
13. Males are better at mechanical tasks than females are.
15. You need to be strong to work in a technology field.
16. Males know more about technology than females do.
28. If I knew more about designing and building things, I could be better at it.

Table 45 represents student responses to survey question nine, "Technology is as easy for males as it is for females," for the pre-course and post-course surveys.

Table 45. *Technology is as easy for males as it is for females, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	4.36	0.78	1.08
22	male	4.05	1.25	
	DF = 48 Significance (2-tailed) = .29			
Post-course				
28	female	4.57	.84	3.16
22	male	3.55	1.44	
	DF = 31.87 Significance (2-tailed) = 0.01			

N=50

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =4.36, SD=0.78) and males [M=4.05, SD=1.25; t(48)=1.08, p=0.29]. The effect size is small, only 2.3% of the variance in the responses to the statement, "Technology is as easy for males as it is for females," is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was a statistically significant difference in scores for females (M=4.57, SD=0.84) and males [M=3.55, SD=1.44; t(48)=3.16, p=0.01]. The effect size is large, as 17.2% of the variance in the post-course statement "Technology is as easy for males as it is for females" is explained by gender.

Table 46 indicates student responses to survey statement thirteen, "Males are better at mechanical tasks than females are."

Table 46. *Males are better at mechanical tasks than females are, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	1.89	1.03	-1.87
22	male	2.55	1.44	
	DF = 36.74	Significance (2-tailed) = .08		
Post-course				
28	female	1.82	1.12	-1.52
22	male	2.36	1.14	
	DF = 48	Significance (2-tailed) = 0.14		

N=50

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =1.89, SD=1.03) and males [M=2.55, SD=1.44; t(48)=-1.87, p=0.08]. The effect size is moderate, as 6.7% of the variance in the responses to the statement, "Males are better at mechanical tasks than females are," is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=1.82, SD=1.12) and males [M=2.36, SD=1.14; t(48)=-1.52, p=0.14]. The effect size is small, only 4.6% of the variance in the post-course statement "Males are better at mechanical tasks than females are," is explained by gender.

Table 47 illustrates student responses to survey statement fifteen, "You need to be strong to work in a technology field," for the pre-course and the post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =2.07, SD=0.9) and males [M=2.00, SD=0.98; t(48)=0.27, p=0.79]. The effect size is small, only 0.2% of the variance in the responses to the statement, "You need to be strong to work in a technology field," is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=2.36, SD=1.1) and males [M=2.55, SD=1.01; t(48)=-0.62, p=0.54]. The effect size is small, only 0.8% of the variance in the post-course statement "You need to be strong to work in a technology field," is explained by gender.

Table 47. *You need to be strong to work in a technology field, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	2.07	.9	.27
22	male	2	.98	
	DF = 48	Significance (2-tailed) = .79		
Post-course				
28	female	2.36	1.1	-.62
22	male	2.55	1.01	
	DF = 48	Significance (2-tailed) = 0.54		

N=50

Table 48 describes student responses to survey statement sixteen, “Males know more about technology than females do,” for the pre-course and post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =2.00, SD=1.09) and males [M=2.32, SD=1.17; t(48)=-0.99, p=0.33]. The effect size is small, only 2% of the variance in the responses to the statement, “Males know more about technology than females do,” is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course "Seventh-grade Technology and Engineering Survey". There was no statistically significant difference in scores for females (M=2.00, SD=1.31) and males [M=2.23, SD=1.19; t(48)=-0.64, p=0.53]. The effect size is small, only 0.6% of the variance in the post-course statement “Males know more about technology than females do,” is explained by gender.

Table 48. *Males know more about technology than females do, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	2	1.09	-.99
22	male	2.32	1.17	
	DF = 48	Significance (2-tailed) = .33		
Post-course				
28	female	2	1.31	-.64
22	male	2.23	1.19	
	DF = 48	Significance (2-tailed) = 0.53		

N=50

Table 49 represents student responses to survey statement twenty-eight, "If I knew more about designing and building things, I could be better at them," for the pre-course and the post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was a statistically significant difference in scores for females (M =3.82, SD=1.02) and males [M=4.68, SD=0.65; t(48)=-3.45, p=0.00]. The effect size is large, as 19.8% of the variance in the responses to the statement, "If I knew more about designing and building things, I could be better at them," is explained by gender in the pre-course survey. An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=3.57, SD=1.32) and males [M=4.09, SD=1.32; t(48)=-1.48, p=0.15]. The effect size is small, only 4.3% of the variance in the post-course statement "If I knew more about designing and building things I could be better at it," is explained by gender.

