# Developing and Validating a Knowledge-Base for Professional Development Activities In Gender Equity for the Study of Technology

by

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## ABSTRACT

An underlying philosophical premise of technology education is that technology is a human endeavor that is performed by all people regardless of gender. The importance of this philosophical premise being a reality of education becomes imperative to life in a society which strives to continually advance itself. In spite of this importance, there is compelling evidence which suggests that technology education does not equally serve all people in this endeavor regardless of gender.

In an effort to affect change with the issue, five key influences were identified as being significant in their effect on the status of girls and young women in technology. A publication that describes these salient topics was developed as a knowledge-base to be used to generate professional development activities.

A focus group of professionals evaluated the publication as to its relevance, accuracy, comprehensiveness, and adequacy in relation to each of the key influences. The data was subsequently used to revise the publication before dissemination and implementation.

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# Chapter I: Introduction

Technology education was introduced to the United States around the turn of the nineteenth century. From its inception, technology education, then called manual training, was thought of as a male endeavor. The "Father of Manual Training", Dr. Calvin M. Woodward considered manual training studies to be a fruitful pursuit of boys (Woodward, 1890). He proposed to create well-rounded citizens of all boys, no matter what their level of intellectual aptitude.

Over the years many theoretical movements have been proposed to make the study of technology a more equitable pursuit for both genders. Both the Sloyd movement and the philosophy of John Dewey promoted the concept of "busy" and "industrious" children (boys and girls). Charles Bennett envisioned manual arts studies as a general education component. Then in 1947 came William Warner's appeal to view the world and this discipline through a technology perspective rather that an industrial one. The discipline is now known as technology education (Salomon, 1896, Dewey, 1899, Bennett, 1917, & Snedden and Warner, 1927).

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. Despite the philosophical appeal of this fundamental idea there is compelling evidence that suggests men and women are not equal players in the enterprise called technology. In reality men clearly dominated many technological endeavors. For example, at the professional level only 22.6% of the architects and less than 10 percent of the engineers are women. Similar demographics are apparent for many of the classical occupations commonly associated with technology. The predominance of the men at all levels of technology activity has created the common perception that doing technology is a male gender role. This conclusion is inconsistent with the philosophy

and mission of technology education, and it does not address the needs of people living in a technological society (Welty, 1996).

The twentieth century has seen the human endeavor for a better life literally catapulted into outer space. Technology has had an effect on most every aspect of human life. At the current rate, the twenty-first century promises to provide even greater enhancements. Yet, in spite of all the technological advances and educational reforms, technology education and technical careers continue to attract limited numbers of girls and young women.

There is and old saying that "the more things change, the more they stay the same." This saying has some profound and troubling implications for technology education and the preparing of girls and young women for careers in technology. Patricia O'Riley (1996) points out that "a multiplicity of exclusionary practices has contributed to the mapping of women on the periphery or invisible technology stories {and studies} including: the assignment of women to the private sphere since the Industrial Revolution; the gendering of work tools; and the omission of women's perspectives and contributions to technology in historical records." Although the last one hundred years has seen various changes in the study of technology, more work needs to be done.

This situation must be examined, and further reforms launched. The examination and the corresponding reforms must be systemic in nature because of the history that has fostered this situation and the various influences involved. There is no one reform that can expand the current focus of technology education to and be attentive to girls and young women.

The systemic reforms that will be required to alter this situation need to be delivered in a manner that can be absorbed and utilized by classroom practitioners and administrators. The ever expanding roles and responsibilities of these professionals in the lives of children limit their

ability to develop their own course of action. This is coupled with a multiplicity of issues involved and corresponding theories for each. The result is overwhelming for even the most dedicated professional.

The Carl Perkins Vocational Education Act makes funds available to each state for the purpose of preparing students for nontraditional training and employment. The Wisconsin Department of Public Instruction has proposed that the best way to initiate the necessary reforms for gender equity in the study of technology is to provide pre-service and in-service instruction for professionals, especially classroom practitioners, administrators, and counselors. This training will allow teacher time to concentrate on the salient issues influencing the situation, and provide them with useful tools for attracting and being attractive to the perspectives of girls and girls and young women in the study of technology. It will also ensure that professionals have a common frame of reference from which they can draw their ideas and practices.

Results of this training will focus on expanding opportunities for students in the study of technology. Technology education instructors and counselors may find this study useful in influencing the enrollment and retention of female students. This could also influence the number of girls and young women pursuing technological careers, particularly for young women in the trades and technical fields; these fields are generally "high skill, high wage" occupation in which the number of females is quite low.

The challenge is to develop and validate a knowledge-base that will be used to generate professional development activities. The current knowledge-base must be gathered from research being done in computer science, science, and mathematics, and adapted to technology education because of the thin knowledge-base available for the study of technology. The salient issues of this knowledge-base must then be synthesized into a document that can be efficiently

absorbed and utilized by professionals. The significance of such a document would provide a common frame of reference and a sound foundation for professional development activities that target the status of girls and young women in technology education.

*Statement of the Problem*

Unfortunately, the review of literature did not uncover a single concise treatment of the salient variables that are involved in attracting, or turning away girls and young women from the study of technology. Therefore, there is a need to develop and validate a knowledge-base for professional development activities on gender equity in technology education that can be used by professionals.

*Purpose of the Study*

The purpose of this descriptive study is to develop a publication that describes the salient issues that affect the status of girls and young women in technology in a matter that is relevant, accurate, comprehensive, and adequate.

*Objectives*

This study will strive to produce a publication that meets the following objectives:

1. Describe the social and cultural factors that contribute to or diminish the extent to which girls and young women feel like they fit into technology education.
2. Describe the curriculum and instruction issues that affect the status of girls and young women in technology education.
3. Describe the classroom climate variables that temper or enhance the participation of girls and young women in technology education.
4. Describe the function role models, mentors, and peers play in the recruitment, retention, and advancement of girls and young women in technology education.

5. Describe the influences that messages from counselors have on the enrollment of girls and young women in the technology education.

*Definition of Terms*

The following definitions of terms were used to clarify and identify the problem:

*Accuracy:* Is the text in conformity with fact, reality (Merriam-Webster, 2000)?

*Adequacy:* Is the text proportionate in its coverage to its importance to the topic (Merriam-Webster, 2000)?

*Classroom Climate:* The signals sent to students through teacher-student interactions and student-student interactions, and the physical environment (Sandler, 1992).

*Comprehensiveness:* Is the text large enough in scope to exhibit extensive understanding of the topic (Merriam-Webster, 2000)?

*Curriculum and Instruction:* The ways in which young people are asked to think about technology, and the topics, activities and examples used in instruction (McIntosh, 1984 & Rothschild, 1988).

*Focus Groups:* An organized discussion with a selected group of individuals to gain information about their views and experiences of a topic (Gibbs, 1997).

*Mentors:* A wise and trusted counselor or teacher (Merriam-Webster, 2000).

*Peers:* A person who has equal standing with another, as in rank, class, or age (Merriam-Webster, 2000).

*Relevance:* Is the text of, relating to, or connected to the topic, and appropriate to the readers' needs (Merriam-Webster, 2000)?

*Role Models:* An individual who serves as a model in a particular behavioral role for another individual to emulate (Merriam-Webster, 2000).

*Social Fit:* The perceived "fit", or "lack of fit" in technology careers due to identity, role identity, gender identity and occupational roles (AAUW, 1995).

*Technological Careers:* Occupations in fields that are generally "high skill, high wage" (United States Department of Commerce, 1999).

*Technology Education:* A course of study with a content that focuses on the knowledge, tools, processes, and systems of technology in society (Parrish, 2001).

*Technology:* The generation of knowledge and processes to develop systems that solve problems and extends human capabilities (International Technology Education Association, 1996).

*Limitations of the Study*

The limitations of the study are as follows:

1. The content researched was limited to five influences.
2. The classroom practitioners, administrators and the counselors reviewing the document are from the State of Wisconsin.

# Chapter II: Literature Review

Throughout history and across cultures women have played an integral role in the development of technology. The mechanical inventiveness of women helped achieve the advancement of many civilized societies known today. Historically, this influence was so important, that many cultures had heroines of technology as cultural icons.

For example, Greek culture holds the goddess Athena in reverence as the original inventor of all mechanical arts. The mythology credits Athena as being the senior partner in a workshop with the Greek god, Hephaestus. It is also believed that Athena taught the Mediterranean god, Daedalus, the lost-wax method of bronze casting. Women in this culture were so revered for their mechanical skill that when Hephaestus set up his own smithy, he did so under the protection and patronage of two females; and he created female robots to help him (Graves as cited in Stanley, 1993).

Roman culture offers Minerva as the deity of handicrafts. Stanley (1993) reports that Minerva is specifically credited with inventing the distaff and the needle, weaving (thus presumably the loom), olive "mills" and the technique of crushing olives to extract the oil, among other things. She is a good role model for female ingenuity because "some sources consider women's food-processing apparatus and system the world's first venture into engineering.

Many more mythological examples provide evidence of the mechanical ingenuity of women. Other cultural icons include: Brigit, the Irish Saint and Celtic Triple Godess; Tsenabopil of Melanesia; Miti-Miti of Siberia; and Sara(s)vati of India. The myth related to female ingenuity becomes reality as divisions of labor in prehistoric and early historic societies are examined. Because women used more tools than men in early history to accomplish their

burden-bearing labor it is reasonable to conceive that women probably invented most if not all of the five primary machines (lever, wedge, screw, pulley, and inclined plane) that are the basis of all mechanical invention (Stanley, 1993).

As civilized societies have evolved, so has the stereotype that separates women from machines as smoothly as oil from water. Although many women have defied the stereotype by pursuing their mechanical ingenuity, it has not been without great sacrifice. Most of these women's inventions have been patented under a man's name, held as a trade secret, or simply dismissed as "domestic". The stereotype that separates women from technology not only paints a false picture of the history of technology, but it also threatens to exclude at least fifty percent of the population from being prepared to work and participate as literate citizens in an increasingly technological society because girls and young women fail to see their importance as technicians.

Advances in technology continue to affect every human being on the face of the planet. The numerous applications are an integral part of the way people interact and connect. No matter what walk of life a person pursues, he or she will be confronted by the need to know about nature of technology, how to use it, and its impact on the world. Many of the things that are taken for granted in the daily courses of life are quite technological in nature.

These advances in technology have also impacted the professional world of work. The roles of employees, and the skills required by the jobs available demand a greater understanding of technology (United States Department of Labor, Bureau of Labor Statistics, 1999). This coupled with the changing demographics of the workplace calls for an examination of the impacts of our current treatment of how we prepare young people, especially girls and young women, for these technical careers.

The need for appropriate technical education by all Americans has never been greater (United States Department of Labor, Bureau of Labor Statistics, 1999). Yet, a large sector of Americans has been classified as technological illiterates (Gilberti, 1991). Many of the people under this classification are girls and women. In fact, it is known that a majority of female secondary students are unfamiliar with the term technology education (Klecker, 1987). In 1992, it was discovered that only 12.1 % of female students were enrolled in technology education classes. That is a decline of over half the number of female students that participated in such courses over 20 years ago (Staff, 1994). In 1998-99 (the latest year for which data is available), only 17% of the students enrolled in technology education in Wisconsin's secondary schools were female. And their enrollment was concentrated in printing, drafting, and design. These figures are especially significant because of the rapid increase of technology used in the workplace and society.

There are many things that turn females away from the study of technology, and the pursuit of careers in the trades and technical fields. Based on a review of literature concerning the relevant theories and best practices concerning women in technology, there are five key influences over which classroom teachers, counselors, and students have some control. These influences, which include curriculum and instruction, classroom climate, social fit, role models, mentors, peers and messages from counselors, form the conceptual framework under which expanding opportunities for technical literacy for all students, especially girls and women, can take place.

*Curriculum and Instruction*

Since the inception of organized education in this country, the upper class, white male perspective has been used as the universal experience for all students. The use of this

perspective as the standard is not surprising because these people have long held the most prominent positions in society. This perspective assumes that this experience can be generalized to that of all human beings regardless of gender, race, or social class. The contributions, participation, and perspective of females are rarely honored by this male-defined curriculum. It also creates the side effects of limiting the access of girls and women to the education and jobs important to life in a technological society.

The ways in which we ask young people to think about technology, and the topics, activities, and examples used to instruct are derived from a male perspective. The male-defined curricula perspective utilizes terminology, activities, and examples that are closely tied to the life experiences of boys. For example, the average technology class will give the student and opportunity to "tinker" with technological "objected", or "tackle" a technological problem; or a drafting class insists on drawing car parts.

The addition of the female perspective explores the significance of the individual human experience. It considers women's ways of knowing, and an analysis of experience intrinsic to the everyday lives of females such rituals, housework, childbearing, child rearing, female sexuality, female friendship, and studies of life cycle (Banks & Banks, 1997). These are considered in not only what it means to be female, but also what it means to be part of the human race. For example, Eisberg (1993) references a class being taught a UW-Waukesha called "Biology of Women". This course teaches students about basic scientific knowledge as well as viewpoints seldom seen in scientific and medical literature. Health issues that ultimately impact all human beings, like breast cancer, Aids, sex and reproductivity are discussed.

When considering female pedagogy that take into account the perspectives of both males and females, brain research and cultural/communication differences need to be understood.

According to Restak (1979), boys and girls have different "biological and intellectual repertoires". Despite the concerns about the role that stereotypes and culture play in a child's development, the part that basic brain functioning plays cannot be overlooked.

Basic brain research (as discussed by Restak, 1979) shows that, at birth, girls are more sensitive to sound, have increased skin sensitivity, better fine motor performance, have a greater social awareness, and increased language abilities. When problem-solving, electrical activity occurs across both hemisphere of the brain. Tests indicate that these abilities develop early in life and linger later in life.

Boys on the other hand, display early visual superiority, total body coordination, more curiosity, increased attention to inanimate objects, their environment, and are better at manipulating three-dimensional space. Electrical activity is centered in the right hemisphere of the brain when handling special tasks. Interestingly, "intellectually outstanding boys are often timid, anxious, not overly aggressive, and less active" (Restak, 1979).

The studies being conducted on brain research do not attempt to prove superiority of one sex over another; they instead allow for a better understanding of basic psychobiological differences between the sexes. This understanding is critical to creating curriculum and instruction that will allow girls and young women opportunities to excel in classrooms that have been normally structured to engage the learning preferences of boys.

Another critical element to the success of female students in technology education is a consideration of the role that culture plays in the life of the student. With the diversity of today's student population, "the teachers, schools, curriculum, and/or instruction do not always share the cultural lens through which children participate in the lessons of school" (Adler, 1999). Studies conducted by Fleer, Au and Kawakami (as cited in Adler, 1999) reveal that classroom instruction

is most effective when it is sensitive to both learning styles, and cultural values. This cultural sensitivity allows incorporation of a student's ancestral culture into curriculum, teaching methods, and instructional materials. In cultures, such as African-American and Mexican-American, that value the cooperation and interdependence of its members, students prefer to work together and share; whereas, cultures that value independence and self-reliance as does Euro-American culture, students prefer to work alone. It is therefore important to actively engage the parents and community of children, whose cultures are not white, middle-class mainstream culture in the development and selection of curriculum.

Integrating the perspectives and contributions of women into the technology education curriculum is not a simple endeavor. In her book, Rothschild (1988) recounted a few words of caution offered by Charlotte Bunch at the close of the first convention of the National Women's Studies Association in 1979. The essence of her message was that educators in their efforts to balance the curriculum should not just "add women and stir". Rothschild illuminated Bunch's "culinary metaphor" by stating "if one adds a new ingredient to the beef stew without changing the basic recipe, the flavor or consistency might change somewhat, but we still have only a variation on the same beef stew" (p.30). If the technology education community strives to use gender neutral language, employs gender-balanced media, and introduces students to female role models, the curriculum will be ultimately richer. However, the ways we ask young people to think about technology will remain essentially the same. Although these are basic and essential interventions, they are by no means sufficient. Removing gender bias from the technology education curriculum will require systemic change.

Several models have been developed for integrating women's perspective into the science curriculum (Baker & Scantlebury, 1994). In addition to serving the science community, these

models could also be used to infuse the contributions and perspectives of women into the study of technology. The most widely quoted model in the literature was developed by Peggy McIntosh (1984). According to her model, the infusion of women into the curriculum goes through five phases. With each phase, leaders would further develop their awareness of women's roles in technology and implement more sophisticated and inclusive curriculum reforms. For the purpose of this paper, McIntosh's model would be "womanless technology". In phase one, the curriculum does not acknowledge women's contributions to, or their participation in technological endeavors. Furthermore, the curriculum does not account for women's concerns about the ways in which technological activities are conducted. Women are absent from course content and instructional materials. In short, the curriculum is presented solely from a male point of view. Lastly, with only few isolated expectations, the teachers and students participating in the discipline are male. Old textbooks featuring images of men doing technology could serve as an icon for phase one.