Table 49. *If I knew more about designing and building things, I could be better, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	3.82	1.02	-3.45
22	male	4.68	.65	
	DF = 48	Significance (2-tailed) = 0.00		
Post-course				
28	female	3.57	1.32	-1.48
22	male	4.09	1.11	
	DF = 48	Significance (2-tailed) = 0.15		

N=50

Students' attitudes toward enrollment in technology and engineering were tested in the following survey statements:

10. I hear a lot about technology and careers in technology at school.
30. My parents and family have the most say on whether or not I will enroll in eighth-grade technology and engineering.
31. I will only enroll in eighth-grade technology and engineering if my friends do.
32. I enroll in electives based upon my own personal interests.
33. Technology and engineering seems like an exciting eighth-grade elective.
34. I will enroll in eighth-grade technology and engineering.

Table 50 shows student responses to survey statement ten, "I hear a lot about technology and careers in technology at school," for the pre-course and the post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was a statistically significant difference in scores for females (M =3.46, SD=0.74) and males [M=4.05, SD=0.84; t(48)=-2.58, p=0.01]. The effect size is moderate, only 12.2% of the variance in the responses to the statement, "I hear a lot about technology and careers in technology at school" is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=3.71, SD=0.74) and males [M=4.05, SD=0.84; t(48)=-0.82, p=0.42]. The effect size is small, only 1.3% of the variance in the post-course statement "I hear a lot about technology and careers in technology at school," is explained by gender.

Table 50. *I hear a lot about technology and careers in technology at school, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	3.46	.74	-2.58
22	male	4.05	.84	
	DF = 48	Significance (2-tailed) = .01		
Post-course				
28	female	3.71	.9	-.82
22	male	3.91	.75	
	DF = 48	Significance (2-tailed) = 0.42		

N = 50

Table 51 describes student responses to survey statement thirty, "My parents and family have the most say on whether or not I enroll in eighth-grade technology and engineering," for the pre-course and post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =1.46, SD=0.79) and males [M=1.68, SD=1.17; t(48)=-0.78 p=0.44]. The effect size is small, only 1.25% of the variance in the responses to the statement, "My parents and family have the most say on whether or not I will enroll in eighth-grade technology and engineering" is explained by gender in the pre-course survey.

Table 51. *My parents and family, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	1.46	.79	-.78
22	male	1.68	1.17	
	DF = 48	Significance (2-tailed) = .44		
Post-course				
28	female	1.64	.87	-1.89
22	male	2.24	.1.34	
	DF = 32.28	Significance (2-tailed) = 0.09		

N=50

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=1.64, SD=1.79) and males [M=1.68, SD=1.17; t(48)=-1.89, p=0.09]. The effect size is moderate, as 6.9% of the variance in the post-course statement "My parents and family have the most say on whether or not I will enroll in eighth-grade technology and engineering," is explained by gender.

Table 52 illustrates student responses to survey question thirty-one. "I will enroll in eighth-grade technology and engineering only if my friends do," for the pre-course and post-course surveys.

Table 52. *I will enroll in eighth-grade technology and engineering if my friends do, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	1.93	1.12	1.11
22	male	1.59	1.01	
	DF = 48	Significance (2-tailed) = .27		
Post-course				
28	female	1.82	1.12	-1.07
22	male	2.19	1.29	
	DF = 47	Significance (2-tailed) = 0.29		

N=50

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =1.93, SD=1.12) and males [M=1.59, SD=1.01; t(48)=1.11, p=0.27]. The effect size is small, only 2.5% of the variance in the responses to the statement, "I will enroll in eighth-grade technology and engineering only if my friends do," is explained by gender in the pre-course survey.