The second phase would essentially be "women in technology". During phase two, famous women in technology are featured in technology education curricula and instruction. The curriculum presents the perspectives and contributions of exceptional or elite women in technology in periodic vignettes. However, the fundamental definitions, assumptions, methodologies, and values underlying the study of technology remain essentially the same. The special attention given to the technology's heroines puts women on the periphery of mainstream technology. Rothschild (1988) equated phase two with "add women and stir" (p.39). An icon for phase two could be a textbook featuring stories about "heroines of technology" in sidebars or boxes that are separate from the main text.

In phase three, the central theme would be "women as a problem, anomaly, or absent from technology". During this phase women are studied in the context of being overshadowed by men and victims of the "good-old-boy" fraternity within the technology community. Questions are raised and discussed regarding the ways in which women have been left out of the structure of technological knowledge and subsequently, the school curriculum. Women in technology become a curriculum issue and they are studied in the context of race, gender, and class within sociological and political aspects of the technology enterprise. Although the absence of women as the discipline's culture received scholarly attention, women are still not treated as an integral part of mainstream technology. A book addressing the lack of recognition given female inventors because of sexist patient laws and social norms could be an icon for phase three.

Phase four would be called "women as technology." During this phase, the curriculum would recognize that women account for at least half of human history (Rosser, 1986) and the intellectual resources available to humankind. More specifically, the curriculum would take a proactive stance toward women by including topics, learning activities and examples that are consistent with the experiences, interests, concerns and learning styles of women. Reaching phase four requires a systemic reconceptualization of the technology education curriculum. Since very little if any tangible progress has been made toward reaching this goal, an icon for this phase is difficult to visualize. However, one could assume that approximately half of the students and teachers participating in technology education would be female. Furthermore, significant innovations in textile and food technology would be studied based on their contributions to human potential in contrast to their potential role in helping the discipline be politically correct.

The last phase in McIntosh's model would be called "technology reconstructed and refined to include us all." At this level women would be intrinsic and an integral part of the enterprise called technology. The attention given to the contributions, perspectives, and potential of women in the previous phases would result in new epistemological foundation for the study of technology (Rothschild, 1988). McIntosh estimated it could take over 100 years for the science community to reach phase five.

Assuming McIntosh's model is a valid tool for gauging the field's progress toward a truly gender balanced curriculum; it is safe to say that technology education has been in phase one for most of history. The modest attention given to gender equity in technology education textbooks, curriculum guides, student recruitment activities, instructional media, and the professional literature indicates that the field is somewhere in phase two. Perhaps the number of sessions addressing gender issues during recent ITEA conferences suggests that some leaders might be moving toward phase three. However, in order to enter phase four, leaders in technology education will need to confront unsettling ideas about the assumptions that underlie our curriculum, pedagogy, and collegial behavior.

The students in classrooms are becoming increasingly diverse as time pushes into the twenty-first century. The global society that is being propelled by the development, acceptance, and use of technology makes it imperative that all citizens are technologically literate. As the contributions, participation, and perspective of women are incorporated into curriculum, not only are students and educators taught about the lives and concerns of women, but also the lopsided view of the male experience is also exposed.

When considering how to create concrete examples for a technology education classroom that will be sensitive to needs of girls and young women, the base premise of technology

education must be kept in mind. Technology is frequently thought of as physical, tangible things, and is the result, or end product of technological innovation, knowledge and or process. A more inclusive way to think of technology is as the generation of knowledge and processes to develop systems that solve problems and extend human capabilities. At the heart of technology education is the concept of solving problems for the enhancement of human life. Pedagogy that takes into account the female perspective embraces the opportunity to solve such problems; thus, the curriculum and instruction of technology education can engage a broader spectrum of students by being portrayed as a way to solve problems rather than just as a plaything.

Pollina (1995) offers some successful practices from girls' schools that are sensitive to female pedagogy, and can bolster the effect of technology education lessons:

- Connect mathematics, science, and technology to the real world...connecting any subject to the lives of real people and the good of the world is a powerful hook for girls.
- Choose metaphors carefully, and have students develop their own. Terminology and examples come from the masculine perspective.
- Foster an atmosphere of 'true' collaboration. This requires projects that need the help of each member to be complete.
- Encourage girls to act as experts. Allow students to develop and exhibit their self-confidence verifying their own logic and critiquing their own work.
- Give girls the opportunity to be in control of technology.
- Portray technology as a way to solve problems as well as a plaything.
- Capitalize on girls verbal strengths.
- Experiment with testing and evaluation. Try using embedded assessments.

- Give frequent feedback, and keep expectations high. ...It's vital to provide frequent feedback in the form of homework checks, quizzes, and comments, thereby reinforcing students' belief in their control of the material.
- Experiment with note-taking techniques.

Thus, the challenge that currently stands before technology education teachers is to rethink traditional curriculum and instruction based on the recognition of an increasingly diverse student population, and the need for all students, especially girls and young women, to understand, use, and manage technology. A fresh understanding of how boys and girls develop and learn, and an examination of the lens through which technology education is being taught will go a long way towards affecting the changes necessary to allow curriculum and instruction to engage girls and young women.

*Classroom Climate*

The signals sent to young women through teacher-student interaction and student-student interactions, and the physical environment can send a chilly message to females. Sandler (1991) states that the heart of the education process is what actually happens within the classroom. Inadvertent verbal and nonverbal behaviors play a major role in determining how students feel about being in a particular class and whether students engage in and reap the maximum benefits from the educational experience. Numerous researchers have documented that many faculty members unknowingly treat men and women differently in their classrooms. However, faculty members can be taught to eliminate unfair behaviors and replace the chilly classroom climate with a more interactive classroom that provides a better learning environment for all students.

Shakespeare said, "life is a stage...," and to teachers the classroom is the stage. Teachers need to be aware of how their own "class fright" (Hill, 1993), and personal bias is reflected in

their own teaching style. Since few teachers ever receive training in acting it is no wonder that many teachers are unaware how their behaviors affect their audience – the students.

Most students come to class with more "class fright" than the teacher. Students, girls and young women especially, come to the technology education classroom with preconceived ideas about the subject, and of what the teacher will be like (Hill, 1993). Although these notions are not all negative, the technology education classroom carries a variety of bias because of negative notions attached to the traditional "shop". It is the role of the teacher to reshape and break down these negative beliefs and create a more equitable and effective classroom. 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 climate for girls.

Verbal behaviors that create a chilly classroom climate can range from a simple "vague" answer, to a blatant comment that is disrespectful to a female student's perspective. Girls and young women feel their presence and perspective devalued when teachers ignore male students that interrupt female students, or when teachers call on male students by their last names, and female students by their first.

Some verbal behaviors that teachers can incorporate into their teaching style that encourage their female students to participate equally in the classroom are easier than one might think. For example, treat all students equally as individuals rather than members of a particular gender, and use gender-neutral language and terminology. Using the terms "guys and gals" or "ladies and gentlemen" can actually serve to separate and alienate female students. Addressing each student by their name lends to more equal treatment of the students as individuals. Uniformity in use of either first or last name among students is also important. Calling on

female students with approximately the same frequency as male students legitimizes the female students' perspective as well as sets up an equal standard of participation for all students. In a study conducted by Myra and David Sadker (as cited in Sandler and Hoffman, 1992) "the instructor asked three times as many questions of the male students and gave four times as much praise to male students". Although a teacher may be aware of this lack of attention, it speaks volumes to the students in the classroom.

The nonverbal interaction cues between teachers and female students are also critical. Body language has been the cause of many misunderstandings over the years. Here teachers need to be as aware of their own body language as that of the female student. Although girls are more likely to raise their hands than boys, some girls may not raise their hand out of fear, but will instead lean forward in their chairs, or give other facial clues that they want to participate (Sandler and Hoffman, 1992). Using direct eye contact (not staring) with female students lets them know that there is interest in what they have to say.

In addition to being aware of the signals sent by teacher-student interaction, a teacher must consider how long student-student interactions create a chilly classroom climate for girls and young women. Since boys have been in the majority of students enrolled in the technology education classroom, female students tend to be uncomfortable, and perceive themselves as being on display. The basic behavioral nature of boys makes the classroom atmosphere intensely competitive, and many boys see the female students as either intruders or romantic targets (Eisberg, 1993). The notion of a "boy's club" has attached itself to the subject, and girls appear as intruders when they choose to enroll in these classes.

Teachers can facilitate student-student interactions that encourage gender equity in technology education classrooms. Beginning with the first class, the teacher should establish

classroom norms and response etiquette that is respectful of all students. By incorporating the learning styles of students into instruction, and having an awareness of cultural influences teachers can organize labs and work groups in a manner that allows for positive cooperative learning experiences that meet the needs of all students. One example is to initially pair female students together. This allows and encourages female students to take charge and become experts of technology. Once their confidence and skill is developed, they are more likely to actively participate with male students. Although it is difficult for teachers to have direct control over all student-student interaction, if they "actively point out and dissuade activities, comments, and jokes that reflect stereotyping or bias, they will create an environment where gender putdowns and insensitivity (even in the guise of humor) go un-rewarded or are actively discouraged" (Henes, 1994).

The physical technology education environment is another element that can either welcome or be a turnoff to girls and young women. Females tend to avoid technology education classrooms and related careers because dirty, rough, stressful environments and the physical strength that has been required to operate equipment intimidate them. Although technological careers as well as some technology education classrooms have become much more "sterile" environments, the stereotype of the "dirty shop" remains in the minds of many girls and young women. A way to dispel this stereotype is to encourage people to visit the technology education classroom, see the concepts being taught, and their application to life.

A climate prevalent in a classroom plays another key role in the potential of women in technology. There are a multitude of strategies that teachers can use to create a productive classroom environment that actively engages both the student and teacher, and student and

student for a positive learning experience. Awareness of behavioral signals and basic environment are the starting point.

*Social Fit*

From the time children are born their identity is being shaped by an array of influences. Each of these influences carries its own set of expectations for the potential of the child. Experience, confidence, gender bias and stereotyping, and parental perspective are all factors that can contribute to a "lack of fit" for females between perceived appropriate roles and technical careers in fields that are male dominated. As Sandler and Hoffman (1992) point out "...we are all influenced deeply by the educational and social environments in which we grew up and were educated as well as by societal patterns of beliefs and behaviors".

Girls develop their identity through social interactions, by connecting and communicating with others, more than boys (Gilligan, 1982). Therefore, it is not surprising that girls and women tend to value and perceive technology as a means of facilitating collaboration, communication, and linkages between people. Men, on the other hand, tend to see technology as a means of extending their control over their physical environment. Lastly, men tend to identify strongly with the technical details associated with a given technology, while the females are more attentive to its practical applications (Bank Street College of Education, 1991).

These basic biological dispositions for developing an identity and relating to the world are also connected to the expectations set forth by the society within which a child grows up. Each society has a history that predisposes on the people who live within the society. Feminist theory believes that the patriarchal history of American society limits the potential of girls and women through gender bias and stereotyping, and the absence of women's contribution, and

perspectives. Some of this can be seen through as examination of the toys used in a child's identity development.

Girls are taught to be helpless and fragile. Traditional gender roles prescribe that girls are dressed in pink, and given dolls to play with, in spite of advances. The typical damsel in distress as portrayed by popular media becomes the expected behavior. "At an early age, girls have fewer opportunities to engage in sports or hobbies that enhance their mechanical aptitude, and later they have typically played less with computers and high tech toys than boys have" (Eisberg, 1993). Girls learn this lesson well because "girls tend to demonstrate a learned helplessness in regard to technology" (Koch, 1994).

Boys on the other hand, tend to be encouraged to play with electric cars, tools, and other technically enhanced toys. This encouragement not only attends to their basic biological disposition towards inanimate objects, it also facilitates acquisition of the technological skills required for survival in a technological society. The design of the toys that boys are given accentuates the technology involved. Manufacturers will also use advertising to promote the technological nature of a toy for boys.

Toys designed to appeal to girls are becoming more technologically enhanced. For example, many dolls have small mechanical devices, and computer chips that allow the toys to perform certain human-like actions. This includes everything from basic talking and walking to eating and other human bodily functions. Although these toys are technologically enhanced, they reinforce the traditional gender stereotypes, by hiding the technology involved, or portray the female character as being masculine. Toys tend to either follow the "motherly nurturing", or "masculine" concepts. As Farmer (1998) pointed out, "More female role models are being presented (especially) in software", but the video games being produced with women as

heroines, give the female very masculine characteristics. This lesson in remedial masculinity does little to encourage girls and young women to step out of traditional stereotypical roles, or acquire the skills needed to function in a technological society.

When examining the role that bias plays in the development of a child's identity, and how it impacts later educational choices, one must look at all six forms of bias in order to see the whole picture. Sadker & Sadker (as cited in Banks & Banks, 1997) recommended that these forms of bias be used as criteria for evaluating teaching materials, as well as understanding their impact on a child's identity (p, 132).

Linguistic bias is the most pervasive form of bias, and the easiest to eliminate. The English language has a strong masculine bias. The use of mankind and he in reference to all people denies the existence of women. Occupational titles such as, mailman, policeman, and businessman fail to recognize the contributions women make to the world of work. Women also feel the shackles of linguistic bias when they are referred to as someone's wife or possession (Banks & Banks, 1997).

Stereotyping is a form of bias that plagues all human beings, especially women; they "may not be accurate, fair, or politically correct, but they are powerful". "Stereotyping [is] the biggest barrier women in "male" jobs face (Owen, 1993). For example, common careers for Anglo men are professional careers such as doctors, lawyers, and policemen. Anglo women tend to be portrayed as mothers, teachers, authors, and princesses. Role models for men of color are frequently shown as common laborers, farmers, warriors, Indian chiefs, and hunters. The portrait of women in color is no less dismal. They are shown as mothers, slaves, and common workers. These stereotypes are prevalent in all forms of popular media, toys and educational materials.

Another form of bias that is damaging for girls and young women is the invisibility of women. Throughout history women have made significant contributions to the enhancement of human life on this planet, yet their perspectives, contributions, and achievements are rarely honored. Sadker & Sadker (as cited in Banks & Banks, 1997) found that when students were asked to name twenty famous women, most could not even list five (p.133). According to Banks & Banks (1997), it is for this very reason Women's Studies programs were created. "Women's studies correct the history that has been written almost solely by White men about White men." Even though Women's studies have done a lot to break down problems associated with traditional stereotypical gender roles, these roles are still prevalent in society (p.68).

This prevalence is due to the imbalance of perspective offered. Girls and young women still see the role of women minimized by the limited offering of women's perspectives, contributions and achievements. Limited time, space, or lack of information about women is usually offered as the reason for this imbalance.

The fragmentation of women's contributions in technology and society also lends bias to the stereotypes that keep girls and young women from pursuing technological careers. Women whose perspectives, contributions and achievements are recognized are presented in a manner that creates the image that they are the exception rather that the norm.

Children are largely a product of their environment, and the messages given to girls and young women by parents and culture have an influence that cannot be ignored. Carnegie-Mellon University (Pittsburgh) conducted a survey (as cited in Owen, 1993) of students to find out how they chose a field of study. They discovered that males and females used different criteria to make their choices. Women said that they relied much more upon the influence and opinions of parents, spouses, family and friends than did men.

Bullivant (as cited in Banks & Banks, 1997) defines "culture as a group's program for survival in and adaptation to its environment" (p.8). This definition transcends the basic tangible elements that are important to archaeologists; it encompasses all the knowledge, values, and rituals that are used by the members of the cultural group to interact. The cultural diversity of the United States offers its inhabitants multiple microcultures in addition to the national macroculture. These cultures should be viewed as rings with the core values of these cultures overlapping. Children will be affected by the microculture of the family and ethnic community that they live in, as well as the national macroculture. The differences between cultural rings will compete for influence upon children's identities as they come in contact with them, but the microculture will tend to retain the most influence upon them. The national macroculture of the United States values a strong belief in individualism; but many microcultures such as African-American, Hispanic-American, and Indian-American prefer the cooperation and interdependence of their members (p. 11). The study of technology has been seen as a pursuit of the White microculture and the national macroculture. It is therefore an important consideration to understand how cultural identification affects not only girls in general, but those of different microcultures.

The array of influences to which girls and young women are exposed at an early age will have a significant impact upon the educational and career path that they choose. The impacts of social influences such as gender bias and stereotypes, parents, and culture must be recognized and dealt with before puberty; otherwise, interest in technology education is not likely to be strong. Also, utilization of technology in the lives of these contacts serves as a gauge for girls and young women. The context within which girls and young women see technology

represented and utilized in their lives will shape their identity in relation to the study of technology education, and the pursuit of a technological career.

*Role Model/Mentors/Peers*

The twentieth century has seen great strides in the area of technology. Human ingenuity has definitely been the "mother" of invention during this period of time. "Despite the suspicious absence of women in technological endeavors, there is compelling evidence that suggests women have made significant contributions to the development of technology. For example, the plow and harrow, the automobile windshield wiper, Kevlar, and Scotchguard protection were all invented by women" (Welty, 1996). Yet students, especially girls and young women, are not being exposed to these successful, creative examples.

Because of this lack of female role models, both in the public and private sector, girls and young women are reluctant to consider the study of technology and the pursuit of nontraditional occupations among their life options. 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, 1996).

Research indicates that role models and mentors, especially family members, are a powerful influence on females who pursue careers in technology. Critical attention must be paid to how role models and mentors are and can be used to open up technological careers to young women. Girls and young women still see mostly men in scientific careers and teaching classes related to mathematics, science, and technology. Although these male teachers work hard to be inclusive, there is still a perception that the absence of women means that women are not as welcome to pursue technology (Owen, 1998).

"Exposing children to successful women in technology can provide inspiration and role models for young women" (Dorman, 1998). These role models are the inspiration they need. Seeing other women making a difference in technology convinces girls that technology is not "just for boys".

If girls and young women can be exposed to women successful in technology at an early age, it can provide phenomenal results later in life. Children make critical gender role decisions based on their exposure to role models, and once students, girls and boys, reach puberty; they usually resist venturing outside these prescribed gender roles.

Public education plays an important role in the development of girls and young women for citizenship in technological society and more specifically, careers in technology. Despite the fact that women receive a majority (78%) of the education degrees, 97% percent of "industrial arts" teachers are men (National Center for Education Statistics, 1991). The absence of women among the ranks of technology educators reinforces the subliminal misconception that the study of technology education is a male endeavor. Without female role models, both within public education as well as from the private sector, girls and young women will be reluctant to consider the study of technology and the pursuit of non-traditional occupations among the options.

Only 1.7% of female high school seniors expressed an interest in pursuing a career in engineering in comparison to 8.6% of their male counterparts (National Science Foundation, 1993). However, once enrolled in an engineering program, women are more likely to drop out of the program than men. The women who dropped out of Michigan State University's engineering programs in 1990 reported that they withdrew from their program because they were not taken seriously in class, the labs were dominated by men, and there were few, if any, role models or

supportive peer networks. Ironically, women who do graduate from engineering and computer science programs have on average higher GPAs than their male peers (Owen, 1993).

In a study conducted by the Center for Technology in Education, a team of researchers interviewed 44 women and 22 men who were engaged in careers related to technology (Bank Street College, 1991). Most of the women reported having fewer experiences with technology during childhood than their male counterparts. Many reported being encouraged to pursue a technical career based on the encouragement of a mentor, who was typically male. Ironically, some of the women recounted being inspired to pursue non-traditional careers based on the counsel of others, often teachers, who said they could never succeed because of their gender.

Girls and young women need to be exposed to women who have successful careers in technical fields. However, some experts recommend avoiding placing too much emphasis on the "heroines of technology" (McIntosh, 1984; Rosser, 1986, 1990 & 1994; Sanders, 1994). Girls and young women are being told that they can have a career and a family. Some of the women featured in the popular press and recruitment campaigns have dedicated their lives to their careers and have not made time for families. These leaders argue that these role models can be counterproductive because they suggest girls and young women have to make significant sacrifices to become accomplished technologists. Instead of relying on people that might be perceived as "super women", these leaders recommend using everyday women from the community who have careers in technology and lead ordinary lives. Therefore, some of the more effective role models are the architects, engineers, computer programmers, and plant managers that live in one's community and happen to be women.

Technology is creating a global economy that is increasingly diverse. With this in mind, attention should also be given to providing role models from various cultures. Because culture

plays such an important role in the development of a child's identity, it is critical for girls and young women to see women from their own race being successful in technology, especially if they are not representatives of mainstream white culture.

Adolescent girls form very strong social bonds with female peers. They tend to go from one class to the next in groups and prefer activities that provide them opportunities to work together. Sanders (1994) recommends capitalizing on "the herd instinct and peer pressure" by implementing recruitment strategies that target groups and subsequently provide girls with opportunities in work groups (p.10).

In light of the biological predisposition of females and the significant impact that social contacts play in the development of female identity, it should come as no surprise that other role models, mentors and peers also serve as integral function in the choices that girls and young women make about their lives and how they relate to the world around them. The task of providing appropriate role models and mentors for girls and young women is of utmost importance, if they are to be encouraged to participate in technology education, and choose to pursue a technological career.

*Messages from Counselors*

Guidance counselors provide students with information and advice, about careers that will compliment their skills and interests, and recommend classes to take in order to prepare for those careers. Anecdotal information suggests that counselors turn young women away from technological careers more often than towards them, especially male dominated careers that require less than a four-year college degree. These messages fall into three categories: (1) Lack of Information, (2) Lack of Connection, and (3) Lack of Flexibility (Silverman and Pritchard, 1993).

A lack of information can make a significant impact on the impressions that children form about the world around them, and the decisions they make about what their potential is in this world. Students are not receiving the appropriate exposure to careers at an early age, especially technological careers. Middle school students tend not to know the meaning of the terms technology education and vocational education. They also tend to view careers as either male or female, and are unaware of the educational requirements and salary potential of most careers.

Because of school budget cuts many schools no longer have the resources available to inform students about different careers. Greene (1998) found that "guidance counselors feel that they are overworked to the point that they cannot steer girls into nontraditional fields". These funding cuts require a school district to usually focus career-counseling services on the high school students directly before they graduate. Some schools have even had to close their career centers.

This allocation of services is significant because the American Association of University Women indicates that girls still choose jobs and careers based on stereotypes (Greene, 1998). These stereotypes are developed early in a child's development, and it is more difficult to persuade a student to step out of these stereotypes the older they are. Because of this lack of exposure at an early age, girls still tend to "cluster in traditionally female occupations in vocational education and School-to-Work programs that prepare students for jobs after high school, and still tend to pick stereotypically female college majors, such as education or health services (Greene, 1998).

Parents as well as students need more information, and involvement in the career selection process. Since parents also play a significant role in a student's career selection, it is

important for parents to understand the options available for their child. This is sometimes easier said than done because of the stereotypes to which the parent may be predisposed.

In addition to the lack of exposure to careers at an early age, middle school girls are uninformed about the various technology education classes that are available to them at the high school level that could encourage pursuit of a nontraditional career. This lack of awareness of technology education class options keeps female students in traditional elective class tracks.

Silverman and Pritchard (1993) found that girls in the middle school did not make "connections between what they are learning in technology education classrooms and careers in technology fields". Because of the lack of exposure to careers in the world of work and economic realities, girls do not recognize the application of the knowledge they are acquiring. Students are also at a developmental stage where they "find it difficult to imagine themselves working in the real world" (Silverman and Pritchard, 1993). The false reality presented in popular media, and the lack of female role models in nontraditional careers does not help this lack of connection.

Education about possible technical careers involved with technology education classroom lessons, the corresponding salaries, possibilities for promotion, and preparation for such careers is seen as separate from the technology education lesson. That is an unfortunate perspective. Rather than only having such career exploration at career fairs, this pertinent career information could be available in the classroom in conjunction with the students' hands-on projects. This combination not only helps connect the knowledge with corresponding professions, but it gets girls in technology education classes to think about nontraditional careers, and it can dispel occupational stereotypes.

Role models and "special initiatives" like summer technology camps can bridge the connection gap between women and technology. Both Sandler (1993) and Pedras, Oaks, and Vail (1994) said that female role models, especially those serving as female technology education teachers, could go a long way in breaking down the barriers that keep girls and young women from technological careers.

Providing opportunities for job shadowing and internships with local industries and businesses can also serve as a link to connect women and technology. This can supply female students direct experience with the knowledge required by technological careers, and can serve as another avenue to offer examples of women working in such careers. A link with local industries and businesses can also make available to school personnel important information and equipment that will allow the school to offer students up-to-date career experiences.

A lack of flexibility in scheduling creates its own set of problems for advising students to take technology education courses. This lack of flexibility is especially evident for those students who are "college bound". If colleges continue to expect such students to take a foreign language, and liberal arts classes, such as music, there is no room left for electives in technology education.

Technology education is typically viewed as outside of the core academic courses, and not for "college bound" students. Because technology education courses are not required by colleges, and do not seem as relevant to the careers that "college bound" students will choose; counselors have been reluctant to recommend enrollment in these courses. Until this connection is seen, this will remain yet another factor limiting the participation of girls and young women in technology education and technology careers.

There is an urgent need for this viewpoint to change. In its latest employment predictions, the United States Department of Labor (1999) projects that 5.3 million jobs will be added in professional specialty areas by 2008. The fastest growth occupations will employ engineers, technicians, and related support personnel. The largest numbers of positions projected to be added are in the area of informational technology occupations.

The real significance of these statistics is apparent when the labor force demographics are considered. The women's labor force in nearly all age groups will increase faster than that of men's, to a high of 48 percent by 2008. The USDL (1999) also predicts that

> "Asian and other labor forces, and the Hispanic labor force [will] increase faster than other groups, 40 percent and 37 percent, respectively, because of high net immigration and higher than average fertility. The black labor force is expected to grow to 20 percent, twice as fast as the 10 percent growth rate for the white labor force".

This information is a wake-up call for counseling departments and school personnel to provide girls and young women with the technological information and education needed to succeed in the projected labor market. Sandler (1993) offers ten valuable ideas for counselors on how they can encourage gender equity in technology education:

- Guidance programs (in coordination with technology education teachers) should provide more information to students and parents about the salaries, necessary preparation and promotion prospects of various kinds of technological careers.
- Gender equity needs to be a clear focus in activities such as career days or career fairs at schools. Counselors must make an effort to attract female role models working in nontraditional occupations to talk to students and insure that presentations are balanced.

- Middle school students could visit technology education labs at high schools to see the kind of equipment and classes available.
- High school teachers could visit middle school classrooms, or there could be elective "fairs" where they discussed the kind of programs available at the high school.
- Guidance counselors could work with technology education teachers in the classroom to get more information to students and help make the connection between what students are doing in class and technological careers.
- Guest speakers (with significant representation of females) can be brought into technology education classes to discuss the world of work.
- Schools need to develop links with local business/industry to provide guest speakers, opportunities for field trips, job shadowing or internships.
- Course structures could be made more flexible, with more opportunities for students to take vocational subjects. These opportunities could be part of a career exploration guidance program.
- Career centers could be introduced in middle schools to provide students with more opportunities for exploration.
- Interdisciplinary courses between technology education and other academic departments could be developed.

It is imperative that guidance counselors work with teachers, administrators, parents and students to provide more information about the relevance of technology education to the world of work for girls and young women. The receipt of this information, especially at an early age, is the only way that opportunities to connect women and technology can move forward. Girls will

be empowered with the information and knowledge needed to succeed in the technological careers of tomorrow, through the innovative ideas of guidance counselors today.

*Summary*

The study of technology in public education has undergone many changes since the inception of manual training. The laboratory facilities, courses of study, and teaching methods associated with exemplary practice today have very little in common with those used a hundred years ago. However, despite education, one thing remains constant. Without the benefit of compulsory technology education course requirements, an overwhelming majority of the students participating in technology education are males. We espouse to be an integral part of the general education of all students, yet we seem to specialize in preparing young men for life in a technologically sophisticated society (Brusic, 1990).

To truly attract and subsequently serve the technological literacy needs of young women, the discipline needs to empower its pre-service and in-service teachers to integrate the perspectives, contributions, and learning styles of women into the technology education curriculum. An increase in the voluntary participation of girls and young women at the middle school and secondary school levels will enrich and help balance technology education classes. The participation of girls and young women in our classrooms and laboratories will reap many benefits, not the least of which will be aspiring technology education teachers. Analogous reforms in mathematics and science education will also reduce the barriers that stifle young women entertaining non-traditional careers.

The task is at hand, modeling Athena for a new generation of girls and young women who live in an increasingly technological society. The near future promises to require even more technological literacy of its citizens for survival. The spirit of Athena resides in the young

women of this nation. In order for girls and young women to be prepared to be an integral part of this society, classroom teachers, counselors, and administrators need to act today. The five key influences covered above provide the framework needed to affect the changes required to endow girls and young women with the connection and skill necessary to participate in technology education, and pursue technological careers.

# Chapter III: Methodology

This chapter will outline the methods and procedures used in this study to develop and validate a knowledge-base for professional development activities in gender equity for the study of technology. The purpose of the descriptive study was to develop a publication that describes the salient issues that affect the status of girls and young women in technology education in a manner that is relevant, accurate, comprehensive, and adequate.

## *Research Design*

A research and development (R&D) strategy was chosen for this study. This design "consists of a cycle in which a version of the product is developed, field-tested, and revised on the basis of the field-test data" (Borg and Gall, 1983, p.771). The primary goal of research and design is to take research knowledge and incorporate it into a product that can be used in schools.

The major steps in the research and development cycle include:

1. Research and information collection.
2. Planning.
3. Development of the preliminary form of the product.
4. Field-testing.
5. Product revision.
6. Dissemination and implementation.

After the knowledge-base was developed into a publication, there was a need to validate this. An attempt was made to identify an existing measurement instrument for this research, but none of those that were researched addressed all of these concepts. Therefore, the measurement instrument used in this research was developed by the author.

The questions used in this study addressed each of the five key influences to determine if the objectives of the study had been met in a manner that is relevant, accurate, comprehensive, and adequate.

*Subject Selection and Description*

The subjects for the study were a sample focus group of classroom practitioners, counselors, and administrators from the State of Wisconsin. The subjects submitted applications with the Wisconsin Department of Public Instruction (DPI) to participate in the field study, and were chosen by DPI based on their interest in and experience with the subject. DPI chose 15 applicants to participate in the study.

*Instrumentation*

The Modeling Athena: Preparing Young Women for Work and Citizenship in a Technological Society Evaluation Instrument (Appendix A) was developed by the author of this research and was used as the single instrument of measurement for this study.

The Modeling Athena: Preparing Young Women for Work and Citizenship in a Technological Society Evaluation Instrument was designed to rate the efficiency of the publication at meeting the set of defined objectives. This would provide feedback needed to revise the product for dissemination and implementation.

The format of the evaluation instrument asked the evaluators to review the publication, compare it to a set of defined objectives, and rate its efficiency at meeting those objectives. The evaluation instrumentation is divided into seven parts and consists of twenty-five questions in total.

*Part One*

The first part was written to address the Forward and Introduction sections of the publication. The goal of the Forward and Introduction is to acquaint the reader with the background and framework for the publication, and to peak their interest in the remainder of the document.

Four open-ended questions were used to measure the efficiency of these sections at meeting these objectives. The responses to these questions were measured on a four point Likert-type scale, using a range defined with "Strongly Disagree (narrative conveys the goal)", "Disagree (narrative fails to address the goal)", "Agree (narrative conveys the goal)", and "Strong Agree (narrative fulfills the goal)". The evaluators were asked to circle one response for each of the four questions. The evaluators were also asked for specific recommendations for improving these sections (Appendix B).

*Part Two*

The second part addressed the Curriculum and Instruction section of the publication. The goal of the Curriculum and Instruction section is to call attention to the ways young people are asked to think about technology, topics, activities, and examples used to instruct that are derived from a male perspective. This perspective rarely honors female contributions, participation, or perspective.

In parts two through six of the evaluation the evaluators were asked questions to measure the efficiency of the publication at meeting the defined objective areas based on the following criteria:

Criteria one (Relevance): Is the text of, relating to, or connected to the topic, and appropriate to the readers' needs? Research shows that there is a need for a publication that can be efficiently absorbed and utilized by professionals.

Criteria two (Accuracy): Is the text in conformity with fact, real? In order for the information to be taken seriously, and utilized, it must present a picture of the situation as it actually exists.

Criteria three (Comprehensiveness): Is the text large enough in scope to exhibit extensive understanding of the topic? The findings of the review of literature show that there are a multiplicity of issues involved and corresponding theories for each. A thorough overview of each key influence is required to provide each reader a common frame of reference.

Criteria four (Adequacy): Is the text proportionate in its coverage to its importance to the topic? In order for the publication to reach optimal efficiency, the treatment of each key influence must be in balance with its impact on the status of girls and young women in technology education.

The responses to criteria one are measured on a four point Likert-type scale using a range with "Irrelevant (of no value)", "Marginally relevant (of some value)", "Relevant (of value)", and "Critically relevant (of essential value)". The level of relevance was related to five categories of readers of the publication: a) Technology teacher educators, b) Administrators, c) Guidance Counselors, d) In-service providers, and e) Classroom practitioners.

The responses to criteria two, three, and four are also measured on a Likert-type scale, but using a range defined with "Strongly Disagree (narrative conflicts radically with the goal)", "Disagree (narrative fails to address the goal)", "Agree (narrative conveys the goal)", and "Strongly Agree (narrative fulfills the goal)".

*Part Three*

The third part of the evaluation focused on Classroom climate. The goal of this section of the publication is to emphasize that the signals sent to young women through teacher-student interactions, student-student interactions, and physical environment that can send a chilly message to females.

*Part Four*

The topic of Social Fit is addressed by the fourth part of the evaluation. The goal of the Social Fit section of the publication is to underscore the importance that experience, confidence gender bias, and stereotyping and parental perspective play in contributing to a "lack of fit" for females between perceived appropriate roles in technological careers in fields that are male dominated.

*Part Five*

The fifth part of the evaluation references the Role Models, Mentors, and Peers section of the publication. This section of the publication has as its goal, to point out the powerful influences that role models, mentors, and peers, especially family members are on females who pursue careers in technology.