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=1.82, SD=1.12) and males [M=1.59, SD=1.01; t(48)=-1.07, p=0.29]. The effect size is small, only 2.3% of the variance in the post-course statement "I will only enroll in eighth-grade technology and engineering if my friends do," is explained by gender.

Table 53 shows student responses to survey statement thirty-two, "I enroll in electives based upon my own personal interests," for the pre-course and the post-course surveys.

An independent samples t-test was used to compare the scores for males and females on the pre-course survey. There was no statistically significant difference in scores for females (M =4.39, SD=0.74) and males [M=4.55, SD=0.91; t(48)=-0.66, p=0.52]. The effect size is small, only 0.9% of the variance in the responses to the statement, "I enroll in electives based upon my own personal interests" is explained by gender in the pre-course survey.

Table 53. *I enroll in electives based upon my own personal interests, by gender*

Number	Gender	Mean	Standard Deviation	t- value
Pre-course				
28	female	4.39	.74	-.66
22	male	4.55	.91	
	DF = 48	Significance (2-tailed) = .52		
Post-course				
28	female	4.57	.69	2.08
22	male	4.05	1.07	
	DF = 32.08	Significance (2-tailed) = 0.6		

N=50

An independent samples t-test was also used to compare scores for males and females on the post-course survey. There was no statistically significant difference in scores for females (M=4.57, SD=0.69) and males [M=4.05, SD=1.07; t(48)=2.08, p=0.06]. The effect size is moderate, only 8.2% of the variance in the post-course statement "I enroll in electives based upon my own personal interests," is explained by gender.

What do current female 8th grade technology and engineering students view as positive and negative aspects of the middle school's technology and engineering coursework and facilities?

All thirteen female students enrolled in eighth-grade technology and engineering were asked to be part of a focus group to comment on the middle school's technology and engineering curriculum and facilities. Eleven of the thirteen students chose to participate.

The group discussion was started with a series of six topical questions, such as, "why did you choose to enroll in eighth-grade technology and engineering" and the students were allowed to answer freely from there.

The students were first asked why they chose to enroll in eighth-grade technology and engineering. Three of the students noted that they had experience building things with their dads. Another common response (five students) was that they liked designing and building things and that they were good at it. One student stated that she didn't want to take a foreign language or art class, so she took technology and engineering, and another stated that she felt technology and engineering would be more of a challenge than art or language. One girl interjected that she took it because she liked boys.

The second question was, "What things about seventh-grade technology and engineering made you want to enroll in eighth-grade technology and engineering?" Five students agreed that they liked the projects and computer aided design from seventh-grade. Two students said how they liked working independently on projects and designs. One student mentioned that she liked working with machines and different materials. Another student said how she liked that the small steps in a design and fabrication process added up into a finished project.

The third question asked students to consider things in seventh-grade technology and engineering that may have steered their friends away from enrolling in eighth-grade technology and engineering. It was mentioned that some female students are scared of the machines or intimidated by computer design. Two mentioned that their friends thought that it was too dirty. Another student stated that some female students see the class as a boys-only area. Some of the suggestions the focus group made to improve the seventh-grade course included showing more pictures of female students working, the inclusion of more design in curriculum, and to bring in eighth-grade female technology and engineering students to speak to seventh-grade classes.

The group was then asked to comment on the laboratory and classroom area. The consensus among the students was that laboratory was a "guys room" because of the machines, the noise, and the dull colors. Students suggested hanging more pictures in the laboratory, painting the walls bright colors, and hanging up more examples of projects. When commenting on the classroom, they all agreed that they liked the example projects hanging on the walls, and they liked being able to pick their own seats in the computer lab. One student also stated that the classroom is too cold, and that the temperature may have been a consideration for some of their friends who did not enroll in eighth-grade technology and engineering.

When asked to sum up their suggestions for the technology and engineering department, the group stated: make the laboratory more girl friendly, add a few projects to seventh-grade technology and engineering, and bring eighth-grade girls in to speak to seventh-grade classes.