*Part Six*

Part six of the evaluation instrument covers the section in the publication describing the impact of messages from counselors. The goal of the Messages from Counselors section is to address the anecdotal information that suggests that counselors turn young women away from technological careers more often than towards them, especially male dominated careers that require less than a four-year degree.

*Part Seven*

The final part of the evaluation instrument addresses the Summary section of the publication. The goal of the Summary section is to review the main points of the publication, and motivate the reader to become a member of the cohort of teachers, counselors, and administrators committed to change.

One open-ended question is used to measure the efficiency of this section. The responses are measured on a Likert-type scale, using a range defined with "Strongly Disagree (narrative conflicts with the goal)", "Disagree (narrative fails to address the goal)", "Agree (narrative conveys the goal)", and "Strongly Agree (narrative fulfills the goal)".

*Data Collection Procedures*

The Research and Development methodology requires field testing of the product to collect data which can then be used to revise the product for dissemination and implementation. The following procedures were used with the focus group evaluating the monograph.

All of the evaluators participated in a four day gender equity seminar that was held over a two-week period of time at the University of Wisconsin-Stout. The evaluation instrument and a copy of the publication, which is being called "Modeling Athena: Preparing Young Women for Work and Citizenship in a Technological Society", were given to each of the evaluators at the beginning of the seminar.

It was recommended that each evaluator read through the entire manuscript for an overview of the message. Then the evaluators were asked to begin the evaluation process using the evaluation instrument. The evaluators were instructed that the evaluation could be completed in multiple sittings, and that the total suggested amount of time to allow for each section was one hour. Upon completion of the training seminar, each evaluator deposited an evaluation

instrument in a collection box for data analysis by the researcher. The collection process was not monitored by the researcher, and names were not included on the evaluation instrument to ensure anonymity of the evaluators.

*Data Analysis*

A number of statistical analyses were used in this study. The Statistical Program for Social Sciences, version 14.0, (SPSS, 2006) was used to analyze the data.

Independent groups of T-Test analyses were conducted on all Likert-scale items between:

1. Males versus females (9 versus 6), and
2. Technology educators (college prep) versus all others (high school personnel) (7 versus 8).

Frequency analyses were conducted on all Likert-scale items for percentages, mean, count, standard deviation, and inferential statistics.

*Limitations*

The limitations of this study are as follows:

1. The content researched was limited to five key influences; and
2. The classroom practitioners, administrators, and counselors reviewing the document are from the State of Wisconsin.

*Summary*

Therefore, in order to develop and validate a knowledge-base for professional development activities in gender equity for the study of technology, a product was developed and field-tested in accordance with a Research and Development (R&D) strategy. A focus group of professionals from the state of Wisconsin was utilized to provide an evaluation of the product.

A survey instrument was developed by the author to measure the relevance, accuracy, comprehensiveness, and adequacy of the product. The focus group evaluated the product over a two-week period of time during a seminar on the University of Wisconsin – Stout campus.

The data collected was analyzed via the Statistical Program for Social Sciences to identify areas of statistical significance which would allow the author to revise the product before dissemination and implementation. The following chapter will provide details of the statistical analysis.

# Chapter IV: Results

## *Purpose of the Study*

The purpose of this descriptive study is to develop a publication that describes the salient issues that affect the status of girls and young women in technology in a matter that is relevant, accurate, comprehensive, and adequate.

A Research and Development (R&D) strategy was used to study to develop and validate a knowledge-base for professional development activities in gender equity for the study of technology. This strategy requires that a product be developed, tested, and revised for dissemination and implementation.

The product developed for study and validation is a monograph. A focus group of fifteen professionals was chosen to evaluate the product via a survey instrument. The responses on the survey instrument which represented a level of significance are highlighted in the following series of tables.

## *Item Analysis*

The first table, Table 1, provides a classification of the demographics of the focus group of professionals who evaluated the monograph.

Table 1: Evaluator Demographics

| Demographics | Total N=15 | Gender | | Profession | |
|---|---|---|---|---|---|
| | | Males | Females | TE Teachers | Other |
| TE Teacher/ Educator | 7 | 4 | 3 | 7 | 0 |
| Administrator | 3 | 1 | 2 | 0 | 3 |
| Guidance Counselor | 2 | 0 | 2 | 0 | 2 |
| Classroom Practitioner | 3 | 1 | 2 | 0 | 3 |

The section on curriculum and instruction is found to be especially relevant to guidance counselors, as is represented by item 201c, in table 2. More female respondents found that this section is an accurate communication of male bias in curriculum and instruction than male respondents. A few respondents commented that the coverage could be perceived as male-bashing.

Table 2: Items of Significance in Curriculum and Instruction

| Items of Significance | Mean and Std. Deviation Male | Female | T –value | df | Exact Probability |
|---|---|---|---|---|---|
| Item 201c Curr/Instruct: Relevance: Guidance Counselors | 3.000/ .6325 | 3.556/ .5270 | -1.850 | 13 | .087 |
| Item 202 Curr/Instruct: Accuracy: Communicates Male Bias | 2.833/ .7528 | 3.500/ .5345 | -1.945 | 12 | .076 |

The third table illustrates that the male evaluators regarded the section on classroom climate to be critically relevant to guidance counselors and classroom practitioners.

Table 3: Items of Significance in Classroom Climate, Males versus Females

| Items of Significance | Mean and Std. Deviation Male | Female | T –value | df | Exact Probability |
|---|---|---|---|---|---|
| Item 301c Clasrm Clim: Relevance: Guidance Counselors | 3.833/ .4082 | 3.125/ .6409 | 2.359 | 12 | .036 |
| Item 301e Clasrm Clim: Relevance: Classroom Practitioners | 4.000/ .0000 | 3.667/ .5000 | 2.000 | 08 | .081 |

In table four, the critical relevance of the classroom climate section is valued by the technology education educators themselves as well by the other high school professionals. The technology education teachers confirmed the significance of item 303 in their comments. One

evaluator expressed that the section was "too thorough at times in terms of how much tech ed teachers will tolerate".

Table 4: Items of Significance in Classroom Climate, TE Teachers versus Other High School Personnel

| Items of Significance | Mean and Std. Deviation TE Teacher Educators | Other HS Personnel | T –value | df | Exact Probability |
|---|---|---|---|---|---|
| Item 301e Clasrm Clim: Relevance: Classroom Practitioners | 4.000/ .0000 | 3.625/ .5175 | 2.049 | 07 | .080 |
| Item 303 Clasrm Clim: Comprehensiveness: Overview of Behaviors | 3.857/ .3780 | 3.125/ .3536 | 3.875 | 13 | .002 |

In table five, the perception of the technology education teachers is almost unanimous that the section which discusses the importance of role models, mentors, and peers is relevant to all the professions targeted as an audience for this monograph.

Table 5: Items of Significance in Role Models, Mentors, and Peers

| Items of Significance | Mean and Std. Deviation TE Teacher Educators | Other HS Personnel | T –value | df | Exact Probability |
|---|---|---|---|---|---|
| Item 501a Mentors/Peers: Relevance: Technology Teacher Educators | 4.000/ .0000 | 3.250/ .7071 | 3.000 | 07 | .020 |
| Item 501b Mentors/Peers: Relevance: Administrators | 3.800/ .4472 | 3.250/ .4629 | 2.110 | 11 | .059 |
| Item 501c Mentors/Peers: Relevance: Guidance Counselors | 4.000/ .0000 | 3.500/ .5345 | 2.646 | 07 | .033 |
| Item 501d Mentors/Peers: Relevance: In-Service Providers | 4.000/ .0000 | 3.125/ .8345 | 2.966 | 07 | .021 |
| Item 501e Mentors/Peers: Relevance: Classroom Practitioners | 4.000/ .0000 | 3.375/ .7440 | 2.376 | 07 | .049 |

The technology education teachers agreed that the section on role models, mentors, and peers was accurate, comprehensive, and adequate in comparison to the other high school personnel. One of the other high school personnel evaluators commented that this section was most relevant to classroom practitioners. Several of the other high school personnel evaluators requested more information about this topic.

Table 6: Items of Significance in Role Models, Mentors, and Peers, Accuracy, Comprehensiveness, and Adequacy

| Items of Significance | Mean and Std. Deviation TE Teacher Educators | Other HS Personnel | T –value | df | Exact Probability |
|---|---|---|---|---|---|
| Item 502 Mentors/Peers: Accuracy: Importance Role Models/Mentors/Peers | 3.500/ .5477 | 3.444/ .5270 | 1.890 | 13 | .081 |
| Item 503 Mentors/Peers: Comprehensiveness: Importance Role Models/Mentors/Peers | 3.667/ .5164 | 3.444/ .5270 | 2.755 | 13 | .016 |
| Item 504 Mentors/Peers: Adequacy: In Proportion w/Its Impact on Girls | 3.667/ .5164 | 3.222/ .4410 | 2.705 | 13 | .018 |

The other high school personnel evaluators expressed that the section on messages from counselors was critically relevant to classroom practitioners.

Table 7: Items of significance in Counselors

| Items of Significance | Mean and Std. Deviation TE Teacher Educators | Other HS Personnel | T –value | df | Exact Probability |
|---|---|---|---|---|---|
| Item 601e Counselors: Relevance: Classroom Practitioners | 3.167/ .7528 | 3.500/ .7559 | -1.987 | 12 | .070 |

# Chapter V: Discussion

After considerable investigation and research it is apparent that there is a need to develop and validate a knowledge-base for professional development activities on gender equity in technology education that can be used by professionals. Through the utilization of a Research and Development strategy a monograph was developed and field tested with a focus group of professionals who applied with the Wisconsin Department of Public Instruction.

The monograph was evaluated over the course of a two-week period during a gender equity seminar which took place at the University of Wisconsin-Stout. The evaluation instrument was then statistically analyzed to reveal items of significance for the revision of the monograph before dissemination and implementation.

## *Limitations*

The limitations of this study are as follows:

1. The content researched was limited to five key influences; and
2. The classroom practitioners, administrators, and counselors reviewing the document are from the State of Wisconsin.

## *Conclusions*

Analysis of the responses to the Likert-type scale items on the evaluation instrument and the evaluator comments has yielded the several deductions. These deductions validate the effectiveness of the document and provide information for desired areas of improvement.

A validation of the monograph was the overall consensus of the evaluators is that the monograph is relevant to the topic and the intended target audience. It is also an accurate, comprehensive, and adequate representation of the problem. One of the evaluators stated that the monograph "...gives us a purpose – a reason for doing this." Another evaluator commented that

when they had finished reading the monograph they were "feeling like it's time to get to work making the profession and my [the] curriculum better."

The evaluation revealed the need to consider revising the monograph to attract the eye of readers with limited time to spend digesting and implementing such a comprehensive document. There were several comments that requested shorter stories, and the use of more lists and bullet points.

On the other hand, the evaluation revealed that the evaluator's desired to see more examples of how the problem could improve, if positive changes were made in five key areas. Some enjoyed the historical character perspectives and requested modern stories and character examples to assist in motivating change.

The key areas of curriculum and instruction and classroom climate received some concern relative to the strong message communicated about the male bias that exists in these areas. Several evaluators commented that a more "politically correct" approach could help maintain the message while not dissuading a portion of the intended population, namely male teachers.

Another area with a strong message is the section covering messages from counselors. This section received comments similar to those in the curriculum and instruction and classroom climate sections. This section was found to be critically relevant to both guidance counselors and technology education teachers. Several evaluators requested more examples of how guidance counselors and technology education teachers could work together to improve the situation.

*Recommendations*

Based upon the conclusions of this study, the author makes the following recommendations for the revision of the monograph:

1. Identify areas of the monograph that could be shortened to gain the interest of readers while maintaining the message;
2. Increase the use of bullet points, lists, quotes, and bylines to increase readablity;
3. Increase the number of modern examples of people making a positive difference, and how they are making that difference; and
4. Identify and revise language in areas with a strong message that may dissuade the target reader.

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Appendix A: *Evaluation Instrument*

Below is a copy of the evaluation instrument used in this study.

**Modeling Athena: Preparing Young Women for Work and Citizenship in a Technological Society**

**Evaluation Instrument**

Dear Evaluator:

We want to thank you for agreeing to evaluate our work (the enclosed monograph). Your role as an evaluator will help us refine and validate this product being developed. The current task is to review the preliminary manuscript, compare it to a set of defined objectives, and rate its efficiency in meeting those objectives.

It is recommended that you read through the entire manuscript for an overview of its message. Then begin the evaluation process using the instrument that follows. The evaluation instrument has been designed in such a manner that it can be completed in multiple sittings. The manuscript should be evaluated on the following criteria:

Relevance -Is the text of, relating to, or connected to the topic, and appropriate to the readers' needs?

Accuracy -Is the text in conformity with fact, real?

Comprehensiyeness -Is the text large enough in scope to exhibit extensive understanding of the topic?

Adequacy -Is the text proportionate in its coverage to its importance to the topic?

The suggested amount of time to allow for each section is 1 hour. Please return the evaluation instrument by June 27, 2000. Thank you for your commitment to the issue of women in technology, and your participation in this project. If you have any questions, you may contact Dr. Welty, or me as listed below.

Sincerely,

Brenda S. Puck
(715) 831-8847
puckb@post.uwstout.edu

Dr. Kenneth Welty
(715) 232-1206
weltyk@uwstout.edu

Consent Form

I understand that by returning this questionnaire, I am giving my informed consent as a participating volunteer in this study. I understand the basic nature of the study and agree that any potential risks are exceedingly small. I also understand the potential benefits that might be realized from the successful completion of this study. I am aware that the information is being sought in a specific manner so that only minimal identifiers are necessary and so that my confidentiality is guaranteed. I realize that I have the right to refuse to participate and that my right to withdraw from participation at any time during the study will be respected with no coercion or prejudice.

NOTE: Questions or concerns about the research study should be addressed to Brenda S. Puck, the researcher, at (715) 232-2643 or Dr. Kenneth Welty, the research advisor, at (715) 232-1206. Questions about the rights of research subjects can be addressed to Sue Foxwell, Human Protections Administrator, UW-Stout Institutional Review Board of the Protection of Human Subjects in Research, 11 Harvey Hall, Menomonie, WI 54751, phone (715) 232-1126.

For the integrity of this research project, please provide us with the following information.

1. Are you male or female?

   Male: _____

   Female: _____

2. What is your profession?

   _____ Technology teacher educator?

   _____ Administrator?

   _____ Guidance counselor?

   _____ In-service provider?

   _____ Classroom practitioner?

   _____ Other? _____

## PART I - FORWARD AND INTRODUCTION

The goal of the Forward and Introduction is to acquaint the reader with the background and framework for the monograph, and to peak their interest in the remainder of the document. This section is located on pages 3 through 5 between lines 88 and 210. Please read the section carefully, and respond to the questions below.

| | |
|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) |
| 2. Disagree | (narratives fails to address the goal) |
| 3. Agree | (narratives conveys the goal) |
| 4. Strongly agree | (narratives fulfills the goal) |

1. Are the Forward and Introduction sections engaging, compelling you to want to turn the page? 1 2 3 4

If not, what specific recommendation do you have for improving these sections?

_____

_____

_____

_____

| | |
|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) |
| 2. Disagree | (narratives fails to address the goal) |
| 3. Agree | (narratives conveys the goal) |
| 4. Strongly agree | (narratives fulfills the goal) |

2. The Forward and Introduction sections set the stage for the rest of the monograph? 1 2 3 4

If not, what specific recommendation do you have for improving these sections?

_____

_____

_____

| | |
|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) |
| 2. Disagree | (narratives fails to address the goal) |
| 3. Agree | (narratives conveys the goal) |
| 4. Strongly agree | (narratives fulfills the goal) |

3. The Forward and Introduction sections initiate the narrative in a manner that is positive, proactive, and respectful of women? 1 2 3 4

If not, what specific recommendation do you have for improving these sections?

| | |
|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) |
| 2. Disagree | (narratives fails to address the goal) |
| 3. Agree | (narratives conveys the goal) |
| 4. Strongly agree | (narratives fulfills the goal) |

4. The use of cultural icons from mythology will confuse the reader, and lessen the impact of the monograph? 1 2 3 4

If not, what specific recommendation do you have for improving these sections?

## PART II - CURRICULUM AND INSTRUCTION

The first goal of the monograph is to call attention to the ways we ask young people to think about technology, and topics, activities and examples used to instruct that are derived from a male perspective. This perspective rarely honors female contributions, participation, or perspective. This topic is addressed on pages 5 through 10 between lines 213 and 446. Please read the section carefully, and respond to the questions listed below.

| | |
|---|---|
| 1. Irrelevant | (of no value) |
| 2. Marginally relevant | (of some value) |
| 3. Relevant | (of value) |
| 4. Critically relevant | (of essential value) |

1. Relevance: The treatment given to male bias in the technology education curriculum is appropriate for:
   - o Technology teacher educators? 1 2 3 4
   - o Administrators? 1 2 3 4
   - o Guidance counselors? 1 2 3 4
   - o In-service providers? 1 2 3 4
   - o Classroom practitioners? 1 2 3 4

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

2. Accuracy: The narrative communicates the male bias in the technology education curriculum in a factual manner? 1 2 3 4

   If not, what specific recommendation do you have for improving this section?

_____

_____

_____

_____

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative are inconsistent with the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

3. Comprehensiveness: The narrative provides a thorough overview of the male bias within the technology education curriculum? 1 2 3 4

   If no, what aspects of curriculum bias need to be added?

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

4. Adequacy: The treatment of the topic is in proportion with its impact on the status of girls and young women in technology education? 1 2 3 4

   If no, what specific issues need to be given more emphasis?

## PART III - CLASSROOM CLIMATE

The second goal of the monograph is to emphasize that the signals sent to young women through teacher-student interactions and student-student interactions, and the physical environment that can send a chilly message to females. This topic is addressed on pages 11 through 13 between lines 448 and 559. Please read the section carefully, and respond to the questions listed below.

| | |
|---|---|
| 1. Irrelevant | (of no value) |
| 2. Marginally relevant | (of some value) |
| 3. Relevant | (of value) |
| 4. Critically relevant | (of essential value) |

1. Relevance: The treatment given to the technology education classroom climate is appropriate for:
   - o Technology teacher educators? 1 2 3 4
   - o Administrators? 1 2 3 4
   - o Guidance counselors? 1 2 3 4
   - o In-service providers? 1 2 3 4
   - o Classroom practitioners? 1 2 3 4

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

2. Accuracy: The narrative communicates the importance of interactions and environment in the technology education classroom to the participation of females in a factual manner? 1 2 3 4

   If not, what specific recommendation do you have for improving this section?

_____

_____

_____

_____

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

3. Comprehensiveness: The narrative provides a thorough overview of the behaviors that impact how females feel in the technology education classroom? 1 2 3 4

If no, what aspects of classroom climate need to be added?

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

4. Adequacy: The treatment of the topic is in proportion with its impact on the status of girls and young women in technology education? 1 2 3 4

If no, what specific issues need to be given more emphasis?

## PART IV - SOCIAL FIT

The third goal of the monograph is to underscore the importance that experience, confidence, gender bias and stereotyping and parental perspective play in contributing to a "lack of fit" for females between perceived appropriate roles and technological careers in fields which are male dominated. This topic is addressed on pages 13 through 16 between lines 562 and 714. Please read the section carefully and respond to the questions listed below.

| | |
|---|---|
| 1. Irrelevant | (of no value) |
| 2. Marginally relevant | (of some value) |
| 3. Relevant | (of value) |
| 4. Critically relevant | (of essential value) |

1. Relevance: The treatment given to social fit in relation to female enrollment in technology education courses is appropriate for:
   - o Technology teacher educators? 1 2 3 4
   - o Administrators? 1 2 3 4
   - o Guidance counselors? 1 2 3 4
   - o In-service providers? 1 2 3 4
   - o Classroom practitioners? 1 2 3 4

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

2. Accuracy: The narrative communicates the effects of social bias in a factual manner? 1 2 3 4

   If not, what specific recommendation do you have for improving this section?

_____

_____

_____

_____

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

3. Comprehensiveness: The narrative provides a thorough overview of the effects of social fit on the participation of females in technology? 1 2 3 4

   If no, what aspects of social fit need to be added?

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

4. Adequacy: The treatment of the topic is in proportion with its impact on the status of girls and young women in technology education? 1 2 3 4

   If no, what specific issues need to be given more emphasis?

## PART V - ROLE MODELS, MENTORS, AND PEERS

The fourth goal of the monograph is to point out the powerful influences that role models, mentors, and peers, especially family members are on females who pursue careers in technology. Critical attention must be paid to how role models and mentors are and can be used to open up technology careers to young women. This topic is addressed on pages 16 through 19 between lines 717 and 826. Please read the section carefully, and respond to the questions below.

| | |
|---|---|
| 1. Irrelevant | (of no value) |
| 2. Marginally relevant | (of some value) |
| 3. Relevant | (of value) |
| 4. Critically relevant | (of essential value) |

1. Relevance: The treatment given the influence of role models, mentors, and peers appropriate for:
   - o Technology teacher educators? 1 2 3 4
   - o Administrators? 1 2 3 4
   - o Guidance counselors? 1 2 3 4
   - o In-service providers? 1 2 3 4
   - o Classroom practitioners? 1 2 3 4

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

2. Accuracy: The narrative communicates the importance of role models, mentors, and peers in a factual manner? 1 2 3 4

   If not, what specific recommendation do you have for improving this section?

_____

_____

_____

_____

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

3. Comprehensiveness: The narrative provides a thorough overview of the importance of role models, mentors, and peers to the technology education curriculum? 1 2 3 4

   If no, what aspects of role models, mentors, and peers needs to be added?

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

4. Adequacy: The treatment of the topic is in proportion with its impact on the status of girls and young women in technology education? 1 2 3 4

   If no, what specific issues need to be given more emphasis?

## PART VI - MESSAGES FROM COUNSELORS

The fifth goal of the monograph is to address the anecdotal information that suggests that counselors turn young women away from technology careers more often than towards them, especially male dominated careers that require less than a four-year college degree. This topic is addressed on pages 19 through 22 between lines 829 and 995. Please read the section carefully and respond to the questions below.

| | |
|---|---|
| 1. Irrelevant | (of no value) |
| 2. Marginally relevant | (of some value) |
| 3. Relevant | (of value) |
| 4. Critically relevant | (of essential value) |

1. Relevance: The treatment given to messages from counselors is appropriate for:
   - o Technology teacher educators? 1 2 3 4
   - o Administrators? 1 2 3 4
   - o Guidance counselors? 1 2 3 4
   - o In-service providers? 1 2 3 4
   - o Classroom practitioners? 1 2 3 4

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

2. Accuracy: The narrative communicates the messages received from counselors in a factual manner? 1 2 3 4

   If not, what specific recommendation do you have for improving this section?

_____

_____

_____

_____

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

3. Comprehensiveness: The narrative provides a thorough overview of the effect of messages from counselors for enrollment in technology education courses? 1 2 3 4

   If no, what aspect of messages from counselors needs to be added?

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

4. Adequacy: The treatment of the topic is in proportion with its impact on the status of girls and young women in technology education? 1 2 3 4

   If no, what specific issues need to be given more emphasis?

## PART VII - SUMMARY

The goal of the Summary is to review the main points of the monograph and motivate the reader to become a member of the cohort of teachers, counselors, and administrators committed to change. This section is on page 23 between lines 998 and 1032. Please read the section carefully, and respond to the questions listed below.

| | |
|---|---|
| 1. Strongly disagree | (narrative conflicts radically with the goal) |
| 2. Disagree | (narrative fails to address the goal) |
| 3. Agree | (narrative conveys the goal) |
| 4. Strongly agree | (narrative fulfills the goal) |

1. Does the Summary section review the main points of the monograph, and invoke motivation? 1 2 3 4

If not, what specific recommendation do you have for improving this section?

_____

_____

_____

# Appendix B: *Evaluator Responses and Comments*

Below are the evaluator responses and comments to the evaluation instrument.

## Modeling Athena: Preparing Young Women for Work and Citizenship in a Technological Society

## Evaluation Instrument

Fifteen participants who attended a Summer Institute for teachers, administrators, and counselors evaluated the monograph based on the following evaluation instrument. The demographics of this population is:

Gender

| | |
|---|---|
| Female: | 9 |
| Male: | 6 |

Profession

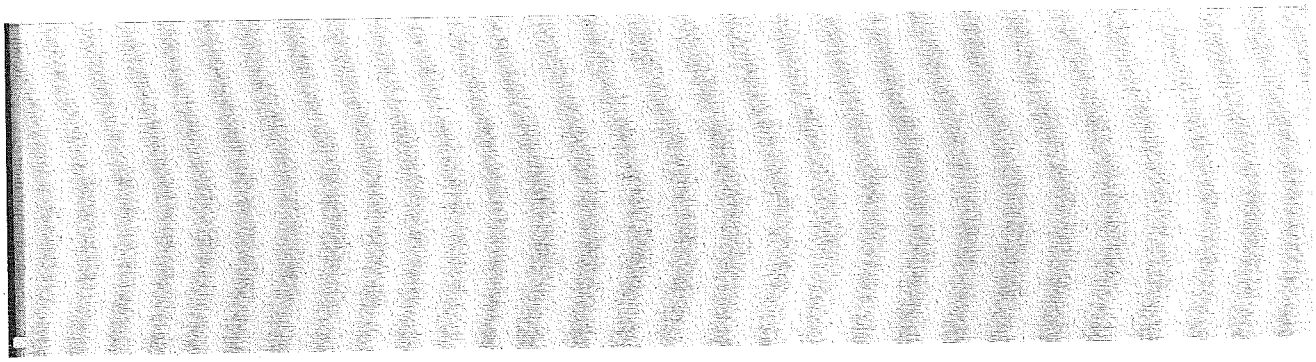
| | |
|---|---|
| Technology teacher educators: | 7 |
| Administrators: | 3 |
| Guidance counselors: | 2 |
| In-service providers: | 0 |
| Classroom practitioners: | 3 |

The role of an evaluator will help us refine and validate this product being developed. The evaluator's task is to review the preliminary manuscript, compare it to a set of defined objectives, and rate its efficiency in meeting those objectives.

The evaluators were asked to read the entire monograph for an overview of its message. Then they were asked to begin the evaluation process using the instrument provided. The instrument was designed in such a manner that it could be completed in multiple sittings. The manuscript was to be evaluated on the following criteria:

Relevance - Is the text of, relating to, or connected to the topic, and appropriate to the readers' needs?
Accuracy - Is the text in conformity with fact, real?
Comprehensiveness - Is the text large enough in scope to exhibit extensive understanding of the topic?
Adequacy - Is the text proportionate in its coverage to its importance to the topic?

The suggested amount of time to allow for each section was 1 hour. A compilation of the question responses and comments are contained on the following pages.



## PART I - FORWARD AND INTRODUCTION

1. Are the Forward and Introduction sections engaging, compelling you to want to turn the page?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 3 |
| 3. Agree | (narratives conveys the goal) | 8 |
| 4. Strongly agree | (narratives fulfills the goal) | 4 |

If not, what specific recommendation do you have for improving these sections?

- "You also need to add the influence of developmental tasks that young adolescents must go through which further serve to complicate the problem of engaging girls and young women in a part of education which is presently perceived as a male domain by both sexes."
- "For me the labor statistics are engaging - this gives us a purpose - a reason for doing this."
- "I think we could work on the Forward - needs to be shorter and more catchy. I'm okay with most of the introduction."
- "Shorter sentences and less wordy."
- "I like the mythology. I would like even more information about how women became disenfranchised from technology and even a word on women in technology in World War II."
- "Shorten the examples - limit them - remove lines that are redundant. Make the forward snappy and shorter."
- "I am still questioning the mythology connection - is it truly appropriate for all intended readers? Lines 130-134 are a bit long and confusing."
- "I feel the first paragraph needs to be engaging maybe even challanging - needs more pull. Really pull in a reader. Into paragraph 1 better than forward paragraph 1."
- "It gets us talking/thinking, but eliminate some of the information. (Wordy) Add some Tim/Jill examples, and put some statistics at the beginning."
- "The flow of the ideas as times is a little hard to follow. In fact if you omit lines 93-122, reading the Forward would be more engaging. Line 81: There is an old saying, "the more things change, the more they stay the some." Line 172: Never begin a sentence with "because."

- "Maybe add a small section about the benefits of having young women in a technology classroom. I can't site research, but I believe the dynamics of the classroom are improved as the population moves closer to 50:50. Summary discusses how tech ed is "enriched" by taking into account the female perspective, yet I don't see this concept presented here."

- "Might add some more examples of the inequities between males and females and discuss how we can provide better ed opportunities for all."

2. The Forward and Introduction sections set the stage for the rest of the monograph?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 0 |
| 3. Agree | (narratives conveys the goal) | 10 |
| 4. Strongly agree | (narratives fulfills the goal) | 4 |

If not, what specific recommendation do you have for improving these sections?

- "It would be helpful to define the terms used in the monograph. One cannot assume that everyone reading the monograph will have the same background knowledge. For example: define the terms technology and technology education. Also, a brief history of the development of technical education would have been helpful to me as this is not my area of expertise."

- "The statistics on line 192 are a very limited sample of jobs. Many jobs in technology are not professional."

- "Still I think it could be catchier."

- "Document strong facts - stay away from blaming facts, if possible."

- "Lines 175-177 lack punch to be the first line of the introduction."

- "Introduction seems much stronger and appealing."

- "Set the stage with good info."

3. The Forward and Introduction sections initiate the narrative in a manner that is positive, proactive, and respectful of women?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 1 |
| 3. Agree | (narratives conveys the goal) | 8 |
| 4. Strongly agree | (narratives fulfills the goal) | 6 |

If not, what specific recommendation do you have for improving these sections?

- "I don't believe Daedalus was a god. I believe he was a mortal and therefore would be considered a Greek hero. Also, the Romans adopted all of the Greek myths and just changed the names of the gods, so Athena in Greek mythology is Minerva in Roman mythology. They are all of the same myths with only minor differences between them."

- "Positive" in general needs a little work."

- "Line 196, 2nd sentence: say it even stronger: The fact is women are highly capable in technology careers. Line 202: The 21st century promises greater enhancements at an even faster rate. Line 210: Are these the key reasons women stay out of technology or those that teachers have control over?"

- "Except for Lines 160-163 - what is wrong with this concentration? To me it seems young women are more progressive in looking at future careers."

- "Are you looking at the reader as a peer or student?"

- "Maybe not as respectful of men and the role they play. It should be viewed as equal."

4. The use of cultural icons from mythology will confuse the reader, and lessen the impact of the monograph?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 2 |
| 2. Disagree | (narratives fails to address the goal) | 4 |
| 3. Agree | (narratives conveys the goal) | 4 |
| 4. Strongly agree | (narratives fulfills the goal) | 3 |

If not, what specific recommendation do you have for improving these sections?

- "I liked this classical approach in the introduction. You might consider adding some of the mythological source material to your bibliography. Bullfinch's Mythology or the volume by Edith Hamilton titled Mythology."

- "The use of the cultural/mythological icons is fine. However, the fourth paragraph, lines 113-122, is hard to understand. I thought, at mid-paragraph, that you were talking about women moving away from technology ("division of labor"), but then there is the mention of the 5 primary machines."

- "There may be a need to reduce the number of examples - seems a bit excessive."

- "I would opt for no mythology ties."

- "I like it."

- "This will turn off the typical technology educator - who probably didn't think much of mythology in the first place. I would rather see it named for women in more recent history."
- "If the reader has no prior knowledge of mythology, their level of respect for "it" may not be present. However, certainly it raises the level of credibility."
- "Not all readers will be compelled to continue reading with the mythology connection."
- "I like the mythology - maybe less."
- "Use Tim/Jill examples - simplify the forward."
- "I agree the use of the cultural icons from mythology will lessen the impact of the monograph. Omit them, use historical/real women. If you omit paragraph 2, 3, 4 (Forward) it will be easier to read."
- "The use of cultural icons is a good example of how women used to be viewed but too much time is spent on this and not enough about the equity difference, and the magnitude of the problem this is creating."
- "Maybe do not need all of the icon examples. Message was clear after Athena and Minerva."
- "There does not have to be such a large writing on this."

## PART II - CURRICULUM AND INSTRUCTION

1. Relevance: The treatment given to male bias in the technology education curriculum is appropriate for:

   - Technology teacher educators?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 1 |
| 3. Relevant | (of value) | 5 |
| 4. Critically relevant | (of essential value) | 9 |

   - Administrators?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 1 |
| 3. Relevant | (of value) | 9 |
| 4. Critically relevant | (of essential value) | 5 |

   - Guidance counselors?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 1 |
| 3. Relevant | (of value) | 8 |
| 4. Critically relevant | (of essential value) | 6 |

   - In-service providers?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 2 |
| 3. Relevant | (of value) | 5 |
| 4. Critically relevant | (of essential value) | 8 |

   - Classroom practitioners?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 1 |
| 3. Relevant | (of value) | 5 |
| 4. Critically relevant | (of essential value) | 8 |

2. Accuracy: The narrative communicates the male bias in the technology education curriculum in a factual manner?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 2 |
| 3. Agree | (narratives conveys the goal) | 7 |
| 4. Strongly agree | (narratives fulfills the goal) | 5 |

If not, what specific recommendation do you have for improving this section?

- "See answer #3. Athena also invented the bridle and tamed horses, so she is the goddess of agriculture, another area of vocational education. She may be the first engineer."

- "I would put Social Fit first before this."

- "Line 240: I find the sentence that describes women's ways of knowing a little old fashioned. Most women work outside the home and those experiences are also a big part of their ways of knowing."

- "Is the automobile our major employer? 1 in 6 future employers will work in some phase of the auto - designing and drafting parts might be appropriate for all. Could you give better examples of gender neutral design and technology? How about habitat related? Showing the example of "Biology for Women" is totally inappropriate for this audience."