Chapter V: Summary, Conclusions, and Recommendations

Introduction

This chapter will include a discussion of results where study findings will be compared to findings from literature reviews. A summarization of researched and studied findings, as well as a set of recommendations for further actions that could be taken to improve female enrollment in technology and engineering programs will be provided. Research questions fall under five broad areas. These areas include demographic information, attitudes toward technology, impacts of peer intervention, impacts of gender, and viewpoints from 8th grade female students.

Discussion and Conclusions

Demographic Information. Seventh grade survey data indicated that 31% of male students had a technical workshop in their home, and 72% of female students had a technical workshop in their home. Fifty-nine percent of male students indicated that they have a brother or sister that is interested in technology, while 67% of female students indicated that they have a sibling that is interested in technology. Research in literature has indicated that one possible roadblock in female enrollment is based in a lack of female student exposure to technology at home. This is clearly not the case in this study. The seventh grade female students involved in this study were exposed to technology at home, through technical workshops, at a rate that is higher than the male students. Eighth grade female students who were involved in the focus group also indicated that interacting with technology at home, with their dads, played a big factor in their choice to enroll in *Eighth Grade Technology and Engineering.*

Attitudes toward technology. All groups of seventh grade students indicate an increasing belief that their parent's jobs are tied to technology. It is possible that students have a greater understanding of the scope and breadth of technology after completing *Seventh Grade*

Technology and Engineering and this greater understanding has lead to an increased belief that their parents are frequent users of technology. It is probable that the increase in students' agreement that parents' jobs are tied to technology is due to both peer-interventions as well as course curriculum. The rise in mean for the control group may be attributed to an increased awareness of jobs tied to technology through instruction while the greater rise in peer-presenter groups' scores may be attributed to peer-presentations as well as course instruction.

When seventh grade students were asked if they were excited to participate in *Seventh Grade Technology and Engineering,* all groups showed a decreasing excitement level from the pre-course survey to the post-course survey. The review of literature suggests that often middle level students are unsure of what technology is, and what common technological terms mean. *Seventh Grade Technology and Engineering* is also the first technology education class available to students in the school district. This decrease in excitement may be driven by a lack of student interest in curriculum, or students not getting what they expected out of the course. Seventh-grade curriculum was revised previous to the implementation of this study. Decreasing student excitement may have been caused by that curriculum revision. It's possible that the revised curriculum is not what students expected it would be. It is also possible that curriculum revisions made in order to appeal to female students don't appeal to male students, and the curriculum items retained that appeal to male students do not appeal to female students. Seventh-grade curriculum includes designing and building a wooden cutting board. It's possible that male students view this project as something that is used by their mothers and are therefore not interesting. The cutting board project may enhance a female opinion that the technology education environment is a dirty and unfeminine place.

When asked if *Eighth Grade Technology and Engineering* seems like an exciting eighth-grade elective, only the female-peer group showed increasing agreement. This may be due to peer-presentations groups received as the course curriculum was otherwise the same. When the same question is analyzed by gender the female group's excitement level drops, while the male group's excitement level increases. This is most likely due to a male bias in curriculum or delivery of instruction. Ninety-seven percent of technology education teachers are male, and male teachers are more apt to recognize male learning styles. The literature review shows that male students are more likely to receive praise for their work, and are offered more constructive criticisms in technology classes than female students are. The literature review also states that female students view the technology education environment as a dirty and unappealing environment. This was corroborated by eighth grade focus group responses, and may also play a factor in the decrease in the female group's level of excitement. When analyzed by peer-intervention, the control group and the male-peer group showed a decreasing view that *Eighth Grade Technology and Engineering* seems like an exciting elective. All groups of students showed an increasing opinion that they would enroll in the course. This could be because students view the course as more exciting than other elective options or, as an eighth grade study participant stated, are not interested in enrolling in a language course.