- "It is a societal issue. Lines 234-245 - Why include this?"

- "Wordy - need current practical examples."

- "Actually seems harsh since the population who will be receiving this material will on the most part be male, I would try to be more positive towards men. Line 235: Contemporary teaching methods are changing this. If this is factual, what source did this come from?"

- "The treatment of females in some tech ed classes as well as curriculum may be at different phase levels within different schools or between classrooms."

- "Teachers make the difference!"

- "I feel that people should know that there are differences within classrooms and there needs to be a method helping teachers and holding teachers accountable for their teaching practices."

3. Comprehensiveness: The narrative provides a thorough overview of the male bias within the technology education curriculum?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 0 |
| 3. Agree | (narratives conveys the goal) | 11 |
| 4. Strongly agree | (narratives fulfills the goal) | 3 |

If no, what aspects of curriculum bias need to be added?

- "I like the McIntosh model of the various stages of development of curriculum development toward a non-gender biased curriculum. Is there any empirical evidence to support the model?"

- "This section does a great job of providing an overview of the bias. But we don't want to create an environment that is not positive for the boys - it needs to be appropriate for all. Line 401 - exposing the lopsided view - continues the divisions rather than eliminates them."
- "Careful we are not too male-bashing. Watch wording."
- "The narrative seems very comprehensive - explaining and defining the term "technology" is helpful."
- "A bit negative towards males."
- "Examples other than textbooks in the phases."
- "But almost comes across as a feminist point of view."
- "McIntosh's model was explained quite thoroughly - why "assume" it is a valid tool, I would question then why is it important at all to understand."
- "Lines 235-237: Need stronger examples of how chosen activities align more closely with boys life experiences. Drawing car parts is good. Need another concete example like this, (ie., dip casting a football tee in plastics unit."
- "Paints a good picture of the male bias. May want to focus more on what we need to do about it, different (specific) learning styles of male and female (brain based learning info). How should curriculum be modified to focused more equitable."

4. Adequacy: The treatment of the topic is in proportion with its impact on the status of girls and young women in technology education?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 2 |
| 3. Agree | (narratives conveys the goal) | 10 |
| 4. Strongly agree | (narratives fulfills the goal) | 3 |

If no, what specific issues need to be given more emphasis?

- "The interference of the developmental tasks of young adolescents in forming sexual identity should be addressed. Also, a recognition that choices should be set up to remain open to return to tech. Educational course work as both boys and girls advance through secondary education. For example, curriculum flexibility should be included as a strategy requirement. The chilling affect of academic technology education also needs some strategic thought."
- "The brain research is great! This gives teachers some solid information that can be used directly."

- "For me, the discussion we had in class about the differences between a traditional curriculum and a contemporary curriculum was the essence of curriculum and instruction. I hope you'll include more of it in this section."

- "Nothing is said about the uniqueness of this situation. Plus, when specifically is the bias in the tech ed classroom. I would imagine that if only one or two females are in a class, they just might stand out a bit more and get called on more than in a typical classroom. I think it is important to speculate on this."

- "Phases? Too lengthy, possibly bullet points. Curriculum and parents - is not necessary. Parents deal with career decisions."

- "Why discuss - UW-Waukesha "Biology of Women".

- "Not sure where to put this paragraph. Lines 281-296 - why suddenly begin talking about cultural influences when clearly stated in your thesis statement you're addressing issues women in technology have been faced with."

- "The impact on the status of girls and young women in technical areas should not rest on the backs of technology educators alone! We need to look at this problem across a broad range of fields (science, math, etc...elementary ed!)"

## PART III - CLASSROOM CLIMATE

1. Relevance: The treatment given to the technology education classroom climate is appropriate for:

   - Technology teacher educators?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 0 |
| 3. Relevant | (of value) | 2 |
| 4. Critically relevant | (of essential value) | 13 |

   - Administrators?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 0 |
| 3. Relevant | (of value) | 6 |
| 4. Critically relevant | (of essential value) | 9 |

   - Guidance counselors?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 1 |
| 3. Relevant | (of value) | 6 |
| 4. Critically relevant | (of essential value) | 7 |

   - In-service providers?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 1 |
| 3. Relevant | (of value) | 2 |
| 4. Critically relevant | (of essential value) | 11 |

   - Classroom practitioners?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 0 |
| 3. Relevant | (of value) | 3 |
| 4. Critically relevant | (of essential value) | 12 |

2. Accuracy: The narrative communicates the importance of interactions and environment in the technology education classroom to the participation of females in a factual manner?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 2 |
| 3. Agree | (narratives conveys the goal) | 5 |
| 4. Strongly agree | (narratives fulfills the goal) | 7 |

If not, what specific recommendation do you have for improving this section?

- "School climate emphasizing academic course work and standards along with high stakes testing in these areas also contribute to a chilling effect on technology education not only for females, but for all students."
- "Great section."
- "This section is well done and certainly appropriate. What does research show on pairing female students. I agree with this, but some teachers may feel that the public may find fault with this. Should we pair children of color? Special needs? We need to show people that this is different and appropriate."
- "Examples of good environment need to be available. Lines 459-461 sets the stage, but needs to be developed. Lines 490-491 - treat all students equally as individuals rather than...is great!"
- "Does not mention the need to "clean up" classrooms."
- "Explain the physical environment with specific examples - I believe this is very important."
- "More emphasis needed on physical environment."
- "More attention needs to be given to the physical environment. If females won't enter the room because it's "dirty", student-student and teacher-student interaction becomes a mute point."
- "Even though I agree with the information, I feel that the classroom climate can vary greatly within the whole school. I again felt tha the teacher makes a great difference."

3. Comprehensiveness: The narrative provides a thorough overview of the behaviors that impact how females feel in the technology education classroom?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 0 |
| 3. Agree | (narratives conveys the goal) | 8 |
| 4. Strongly agree | (narratives fulfills the goal) | 8 |

If no, what aspects of classroom climate need to be added?

- "See comments in previous section. Many biased behaviors are institutionalized so that instructors and students are unaware of the biases they represent. We nee to be sensitive to these behaviors. For example, instructor treating girls in the same way that treat disabled students based on the fact the girl may be the only female in the class."
- "Too thorough at times in terms of how much tech ed teachers will tolerate."

- "Get away from the authoritarian teacher who gives or withholds knowledge for power (okay - often something male teachers do). Empower students to critically think their way through a problem and be in charge of their own learning."

- "Lines 476-77 are supportive of this, and that information needs to be reinforced with an example. I felt the treatment of "climate" was a good outline, but needed more definition."

- "Needs to discuss that "girls" can do it."

- "I would like to see more on the physical. (ie. paint, floors, tables, chairs, etc.)"

- "Social/economic status also plays an important part in creating a classroom climate that is equitable for all students."

4. Adequacy: The treatment of the topic is in proportion with its impact on the status of girls and young women in technology education?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 1 |
| 3. Agree | (narratives conveys the goal) | 10 |
| 4. Strongly agree | (narratives fulfills the goal) | 5 |

If no, what specific issues need to be given more emphasis?

- "I think you have given an "adequate" treatment of classroom climate. But classroom climate will play a very big part of being successful - even more so than curriculum."

- "Yes, however, I think Social Fit is most important."

- "Make the argument for this even stronger. Women typically come into the technology classroom with less experience than men and very different learning styles. Male instructors often give the message that these women are "hopeless." Women avoid technology because they're afraid they can't do it."

- "I would also like to see a discussion of the problems women face once they're in the technology classroom, similar to the discussion we had about Jeff's Good Intentions."

- "Lines 463-467 seem "plugged in." More examples of good climate need to be woven in."

- "The look of the classroom makes the big difference."

- "More."

- "The more informed you can keep teachers, the better chance that they will be aware of equity issues and try to change."

## PART IV - SOCIAL FIT

1. Relevance: The treatment given to social fit in relation to female enrollment in technology education courses is appropriate for:

   - Technology teacher educators?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 0 |
| 3. Relevant | (of value) | 5 |
| 4. Critically relevant | (of essential value) | 10 |

   - Administrators?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 0 |
| 3. Relevant | (of value) | 6 |
| 4. Critically relevant | (of essential value) | 8 |

   - Guidance counselors?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 0 |
| 3. Relevant | (of value) | 5 |
| 4. Critically relevant | (of essential value) | 9 |

   - In-service providers?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 0 |
| 3. Relevant | (of value) | 7 |
| 4. Critically relevant | (of essential value) | 7 |

   - Classroom practitioners?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 1 |
| 3. Relevant | (of value) | 5 |
| 4. Critically relevant | (of essential value) | 8 |

2. Accuracy: The narrative communicates the effects of social bias in a factual manner?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 1 |
| 3. Agree | (narratives conveys the goal) | 7 |
| 4. Strongly agree | (narratives fulfills the goal) | 7 |

If not, what specific recommendation do you have for improving this section?

- "Stereotyping is so prevalent because it is an easy way for humans to classify and therefore make sense of the world. The problem is so pervasive because humans begin to deal with others as if their stereotypes are facts rather than shorthand representations."

- "What are all the "masculine characteristics?" Line 626 Are these physical characteristics or personality characteristics - and what defines them as masculine? Line 633 mentions six forms of bias - are all six described on the next page, or only some of them?"

- "Absolutely!"

- "We don't touch upon the influences of human development - particularily at the ages 11-18 when females would be in one classes."

- "Lines 574-581 - Great support of this. Six forms of bias were cited - I easily found 5 - don't know what I missed."

- "Acknowledge that although women in the past were invisible that it is slowly changing. There are a lot of well known women in very good positions whose successes are acknowledged and celebrated."

- "Even though there have been studies taken to break down barriews for females more has to be done across all levels of society (family, media!, educators)"

3. Comprehensiveness: The narrative provides a thorough overview of the effects of social fit on the participation of females in technology?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 1 |
| 3. Agree | (narratives conveys the goal) | 7 |
| 4. Strongly agree | (narratives fulfills the goal) | 7 |

If no, what aspects of social fit need to be added?

- "To make this section comprehensive, the developmental stages of young adolescents needs to be addressed along with how this stage development interacts with environmental factors to make adolescents less likely to give up gender biased viewpoints and behaviors. The stage needs to be set for returning young women to technology education in the future when sexual identity is not so threatening to both males and females."

- "The larger social or societal climate which contributes to "social fit" should be acknowledged along with the wider educational environment. For example, accountability, high stakes testing, and media."

- "This section - even pointed out toys, identifies the need that all teachers need this info - not just tech ed teachers. We need to start preparing our children at the elementary level."

- "Yes!"
- "See #2."
- "Thought progression easy to follow."
- "Need positive, practical parental influences."
- "Girls nowadays are not taught to be helpless and fragile. Sports are opening up WNBA is a perfect example. There are many professional women's sports teams. I'm having a hard time with the information on toys. Are toys influencing the socialization process of the girls, or are the changing attitudes of girls acceptance or need towards technology changing the design of toys."
- "Section does well with gender bias and cultural influences while just barely touching on parental influence. As a teacher, I have observed that this plays a major role in social fit."

4. Adequacy: The treatment of the topic is in proportion with its impact on the status of girls and young women in technology education?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 1 |
| 3. Agree | (narratives conveys the goal) | 9 |
| 4. Strongly agree | (narratives fulfills the goal) | 5 |

If no, what specific issues need to be given more emphasis?

- "The importance of this set of factors needs to be stressed along with the concept that certain forces may be there always working against the goals of this project unless/until technology education is no longer connected with male vs. female bias."
- "Again - I think more important than curriculum, but it takes more than teachers to solve this problem."
- "Yes!"
- "Deb was right - social fit is the thing that keeps women out of technology. I would like to see you emphasize how it keeps women out of technology - and it's not just men who exclude women. Women who go into technology must often buck considerable pressure from their parents, their boyfriends, and their peers. They are often in an alien culture which they do not understand. They usually navigate these alien waters by themselves. Figure out a way to make technology cool and socially acceptable and you will see women signing up. A TV series "The Technologists?"

- "I think much more needs to be shown as to what goes on with development."
- "Need it sooner - maybe."
- "Explain how teachers could intervene in this process."
- "The physical environment and social influences are "HUGE" factors that impact female enrollment, yet only lines 690-719 (specifically the social factors 1st paragraph) are dedicated to these areas. More info needed on these two areas."
- "Would like to see this be first in line as it seems to be the most relevent."
- "I think the impact that media has and the historical inequity that has been created will take the greatest effort to overcome."

## PART V - ROLE MODELS, MENTORS, AND PEERS

1. Relevance: The treatment given the influence of role models, mentors, and peers appropriate for:

   - Technology teacher educators?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 1 |
| 3. Relevant | (of value) | 4 |
| 4. Critically relevant | (of essential value) | 8 |

   - Administrators?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 0 |
| 3. Relevant | (of value) | 7 |
| 4. Critically relevant | (of essential value) | 6 |

   - Guidance counselors?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 0 |
| 3. Relevant | (of value) | 4 |
| 4. Critically relevant | (of essential value) | 9 |

   - In-service providers?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 2 |
| 3. Relevant | (of value) | 4 |
| 4. Critically relevant | (of essential value) | 9 |

   - Classroom practitioners?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 1 |
| 3. Relevant | (of value) | 3 |
| 4. Critically relevant | (of essential value) | 9 |

2. Accuracy: The narrative communicates the importance of role models, mentors, and peers in a factual manner?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 0 |
| 3. Agree | (narratives conveys the goal) | 8 |
| 4. Strongly agree | (narratives fulfills the goal) | 7 |

If not, what specific recommendation do you have for improving this section?

- "Females need to find ways to get "permission" to do something outside their role of definition. Mentoring is a powerful tool. In the short term, the paper points to one important factor for mentors of girls and that is male mentors. A trusted male mentor, like a father, gives a girl permission to step outside tradition. In the same way, if a trusted mentor disapproves it is very difficult to break away. Perhaps a combination of female role models along with careful application of male and female mentors should be considered."

- "Overall - I think this is most valuable for classroom practitioners."

- "Great section."

- "I appreciate the discussion about "heroines of technology."

- "Lines 753-755."

- "Give examples of student and peer mentors."

- "Line 734: As the result of the lack of female role models, girls and young women are reluctant to study technology, or pursue nontraditional occupations."

- "Line 767: I don't agree with this, is there research to support this? More males may be technology educators simply because females never really thought about teaching technology education."

- "Reference to lines 756-757: Has there been studies done to confirm this?"

3. Comprehensiveness: The narrative provides a thorough overview of the importance of role models, mentors, and peers to the technology education curriculum?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 0 |
| 3. Agree | (narratives conveys the goal) | 7 |
| 4. Strongly agree | (narratives fulfills the goal) | 8 |

If no, what aspects of role models, mentors, and peers needs to be added?

- "I think there is a body of sociological literature on the interaction of male and female roles (eg. Parent-child relationships, same sex and opposite sex) that is involved. Do we know what types of role models to pursue? Do we know how to create good mentors? From the resiliency literature in the at risk area, we are just beginning to look at factors that people coming out of dysfunctional environments use to override the dysfunction and become successful. Maybe we can learn something from this area of study."

- "This part is well done and I think will be well received by technology educators."

- "Good because of facts and narrative."

- "Add more information to this section."

- "We all are technologists and more importance needs to be stressed on this. Just because you don't have a degree in this area or work in a traditional technical area doesn't mean that it's not important to you (females)."

4. Adequacy: The treatment of the topic is in proportion with its impact on the status of girls and young women in technology education?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 0 |
| 3. Agree | (narratives conveys the goal) | 9 |
| 4. Strongly agree | (narratives fulfills the goal) | 6 |

If no, what specific issues need to be given more emphasis?

- "Instructors must begin to see how important it is to give permission when young women and girls seek them out to continue in technology education. They must understand that their permission may be the key that allows females to enter technology education."

- "I think we need to let teachers know how to incorporate role models/mentors in their classes - maybe a part of what is put together as we proceed on this project."

- "Good discussion of role models, but other things are important, too. Women's support groups, professional and community-based organizations, networks - even scholarships and awards, the media. Opportunities to reach beyond the classroom through outreach activities. Clubs, and other chances for girls and women to get into technology in a group."

- "More emphasis on parental role at early age. Lines 775-778 raise the question of how do women see success. Perhaps GPA is more important to women than men. Perhaps women measure success by GPA where men may look more long-term to find their success measure?"

- "Need females as role models included here - give specific examples."

- "Since females are influenced more predominently by role models and mentors and society helps determine which are acceptable, more attention needs to be given to the media and its impacts on young womens perceptions."

## PART VI - MESSAGES FROM COUNSELORS

1. Relevance: The treatment given to messages from counselors is appropriate for:
   - Technology teacher educators?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 2 |
| 3. Relevant | (of value) | 7 |
| 4. Critically relevant | (of essential value) | 6 |

   - Administrators?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 2 |
| 3. Relevant | (of value) | 4 |
| 4. Critically relevant | (of essential value) | 8 |

   - Guidance counselors?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 2 |
| 3. Relevant | (of value) | 3 |
| 4. Critically relevant | (of essential value) | 10 |

   - In-service providers?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 2 |
| 3. Relevant | (of value) | 5 |
| 4. Critically relevant | (of essential value) | 7 |

   - Classroom practitioners?

| | | |
|---|---|---|
| 1. Irrelevant | (of no value) | 0 |
| 2. Marginally relevant | (of some value) | 2 |
| 3. Relevant | (of value) | 5 |
| 4. Critically relevant | (of essential value) | 7 |

2. Accuracy: The narrative communicates the messages received from counselors in a factual manner?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 1 |
| 2. Disagree | (narratives fails to address the goal) | 3 |
| 3. Agree | (narratives conveys the goal) | 6 |
| 4. Strongly agree | (narratives fulfills the goal) | 5 |

If not, what specific recommendation do you have for improving this section?

- "There is no acknowledgement of the role developmental guidance plays and that developmental models include issues such as equity in the competencies the model aims at teaching students. A whole domain of Wisconsin's model across competencies is career education."

- "The main message in the monograph toward counselors is negative. The main basis for this is "anecdotal information". You need, in my opinion, to restructure this whole section and use empirical data like the national standards, or the Wisconsin developmental guidance model."

- "Your anecdotes point to negatives. Where are the positives? We can all cite the horror stories. I am a counselor and even I can give you some."

- "I believe it is relevant to point out damaging things counselors have done, but it is blatantly inaccurate and untrue that the majority of today's school counselors suffer from either a lack of information or flexibility."

- "There is a lack of flexibility in the difference between academics and non-academics, but you give counselors way too much credit for responsibility of these differences. The state, school boards and institutions of higher learning do that. Graduation requirements are determined by statute and by each school district's school board. Our job is to see that students fulfill graduation requirements as defined and determined by these bodies."

- "You also are assuming no exposure to careers and career education which is untrue in any school district in state delivering developmental guidance."

- "This entire section needs to be rewritten. In my opinion."

- "I believe you make salient points about the lack of connection between counselors and technology education educators. The fact that this appraisal of how modern day counselors interact with students is a blaring example. I recommend you including this section and that you also include the chilling effects counselors can have on the process of encouraging young women to participate in technology education."

- "I recommend you add an additional section to address the inflexibility issue, but identify the true sources. (I wish we had that kind of power)."

- "A bit too judgemental. Try to tone down so as not to ailienate."

- "We need to be gentle, yet direct - accurate and documented."

- "In my experience, you have written an accurate account of the messages counselors send, although the counselors at my school are excellent."

- "Missing information - There are schools that provide comprehensive career exploration - where are these schools, and are they more successful?"

- "Line 868 - Parents as well as students...guidance has a role in providing career information, but everyone needs to take responsibility, and this does not fall solely on guidance."
- "Lines 961-992 are the most valuable!"
- "However I can see how an entrenched guidance counselor would be put off from the document by this."
- "Some negative information."
- "Lines 949-953: Once again a cultural comment is made, and the paper does not fully address cultural issues enough to justify including this."
- "The perception of tech ed by counselors and parents varies. The misconceptions need to be changed. Maybe the misconceptions come from the close ties (Tech Ed with Vocational Ed)."
- "Need to focus on what can be done to improve career/decision making."
- "Was a little harsh on counselors that do a good job."

3. Comprehensiveness: The narrative provides a thorough overview of the effect of messages from counselors for enrollment in technology education courses?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 3 |
| 3. Agree | (narratives conveys the goal) | 8 |
| 4. Strongly agree | (narratives fulfills the goal) | 4 |

If no, what aspect of messages from counselors needs to be added?

- "Preservice and inservice of counselors is also necessary."
- "Lines 856-858 - what is this statement and how does it relate to budgets?"
- "Liked the ideas offered for educators/ counselors to use."
- "This way look like counselor bashing. Most readers might not understand all of the duties of the counselor, student-counselor ratio, etc."

4. Adequacy: The treatment of the topic is in proportion with its impact on the status of girls and young women in technology education?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 1 |
| 2. Disagree | (narratives fails to address the goal) | 2 |
| 3. Agree | (narratives conveys the goal) | 7 |
| 4. Strongly agree | (narratives fulfills the goal) | 4 |

If no, what specific issues need to be given more emphasis?

- "See comments above. I have a copy of slides from a presentation I do on developmental guidance and the revised Wisconsin Developmental Guidance Model which I would be happy to share with you."
- "This section leads the reader right into ideas for the Tackle Box."
- "See previous comment. A bit too judgemental. Try to tone down so as not to alienate."
- "Why pin the failings of an entire educational system on the counselors? They have relatively little power in this struggle. The biggest factor in a child's choice of classes and careers are his/her parents. And these parents do not inderstand the rewarding, high wage careers available in technology fields. Policy makers, industry, and all levels of the educational system from Universities to two-year colleges to K-12 need to educate the general public about technology. Far from being the second track for non-college bound students, technology is the future. The nation and the states need to make it a priority to depict technology with the respect it deserves."
- "Lines 954-986 important information. Overall the information was very comprehensive and supported by statistics."
- "The counselors are the most important individuals in these charge!"

## PART VII - SUMMARY

1. Does the Summary section review the main points of the monograph, and invoke motivation?

| | | |
|---|---|---|
| 1. Strongly disagree | (narratives conflicts radically with the goal) | 0 |
| 2. Disagree | (narratives fails to address the goal) | 1 |
| 3. Agree | (narratives conveys the goal) | 5 |
| 4. Strongly agree | (narratives fulfills the goal) | 8 |

If not, what specific recommendation do you have for improving this section?

- "The last section of the monograph needs revision to bring school counselors in. As it is at present, I am afraid the reaction would be very negative for this subgroup."
- "The last paragraph mentions "five key influences." I think those 5 things should be listed here - because not all teachers will read the 20 prior pages."
- "Fine."
- "Good summary."
- "I agree with Ken Bremer - technology education needs to be legislated to be manditory. We all need to be more proactive in making this happen."
- "You briefly touch upon legislative changes in the summary. More needs to be said about this. This is key."
- "Line 1029 - The five key influences need to be stated again. Overall, the monograph was well done, comprehensive and at an academic level that represents the level of respect desired. My only concern is, would the average tech ed teacher spend the time to read the document? I don't think they would. Brevity and style (outline or bullets, etc.) may need to be considered. Excuse the crossed out areas - I did this 3x and found myself not agreeing with my own critique! You have created a super document."
- "I feel the summary is good!"
- "The summary does not clearly summarize the ideas presented in the paper. Try to acknowledge that balance is needed between male and female needs. Line 1010: sentence fragment."
- "Summary left me feeling like it's time to get to work making the profession and my curriculum better."

- "Summary is good. I think the references to Athena can be left out. Athena was a goddess, lets not try to label this problem, or solution with a simple title. Eliminate the first part of the title (Modeling Athena)."

- "Everyone feels as if they are always too busy. If you want people to read the content and implement this into their lives, you are going to have to present this in brief form. A visual that is condensed, simple and reminds them of what we need to focus on. As a teacher, I knew what went into a good lesson, the aid of blooms taxonomy was a great tool to help me build better and better lessons. We need these tools for the equity issues."

- "A lot of finger pointing. Point out the problem, then discuss methods to make it better!"

- "Very good."

## Appendix C: *Research and Development Product*

The monograph below is a copy of the research and development product evaluated by the focus group.

Modeling Athena

Preparing Young Women for Work and Citizenship
in a Technological Society



Wisconsin Department of Public Instruction

Funding for this project is made available through a grant from the Wisconsin Department of Public Instruction with Carl Perkins Vocational Education Act Funds.

# Modeling Athena

Preparing Young Women for Citizenship and Work
in a Technological Society

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## A Framework for Thinking

Throughout history and across cultures women have played an integral role in the development of technology. Inventive women have created or improved many of the products and practices that support our quality of life. Historically, this influence was so important, that many cultures had heroines of technology as cultural icons (Stanley, 1993). For example, Greek culture holds the goddess Athena as the original inventor of all mechanical arts. More recently, feminine ingenuity has given us inventions like the fire escape, windshield wiper, computer compiler, Scotchgard©, liquid paper, and Kevlar© (Macdonald, 1992; Thimmesh, 2000).

The quest for technological achievement carried humankind to the moon. The subsequent momentum of technological advancement has had a profound effect on most every aspect of everyday life. At the current rate of technological development, the twenty-first century promises to provide even more exciting changes in how we live and work. Yet, in spite of our technological progress, very few girls and young women participate in the study of technology and pursue technical careers.

Scotchgard©is a trademark of 3M
Kevlar©is a registered trademark of Du Pont 2

The popular portrayal of technology as being born out of the minds and hands of men paints a skewed picture of history and it perpetuates the unfortunate stereotype that technology is a male endeavor. The inclination to view technology as a male domain intrinsically alienates at least fifty percent of the population from an important school subject that can help prepare young men and women for work and citizenship in an increasingly technological society.

The gender bias embedded in the study of technology needs to be uncovered and the appropriate reforms need to be put into practice. However, it is important to note that gender equity, in any context, is a very complex issue that has many facets. Consequently, there is no single reform that will quickly transform the study of technology so it is more attractive and attentive to the needs and interests of girls and young women. Both the examination and reformation of technology education must be comprehensive and systemic due to the diverse factors that shaped the current state-of-affairs over time.

A review of literature uncovered five key influences that impact girls and young women in non-traditional fields of study. These influences include social fit, classroom climate,

curriculum and instruction, role models and mentors, and messages from counselors. Together they form a conceptual framework that breaks the potential for gender bias in technology education into manageable pieces so they can be more easily understood and subsequently acted upon. Using this framework as a guide, the following document was designed to inform the work of those wishing to make the study of technology more attentive to the needs of girls and young women. The following sections will present the fundamental concepts and recommendations needed to awaken the daughters of Athena.

This narrative will make frequent references to males and females, to boys and girls, and to young men and women. It is important to note that these references refer to populations in contrast to individuals. The authors recognize the fact that all students are unique individuals regardless of their membership in a group based on their gender. Furthermore, the authors support the theory that there is greater diversity within these two populations than there is between them. However, it is extremely difficult for teachers to account for all the unique characteristics of their students. To address the diverse needs of students, conscientious teachers often have to think in terms of addressing the needs of different populations within a class. For example, in contrast to developing 28 different lessons for 28 unique students, teachers strive to address the diversity within a class by designing lessons that account for different learning styles. The authors wrote this monograph to help teachers address the diversity within their classroom based on gender. However, the ideas being presented should not overshadow the need to be attentive to individual differences regardless of gender.

*Margaret Knight began working in a cotton mill at the age of 9. One day she saw a steel-tipped shuttle fly out of a loom and strike a co-worker. Out of concern for people's safety she invented a device that restricted the travel of the shuttle. Later in life she worked in a paper bag factory.*

*Frustrated by the difficulty of filling flat paper bags, she invented a machine that made bags with square bottoms so they could be stood up and filled with greater ease. She founded the Eastern Paper Bag Company in 1870 and patented her machine in 1871.*

*Thus, Margaret Knight is considered the mother of the grocery bag.*

Curriculum & Instruction
Classroom Climate
Sense of Self & Social Fit
Role, Models, Mentors, & Peers
Messages from Counselors
Women & Technology

**Sense of Self and Social Fit**

Children begin to construct their identity at a very young age through their interactions with people and their environment (Gilligan, 1982). One of the first things children learn to do is recognize how they are biologically similar or different from those around them and they begin to make distinctions between people based on their gender. Within the first three years of life, the child starts developing an attachment or separation from their primary care giver, which is typically a woman. Girls are inclined to pursue their femininity by attaching to their mothers. Inversely, boys strive to develop an early sense of masculinity by separating themselves from their mothers. The introduction of gender-specific clothes, toys, and activities helps facilitate the attachment and separation process. The foundation for gender identity is clearly in place by age four (AAUW, 1995).

Children use play to vicariously experience and learn about adult roles, some of which follow gender stereotypes. The importance that play has in the socialization process can be seen through an examination of children's toys (Eisberg, 1993). Boys tend to be encouraged to play with toys that represent prominent technologies in society. Furthermore, some of these toys utilize technology to enhance both their function and realism. Toy manufacturers often accentuate the technical features to market their toys for boys. The use of these toys tends to give boys a head start in developing some of the basic skills needed to function in a technological society. Girls, on the other hand, are encouraged to engage in domestic activities and many of their toys are designed to model family and social scenarios. Some of the toys that are designed for girls also utilize technology to enhance their features. For example, some dolls have small mechanical and electronic devices that allow them to do things like walk and talk. Although these toys are technologically sophisticated, the technology in question tends to be hidden so it does not interfere with the toy's authenticity and primary function.

Parents also play a very important role in the development of their children's gender identity (Fagot, 1978; Morgison, 1995). There is some evidence that suggests parents tend to encourage achievement, competition, and independence for their sons. In several studies, boys tended to receive positive feedback for engaging in exploratory activities. Conversely, mothers tended to restrict and supervise their daughters more than their sons. Girls were often given positive feedback when they asked for help or when they helped others. Both parents tended to react favorably to their children when they engaged in behaviors that were perceived to be gender-appropriate. Inversely, parents tended to react negatively when their children behaved in

ways that were perceived to be inappropriate for their gender. In short, boys are expected and encouraged to behave like boys and girls are expected and encouraged to behave like girls.

It is important to note that the cultural rules, values, and norms that are maintained within families and ethnic communities also have a profound effect on girls and young women. Females are often taught the importance of cooperation and interdependence within African-American, Hispanic American, and Native-American communities. Ironically, the dominant American culture tends to value individualism. Therefore, it might be especially difficult for minority girls and young women to identify with the study of technology if it is implemented in a manner that encourages and celebrates utilitarian autonomy and individual accomplishment. However, programs that are modeled after contemporary industrial practices and utilize current curricula could be very consistent with many of the values taught in homes that promote collaboration and cultural unity.

*"The male form of a female liberationist is a male liberationist — a man who realizes the unfairness of having to work all his life to support a wife and children so that someday his widow may live in comfort, a man who points out that commuting to a job he doesn't like is just as oppressive as his wife's imprisonment in a suburb, a man who rejects his exclusion, by society and most women, from participation in childbirth and the most engrossing, delightful care of young children — a man, in fact, who wants to relate himself to people and the world around him as a person."Margaret Mead*

The socialization process has a profound impact on the ways both boys and girls think about potential occupations. Throughout the formative years, children are bombarded with subliminal messages about what kind of work is thought to be most appropriate for men and what kind of work is thought to be appropriate for women. Once again, the family plays a very influential role in shaping a child's thinking about potential occupations. One study found parents tended to talk to their children about careers that were consistent with their perceptions of what is gender-appropriate (Morgison, 1995). Consequently, children begin to eliminate potential occupations based on gender stereotypes between the ages of 6 and 8. By the time they reach adolescence, they have often limited their career options to occupations that they believe are appropriate for men and women (Basavage, 1996).

According to Whitehead (1996), adolescence is "...a crucial period in the development of identity because individuals are transforming childhood identity into an adult one" (p. 149). During this stage of development, young people are testing and revising their concept of who they are and what roles they will play in society (AAUW, 1995). Adolescents devote a lot of attention to comparing who they think they are in their own eyes with who they think they are in the eyes of others. This is especially true for girls and young women. According to Gilligan (1982), females come to know themselves through their relationships and interactions with others. She also pointed out females evaluate themselves in terms of their ability to care about others. Furthermore, adolescent females tend to remove themselves from situations that can have consequences on their relationships with people contributing to their search for identity. More specifically, young women will choose to maintain a relationship at the expense of success if their success would be at the expense of the relationship. Thus, young women tend to gravitate toward situations that value cooperation in contrast to competition.

Like many occupations, the subjects taught in school are often perceived as being either masculine or feminine. The gender schema attached to school subjects tends to be consistent with the gender stereotypes held by society at large (Whitehead, 1996). Subjects that address topics and skills that are thought to be masculine are perceived to be appropriate for male students. Inversely, school subjects that focus on topics and skills that are considered to be feminine are regarded to be appropriate for female students. For instance, the humanities and social sciences are often perceived to be especially appropriate for females because they focus on beauty, people, relationships, and society. In contrast, technology is thought to be especially appropriate for males because of its focus on tools, machines, industry, and doing work. Therefore, it is only logical that boys would enroll in technology classes to help them develop their gender identity. Inversely, it is not surprising that very few girls take technology classes while they are trying to define their gender identity.

Historically, technology education was initially designed specifically to prepare young men for the roles that they would need to play in society as educated gentlemen. Despite efforts to make the study of technology an integral part of all students' general education, it is still perceived to be a male subject (Gloeckner & Knowlton, 1996). According to Silverman and Pritchard (1993, 1994), the girls that enroll in technology courses often see themselves as nonconformists. Furthermore, the girls that choose not to enroll in technology courses said they felt uncomfortable venturing outside the norm and being one of the only females in the class. It is easy to underestimate the influence that these feelings have on student choices. Girls are less likely to participate in mathematics, science, and technology classes even if they have a talent in these areas and are performing well in other ways (Sadker & Sadker, 1985). Paniagua (1999) found middle school boys wanted to enroll in technology courses regardless of their interest or abilities in this area of study. This can be attributed, at least in part, to the need that boys have to be masculine during early adolescence (Whitehead, 1996). In contrast, Paniagua also found that middle school girls were not inclined to enroll in technology classes regardless of their expressed interest in technology.