Interestingly, when divided by peer-presenter group, and asked if students would enroll in *Eighth Grade Technology and Engineering,* the control group and the female-peer group showed increasing agreement. The male-peer group showed a decreasing interest in enrolling in *Eighth Grade Technology and Engineering.* When data is analyzed by gender, the male group shows a significantly higher interest in enrolling in *Eighth Grade Technology and Engineering* than the female group. However, the female group's interest in enrolling in the eighth-grade technology and engineering course increases from pre-course to post-course survey. The difference in responses by gender suggests that male bias may be present in school technology education culture, and may also suggest that curriculum is too male-focused to attract female students. The increased interest in the eighth-grade technology and engineering course may be attributed to successful peer-presenter interventions, or to increased exposure to the course.

Students exposed to peer-presentations indicated they would consider a job in a technology field at a rate statistically higher than the students in the control group. Career study was not part of the seventh grade curriculum, nor was it a part of the peer-presentations. Research suggests that role models can increase student's interest in technological careers. It is possible that the peer-presenters acted as role models in technology and sparked an interest in technology and careers in technology. When divided by gender, the male group shows that they would consider a job in a technology field more often than the female group. This is similar to research stating that males make up 78% of the technological workforce. Including male and female technology professionals as role models within the course may be a way to reduce this divide.

Impacts of peer interventions. The female-peer group disagrees more strongly with the statement that machines are boring than the control group or the male-peer group. This may be because of the excitement level that the female peer-presenters showed when discussing using machines during their presentation.

Data shows a shift in opinion regarding the use of different materials in technology. When analyzed by peer intervention, pre-course data shows that the male-peer group disagrees with the statement that it is important to use different materials in technology more than the control group and the female-peer group at a level that is statistically significant. Post-course data shows no difference in opinion between the groups. This may be because the students were exposed to the same curriculum and materials during the course. Revised course curriculum may have affected students' awareness of technology and materials used in technology, and eliminated the statistical difference between peer-presenter sections.

When students were asked if males know more about technology than female do during the post-course survey, peer-group data showed that the female-peer group disagreed with the statement the most, and the male-peer group agreed with the statement the most. This may be the result of peer-group role models influencing the opinions of students in class. While the male-peer group presenters reinforced the stereotype that technology and engineering is a pursuit for males, the female-peer group presenters acted as role models for students showing how females can be successful in the pursuit of technology. This data reinforces literature research stating that role-models play an important part in student's technological confidence.

The peer-presenter sections show that peer interventions may impact students' views about having technology lessons in school. All sections disagreed or tended to disagree with the statement, "I would rather not have technology lessons at school." The two peer-presenter sections disagreed the most while the control group agreed with the statement. The difference between the peer-presenter group and the control group reached statistical significance. Of the two treatment groups, the female group was the most interested in having technology lessons at school. This is one indication that peer-presenters may impact students' views of the value of technology lessons in school. Further, when presented with the statement, "Technology lessons should be taken by all students," post-course data for peer-presenter groups showed similar trends when compared to the technology lesson statement. All groups were neutral or tended to agree that "technology classes should be taken by all students." Data reached practical significance when the control group disagreed more than the peer-intervention groups when asked if technology lessons should be taken by all students. The female-peer group was more likely to agree than other groups that technology lessons should be taken by all students. There are a number of possible explanations to this. First, it is possible that participants in the course entered the study with predisposed opinions toward a certain belief. It is also likely that the peer intervention changed student's attitudes to place technology and engineering in a more positive light, as both the female-peer group and the male-peer group identified that technology classes are an important part of curriculum more so than the control group did. Both the literature review and the 8th grade study participants identified role models as an important part of increasing student interest in technology education.

Impacts of gender. When data is analyzed by gender, post-course male students feel more strongly than post-course female students that one needs to be good at math and science to study technology with a statistically significant difference that was not evident at the pre-course survey. While math and science play an important role in the course, primary attention is given to technology concepts. It is possible that female students have a better grasp of math and science concepts, and therefore do not notice underlying math and science principles as much as male students who may be struggling to take hold of concepts. It is also possible that female students are receiving more assistance from the instructor than male students are during math and science related activities.

When divided by gender, pre-course female students feel more strongly than male students that machines are boring at a level which is statistically significant. Responses to this question do not reach statistical significance during the post-course survey. It should be noted that during both the pre-course and post-course surveys both males and females tended to disagree that machines are boring. From pre-course to post course, the female group's opinion stays relatively consistent, however the male group's agreement with the statement increases, showing that male students increasingly believed that machines are boring. This may be due to the fact that using machines was no longer a new process for students by the end of the course.

When students were asked if technology helps people more often than it hurts them, pre-course gender group data shows that female students were less likely to agree with this statement at a statistically significant level. Post-course data, however, shows no significant difference in gender groups. This could be a result of a greater understanding of technology within both groups of students as a result of completing *Seventh Grade Technology and Engineering.*

Data for the statement, "Technology is as easy for males as it is for females," shows no statistical significance during the pre-course survey. However, in post-course data, there is a statistically significant difference. By the end of the study female students were more likely to agree that technology was as easy for males as it was for females. This data may show an increase in female students' confidence in their own technological ability. The male group's agreement with the statement decreased. It is possible that due to male student observations of female student successes in class, male students began to believe that technology education was easier for female students than male students.

Data shows that design and modeling curriculum may be responsible for an increase in all students' perceived technological ability. When given the statement, "If I knew more about designing and building things, I could be better at them," the pre-course gender group data showed male students in stronger agreement. Males agreed with the statement while females indicated a neutral response creating a statistically different response between groups. Both male and female students' perception that they needed to know more about designing and building things to be better at them dropped to a level that was not statistically significant in post-course data. Pre and post-course data may indicate that female students are more confident in designing and building things. This may be because more female students have access to a workshop at home and therefore have built more technological confidence than male students. This could also point to an increased student belief that technological ability is not something that one is assigned with at birth, like gender, but it is a skill that can be improved and honed with practice. It may point to an increased technological confidence level because of what was learned in class. Data shows that course curriculum and instruction may have positively impacted male students' technological confidence in that post-course condition, they more strongly believed that they knew enough about designing and building things to be good at them.

When divided by gender, in pre-course condition, female students state that they hear about technology and careers in technology a significant amount less than male students. In post-course condition, there is no statistical difference between gender groups. Literature research shows that middle level students may be unclear as to terminology dealing with technology, and that they may be intimidated by technological concepts because of their unfamiliar wording. It is possible that students have a greater understanding of technology and engineering terms as a result of completing *Seventh-grade Technology and Engineering*, and that the greater understanding has lead to a homogenization of survey responses. It is also likely that the student's participation in a technology course increased the likelihood of them hearing about technology in school.

Pre-course data, when divided by gender, indicates that there is a statistically significant difference between male and female attitudes regarding the statement, "I would rather not have technology lessons in school." Female students "tend to disagree" with the statement, while male students "disagree" with this statement. By then end of the course both male and female groups "tend to disagree" that they would rather not have technology lessons at school. Male student opinion changes during the course, while female opinion remains consistent. It is possible that curriculum was not as interesting or fun as male students had anticipated it would be, and therefore, their opinions moved away from total disagreement. As discussed earlier, this could be due to a lack of interest in projects, or a due to a misunderstanding of what the course would entail.

Gender groups showed statistically significant differences when responding to the statement, "Technology and engineering seems like an exciting eighth-grade elective," in both pre-course and post-course data sets. Both sets of data showed the male group significantly more excited than the female group. Furthermore, when presented with the statement, "I will enroll in eighth-grade technology and engineering," gender group data showed in both pre-course and post-course surveys that male students agreed with the statement more, at a level reaching statistical significance. The lack of female enrollment can be tied to viewpoints from the interviews with 8th grade female students. Their responses reinforce that classroom climate played a large role in discouraging females from considering *Eighth-Grade Technology and Engineering.* Despite efforts to develop more gender neutral curriculum and lab activities, it is likely that the course is still male-oriented, and therefore not appealing to female students. In order to improve female interest in the technology education course, course projects may need to be re-evaluated.

Viewpoints from 8th grade females. Eighth-grade female technology and engineering students made a number of suggestions on ways to improve *Seventh-Grade Technology and Engineering*. Many of the ideas presented by eighth-grade technology and engineering female students were similar to those that were found in prior research. The students surveyed stated that they enjoyed working with computer aided design software.

When asked to explain what they felt detracted from the technology and engineering environment, the group of female eighth-grade technology and engineering students stated that the noise, dull colors, and machines in the technology education laboratory made it a "guys room," and that the room was too dirty. The group also made the recommendation to have eighth-grade female technology and engineering students speak to seventh-grade technology and engineering classes.

Recommendations

Since female respondents indicated that they have access to a technical workshop at home, and because they also indicated that they were interested *Seventh Grade Gateway Technology and Engineering*, it may be beneficial to develop a technical project that students can take home to work on with their parents or siblings so that they can begin to bridge the gap between an awareness of technology at home and using technology at home.

Feedback from eighth grade students, literature reviews, and study data indicate that peer-presentations and role models can make a difference in student views toward technology and careers in technology. If re-implementing this study, it may be prudent to include professional role models as well as information about careers that highlight people of diverse backgrounds.

It would have been beneficial to survey a group of eighth-grade female students who did not enroll in eighth-grade technology and engineering. While the focus group in the study provided some helpful insights, they had already chosen technology and engineering as an elective, and were therefore, somewhat bias.

Overall, survey data indicated that students were less interested in technology courses after completing *Seventh Grade Technology and Engineering*. This is most likely due to a curriculum that has a gender bias. When participating in curriculum developed for female students, it is possible that male students became uninterested, and while participating in curriculum that male students found interesting, female students may have become uninterested. In order to make the seventh-grade course as gender-equitable as possible, it may be necessary to re-design curriculum an instruction so that it is more gender-neutral, and thereby both male and female students may take an interest in it.

Research completed during this project has left a few suggestions for the improvement of curriculum and facilities. Focus group data suggests that in order to increase female enrollment one should decorate the technology laboratory and classroom with pictures of female students working with technology and examples of female students' projects. Data gathered from both the literature review and from this study indicates that in order to increase female enrollment, one must develop a classroom and laboratory that is clean and interesting. Female students are not interested in typical "shop" environments. Data has also indicated that female students are excited by design projects where they can develop their own ideas, and that simply operating machines does not offer enough excitement to bring female students to into technology education class.

Since both genders increasingly named their parents opinions as important factors in which elective courses they choose. One could focus on improving enrollment through parent understanding of technology and engineering by sending brochures home or through open houses.

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Appendix A

Consent to Participate in UW-Stout Approved Research: Seventh-grade Consent Form

March 19, 2009

Dear Parent or Guardian,

The purpose of this letter is to request permission for your child to participate in research that I am conducting as part of my master's degree program at the University of Wisconsin Stout. Your child is a student in my seventh-grade Gateway to Technology and Engineering class at Templeton Middle School. The topic of my research is "The Effects of Design and Modeling Curriculum and Instruction on Female Enrollment in Eighth-grade Technology and Engineering." During the course of the quarter, your child will participate in an anonymous survey to determine the reasons he / she did or did not enroll in Eighth-grade Technology and Engineering.

Participation is completely voluntary. Students who choose to participate but later choose to withdraw may do so at any time.

My child ____ (does does not)
have my permission to complete this survey. [circle one]

Parent Signature ____

Student Signature ____

This study has been reviewed and approved by the University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have any questions or concerns regarding this study please contact the Investigator or Advisor.
If you have any questions, concerns, or reports regarding the rights of your subject, please contact the IRB Administrator.

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This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

Appendix B

Consent to Participate in UW-Stout Approved Research: Eighth-grade Consent Form

March 19, 2009

Dear Parent or Guardian,

The purpose of this letter is to request permission for your child to participate in research that I am conducting as part of my master's degree program at the University of Wisconsin Stout. Your child is a student in my Eighth-grade Technology and Engineering class at Templeton Middle School. The topic of my research is "The Effects of Design and Modeling Curriculum and Instruction on Female Enrollment in Eighth-grade Technology and Engineering." During the course of the quarter, your child will participate in an anonymous survey to determine the reasons he / she did or did not enroll in Eighth-grade Technology and Engineering.

Participation is completely voluntary. Students who choose to participate but later choose to withdraw may do so at any time.

My child ______________________________________ (does does not) have my permission to complete this survey. [circle one]

Parent Signature ______________________________________

Student Signature ______________________________________

This study has been reviewed and approved by the University of Wisconsin-Stout's Institutional Review Board (IRB). The IRB has determined that this study meets the ethical obligations required by federal law and University policies. If you have any questions or concerns regarding this study please contact the Investigator or Advisor.
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Appendix C

Seventh-grade Technology and Engineering Survey

Derived from the Pupils' Attitude Towards Technology (PATT) USA Instrument developed by Dr. Marc de Vries, Professor at Eindhoven University in the Netherlands; Dr. Allen Bame, Associate Professor of Technology Education at Virginia Tech; and Dr. William E. Dugger, Jr., Professor of Technology Education at Virginia Tech.

Permission Granted 11/2009

http://www.iteaconnect.org/Conference/PATT/PATTSI/PATTSurveyInstrument.pdf

Derived from the Pupils' Attitude Towards Technology (PATT) USA Instrument:
http://www.iteaconnect.org/Conference/PATT/PATTSI/PATTSurveyInstrument.pdf

This research has been approved by the UW-Stout IRB as required by the Code of Federal Regulations Title 45 Part 46.

We are interested in your opinion on technology. Please answer the following questions to the best of your ability. There are no right or wrong answers, only opinions. Section 1 asks about you, and will help us get to know you better. Section 2 asks questions about your feelings toward technology. Section 3 asks about your plans for 8th grade coursework.

Section: ____________________

1. **Are you a male or a female?**
   ○ Male ○ Female

2. **If your mother has a job, how much does it have to do with technology?**
   ○Very Much ○Much ○Little ○Nothing

3. **If your father has a job, how much does it have to do with technology?**
   ○Very Much ○Much ○Little ○Nothing

4. **Were you excited to participate in Technology and Engineering class this year?**
   ○Very Much ○Much ○Little ○Nothing

5. **Do you play with technical toys like Tinkertoys, Erector set, or LEGO at home?**
   ○Yes ○No

6. **Is there a technical workshop at your home?**
   ○Yes ○No

7. **Do you have brothers or sisters that are interested in technology?**
   ○Yes ○No

8. **Would you consider a job in a technology field when you grow up?**
   ○Yes ○No

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9. **Technology is as easy for males as it is for females.**
   ○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

10. **I hear a lot about technology and careers in technology at school.**
   ○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

11. Technology makes peoples lives better.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

12. You have to be smart to study technology.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

13. Males are better at mechanical tasks than females are.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

14. I would rather not have technology lessons at school.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

15. You need to be strong to work in a technology field.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

16. Males know more about technology than females do.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

17. The world would be better without technology.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

18. You need to be good at math and science to study technology.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

19. I think that machines are boring.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

20. Technology classes should be taken by all students.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

21. You have to use tools to study technology.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

22. Working with your hands is part of technology.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

23. Design is an important part of technology.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

24. When I think of technology I mainly think of wood working.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

25. Using different materials is an important part of technology.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

26. Technology is only found in industry.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

27. Technology helps people more often than it hurts them.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

28. If I knew more about designing and building things, I could be better at it.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

29. Technology classes are important for all careers.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

30. My parents and family have the most say on whether or not I will enroll in 8th Grade Technology and Engineering.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

31. I will only enroll in an 8th Grade Technology and Engineering if my friends do.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

32. I enroll in electives based on my own personal interests.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

33. Technology and engineering seems like an exciting 8th grade elective.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

34. I will enroll in 8th grade technology and engineering.
○Agree ○Tend to Agree ○Neutral ○Tend to Disagree ○Disagree

Appendix D

Focus Group Questions

1. Why did you choose to enroll in eighth-grade technology and engineering?

2. What things about seventh-grade technology and engineering made you want to enroll in eighth-grade technology and engineering?

3. What things about seventh-grade technology and engineering may have steered your friends away from enrolling in eighth-grade technology and engineering?

4. Please comment on the classroom and laboratory. Are the rooms girl friendly, boy friendly, or both?

5. Could each of you please sum up your suggestions into one main idea?