Adolescent girls form very strong social bonds with female peers. They tend to go from one class to the next in groups and prefer activities that provide them opportunities to work together. Sanders (1994) recommends capitalizing on "the herd instinct and peer pressure" by implementing recruitment strategies that target groups and subsequently provide girls with opportunities to work in groups (p. 10).

The following recommendations can help technology teachers make the study of technology more attractive to girls and young women while supporting their development.

- Young women tend to do things in groups and their peer relationships play a very important role in their development. Therefore, when recruiting students for a technology class, it is important to recruit potential female students along with their peers (Sanders, 1994). Together, they will support one another in stepping over social boundaries and subsequently help one another succeed.

- Women need to interact with others to develop their identity and entertain potential careers. Allow students to work in groups on design activities and laboratory projects when appropriate.

- To attract females to the study of technology, it is important to break away from the male stereotypes that are attached to "shop courses." One concrete way to present technology education in a new light is to update classrooms and laboratories. Make sure they are clean, feature warm colors, display positive images of women in technology, and portray the study of technology in as contemporary a manner as possible.

- Students tend to see technology as a masculine subject. To make the study of technology more attractive to young women, it is important to promote the feminine side of technology. More specifically, stress the roles that technology plays in improving the quality of life. Emphasize the importance of aesthetics and addressing the people's needs in contexts like product design and architecture.

- Young women need to see the fact that contemporary technology plays important roles in their lives on a daily basis. They also need to discover for themselves that an understanding of these technologies can help them take advantage of the new opportunities for women in both traditional and nontraditional occupations. Make sure the curriculum includes the study of everyday technologies and targets the concepts that enable young people to make sense of our technological infrastructure.

- Evaluate curricula, images, and projects that can reinforce the gender stereotypes that people attach to technology education. The assessment process might uncover the need to update classes, replace posters, and implement new learning activities that reflect the disproportionate attention given to male interests over the years.

Children are largely a product of their environment, and the messages given to girls and young women by parents and the dominant culture influence their choices. The impacts of these social influences must be accounted for when striving to address the technological literacy needs of girls and young women.

**Classroom Climate**

Students, especially girls and young women, come to the technology education classroom with preconceived ideas about what the class and teacher will be like (Hill, 1993). Most of these perceptions are consistent with the biases and stereotypes that have been attached to shop classes over the years. The subtle look and feel of the classroom and laboratory, along with verbal and nonverbal forms of communication, can make girls and young women feel like they do not belong in a technology class. Therefore, one of the challenges facing technology teachers is to examine the climate in their courses. This can be an intimidating task for teachers of a subject that has been predominately a male dominion for decades. However, this kind of introspection is necessary to ensure the culture in the classroom welcomes and respects the potential contributions that girls and young women can bring to the study of technology.

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 climate for girls. These behaviors can range from vague or condescending answers to questions to blatant comments that are disrespectful from a female's perspective. It is easy for girls and young women to feel that their presence, contributions, and perspectives are not valued when they do not receive as much attention as male students.

Myra and David Sadker (1994) uncovered a wide range of inequities in public school classrooms. They found teachers, regardless of their gender, tended to ask male students three times as many questions as their female students. Furthermore, teachers were also inclined to provide their male students four times as much praise. When females did receive praise, it was often about the appearance of their work in contrast to the substance of their work. Inversely, male students received constructive feedback more often than female students. Girls and young women can also come to believe that their ideas are not important when teachers ignore male students that interrupt female students. Similarly, their status in the class is called into question when teachers call on male students by their last names and acknowledge female students by their first names. Because of the subtlety of these inequities, teachers are often unaware that they are treating their male and female students differently. However, these behaviors do chip away at the spirit of girls and young women and give non-traditional classes a negative connotation among female peer groups.

Ideally, teachers should aspire to treat their students equally as individuals rather than as members of a group based on gender. There are some very simple things that teachers can do to

make their teaching more inclusive. For example, using terms like boys and girls, guys and gals, and ladies and gentlemen can actually separate and alienate female students. Addressing each student by their name provides a more equal treatment of the students as individuals. It is also important to be consistent in the use of either first or last names. Calling on female students with approximately the same frequency as male students legitimizes the female students' perspective as well as sets up an equal standard of participation for all students.

The use of inclusive language is also essential to establishing a positive climate for female students. People often use popular terms like man and mankind based on the assumption that they include both men and women. Despite the acceptance of these words as inclusive terms, there is evidence that suggests children associate these words with just males (Henes, 1994). Similar schema can emerge in the minds of young students when teachers use other forms of gender-specific language. Specific examples include common words like craftsman, tradesman, man-made, man-hours, manpower, repairman, salesman, journeyman, and workman. There are several gender-neutral alternatives for each of these terms.

Nonverbal interactions between teachers and female students are also critical. Body language can speak as loudly as words and can cause misunderstandings. Teachers need to be aware of their own body language and how it effects female students. For example, using direct eye contact (not staring) with female students lets them know that there is interest in what they have to say. On the other hand, responding to female students with rolling eyes and a condescending tone of voice will suggest they do not belong in the class.

***Disturbing Attitudes***

*"It is nice that girls are exposed to this stuff, but technology education is really for boys."*

*"I don't have time to teach the girls how to weld when I have boys who really need to learn it."*

*"I keep score of the number of coping saw blades that the girls break in my classes on the chalk-board. Given the number of girls that I have in my classes, I have to have two boxes of blades in my shirt pocket just to get through the day."*

Teachers also have to examine their classroom management style to ensure it provides female students equitable opportunities to participate. More specifically, girls and young women will often follow classroom rules or wait their turn to make contributions to classroom discussions. In contrast, assertive males will often blurt out their ideas in a relatively spontaneous manner. In the interest of equity, it is important to establish and maintain classroom rules that address the unabashed enthusiasm and impulsiveness of male students. Beginning with the first class, the teacher should establish classroom norms and response etiquette that is respectful of all students.

Teachers must consider how interactions between students can create a chilly classroom climate for girls and young women. Given the disproportionate amount of attention given to males over the years, it is easy for people to see technology education classes as a "boys' club." Consequently, female students report that they feel like outsiders when they choose to enroll in technology classes. Being female in a male dominated environment, young women report that

they feel uncomfortable and perceive themselves as being on display (Silverman & Pritchard, 1993). Conversely, many males see their female counter parts as either intruders or romantic targets (Eisberg, 1993). Therefore, it is not surprising that female students enrolled in non-traditional high school courses often experience some form of harassment by their male peers (AAUW, 1995). Unfortunately, teachers and administrators often dismiss these incidences as typical male behavior.

***Reluctant Voices***

*"I do not want to be in the hallway with those boys much less enrolled in a class with them!"*

*"I am not going into that dirty shop and take engines apart."*

The predominance of males in a traditional male environment can also create an atmosphere of intense competition. Technology teachers can organize their labs and work groups in a manner that allows for cooperative learning experiences that meet the needs of all students. One controversial strategy is to pair female students together. This strategy enables and encourages female students to take charge of the learning materials, support one another's achievements, and become experts of technology. Once their confidence and skill is developed, they are more likely to actively participate with male students.

Boys and young men are encouraged to be assertive and competitive. Both of these traits can surface in the classroom with undesirable consequences for other students, especially girls and young women. For example, studies show women are interrupted while they are speaking more often than men (Henes, 1994; Krupnick, 1985). Sometimes these interruptions are in the form of a male helping a female finish her sentence. If these assertive behaviors go unchecked by the teacher, they can give girls and young women the impression that they cannot be trusted with ideas about technology or their contributions are not as important as those of males. Similarly, girls are likely to wait their turn for teacher assistance during laboratory activities while male students solicit the aid of their teacher aggressively by ignoring lines or bellowing questions from across the room. Once again, it is easy for female students to feel unimportant if the teacher responds to these aggressive behaviors. It is essential for teachers to establish and maintain rules for classroom and laboratory etiquette.

Humor is an extremely powerful tool for teaching and learning. Furthermore, humor can play an important role in helping students cope with frustration. Unfortunately, inappropriate attempts at humor can perpetuate stereotypes and alienate populations (Henes, 1994). In the case of gender, sexist jokes that capitalize on popular stereotypes (e.g., blond jokes) or target the unique characteristics of being a young women (e.g., equating IQ with bust size) can severely damage a woman's morale, hamper learning, and discourage participation in technology classes.

Technology teachers need to facilitate student-student interactions that encourage gender equity in their classrooms and laboratories. It is very difficult for teachers to monitor and control all student-student interactions. However, if teachers "...actively point out and dissuade activities, comments, and jokes that reflect stereotyping or bias, they will create an environment where gender putdowns and insensitivity (even in the guise of humor) go un-rewarded or are actively discouraged" (Henes, 1994, p.4).

*"Whatever women do they must do twice as well as men to be thought half as good." Charlotte Whitton*

The physical environment found in technology education classrooms and laboratories is another element that can either welcome or turn off girls and young women. Females tend to avoid technology education classrooms and related careers because they find them to be dirty, cluttered, rough, and stressful environments. The physical strength that has been required to operate equipment can also be intimidating. Although technological careers, as well as some technology classrooms and laboratories, have become more contemporary environments, the stereotype of the dirty shop remains in the minds of many girls and young women. One way to begin dispelling this stereotype is to encourage people to visit the technology education classroom, to observe the concepts being taught, and reflect upon their application to life.

The following ideas are being presented to help teachers make the study of technology more respectful of girls and young women.

- Inequities in the treatment of male and female students can be very subtle and unconscious. To uncover differences in one's behavior, consider setting up a video camera in your classroom or wearing a tape recorder. Review the video or audiotape to identify opportunities to improve classroom climate.
- Inappropriate eye contact can make a female student feel very uncomfortable, especially if they are experiencing dramatic physical changes. Try to avoid dropping one's eyes while pausing to think about a student's question or comment. Consider looking up or to the right or left when the urge to break eye contact emerges.
- Use gender-neutral language and terminology throughout your communications with students and colleagues. For example, words like manufactured, synthetic, hand-made, or human-made can be easily used in place of man-made.
- Female students tend to take a little longer to process new ideas and respond to questions. This can be especially true in a subject where they have limited life experiences. Make sure you provide adequate pause time after asking questions. Impatience can give students the false impression that they cannot handle the material when, in reality, they just want to be thoughtful about their answers.
- Men tend to seek validation and gratification during their discussions with others. This quest can result in a competitive tone and some moderate debate. Ironically, women tend to pursue a sense of validation and gratification by building consensus among discussants. In contrast to being assertive, women tend to welcome and encourage input from others (Tannen, 1986). Therefore, once again, it is important to utilize cooperative learning strategies that acknowledge and support the communication style of many girls and young women.
- Again, it is important that the classroom and laboratory are warm and inviting places as well as exciting and engaging places to work and learn.
- In contrast to their male peers, female students often turn in work that is pleasing to the eye. Do not let the appearance of the work overshadow the substance of the work. Girls and young women need constructive feedback in order to learn and grow. Comments about the appearance of the work in absence of feedback about the content of the work can suggest to the students that it was not taken seriously.

- Too often males assume women are not physically strong enough to handle large machines and perform heavy tasks. It is important to provide all students an equal opportunity to engage in physical activities. Therefore, one should teach the techniques used by industry to enable employees to take advantage of the strength that they do have to perform tasks safely and efficiently.

The signals sent to young women through the physical environment, teacher-student interactions, and student-student interactions can create a chilly message to females (Sandler & Hoffman, 1992). Teachers must carefully manage their interactions with students, as well as interactions between students, to create a positive climate for all students. The ideas outlined above are not likely to make a significant difference in classroom climate if they are implemented in isolation from one another. They are more likely to have a profound impact on classroom climate if they are implemented in a systemic manner. The synergy of these modest recommendations working together can improve the learning climate for both male and female students.

## Curriculum and Instruction

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. Despite the philosophical appeal of this fundamental idea, there is compelling evidence that suggests men and women are not equal players in the enterprise we call technology. In reality, men clearly dominate many technological endeavors. For example, at the professional level, only 22.6% of the architects and less than 10% of the engineers are women (U.S. Department of Labor, 1994). Similar demographics are apparent for many of the classic occupations commonly associated with technology. The predominance of the men at all levels of technological activity has created the common perception that doing technology is a male gender role. This conclusion is inconsistent with the philosophy and mission of technology education, and it does not address the needs of people living in a technological society.

Integrating the perspectives and contributions of women into the technology education curriculum is not a simple endeavor. In her book, Rothschild (1988) recounted a few words of caution offered by Charlotte Bunch at the close of the first convention of the National Women's Studies Association in 1979. The essence of her message was that educators, in their efforts to balance the curriculum, should not just "add women and stir." Rothschild illuminated Bunch's "culinary metaphor" by stating "if one adds a new ingredient to the beef stew without changing the basic recipe, the flavor or consistency might change somewhat, but we still have only a variation on the same beef stew" (p. 30). If the technology education community strives to use gender neutral language, employs gender-balanced media, and introduces students to female role models, the curriculum will be ultimately richer. However, the ways we ask young people to think about technology will remain essentially the same. Although these are basic and essential interventions, they are by no means sufficient. Removing gender bias from the technology education curriculum will require systemic change.

Several models have been developed for integrating women's perspectives into the science curriculum (Baker & Scantlebury, 1994). In addition to serving the science community, these models could also be used to infuse the contributions and perspectives of women into the study of technology. Peggy McIntosh (1984) developed the most widely quoted model in the literature. According to her model, the infusion of women into the curriculum goes through five phases. With each phase, teachers would develop their awareness of women's roles in technology and implement more sophisticated and inclusive curriculum reforms. For the purpose

of this monograph, McIntosh's specific references to science have been replaced with references to technology.

The first phase in a modified version of McIntosh's model would be "womanless technology." In phase 1, the curriculum does not acknowledge women's contributions to, or their participation in, technological endeavors. Furthermore, the curriculum does not account for women's concerns about the ways in which technological activities are conducted. Women are absent from course content and instructional materials. In short, the curriculum is presented solely from a male point of view. Lastly, with only a few isolated expectations, the teachers and students participating in the discipline are male. Old textbooks that feature images of men doing technology provide some evidence technology education was in phase 1 in the recent past.

*"Now we are expected to be as wise as men who have had generations of all the help there is, and we scarcely anything." Louisa May Alcott*

The second phase would essentially be "women in technology." During phase 2, famous women in technology are featured in technology education curricula and instruction. The curriculum presents the perspectives and contributions of exceptional or elite women in technology in periodic vignettes. However, the fundamental definitions, assumptions, methodologies, and values underlying the study of technology remain essentially the same. The special attention given to the technology's heroines puts women on the periphery of mainstream technology. Rothschild (1988) equated phase 2 with "add women and stir" (p. 39). Textbooks featuring stories about "heroines of technology" in sidebars or boxes that are separate from the main text would suggest the emergence of phase 2.

In phase 3, the central theme would be "women as a problem, anomaly, or absent from technology." During this phase women are studied in the context of being overshadowed by men and victims of the "good-old-boy" fraternity within the technology community. Questions are raised and discussed regarding the ways in which women have been left out of the structure of technological knowledge and, subsequently, the school curriculum. Women in technology become a curriculum issue and they are studied in the context of race, gender, and class within sociological and political aspects of the technology enterprise. Although the absence of women in the discipline's culture receives scholarly attention, women are still not treated as an integral part of the mainstream of technology. The popularity of a book that addresses the lack of recognition given to female inventors because of sexist patent laws and social norms might suggest some phase 3 conscience.

Phase 4 would be called "women as technology." During this phase, the curriculum would recognize that women account for at least half of human history (Rosser, 1986) and the intellectual resources available to humankind. More specifically, the curriculum would take a proactive stance toward women by including topics, learning activities, and examples that are consistent with the experiences, interests, concerns, and learning styles of women. Reaching phase 4 requires a systemic reconceptualization of the technology education curriculum. Since very little, if any, tangible progress has been made toward reaching this goal, concrete indicators for this phase are difficult to visualize. However, one could assume that approximately half of the students and teachers participating in technology education would be female. Furthermore,

women's contributions to technological development would be studied based on their contributions to human potential in contrast to their potential role in helping the discipline be politically correct.

*"Something which we think is impossible now is not impossible in another decade." Constance Baker Motley (First Black Woman to become a Federal Judge)*

The last phase in McIntosh's model would be called "technology reconstructed and refined to include us all." At this level, women would be intrinsic and an integral part of the enterprise called technology. The attention given to the contributions, perspectives, and potential of women in the previous phases would result in a new epistemological foundation for the study of technology (Rothschild, 1988). McIntosh estimated it could take over 100 years for the science community to reach phase 5.

Assuming McIntosh's model is a valid tool for gauging the field's progress toward a truly gender balanced curriculum; it is safe to say that technology education has been in phase 1 for most of its history. The modest attention given to gender equity in technology education textbooks, curriculum guides, student recruitment activities, instructional media, and professional literature indicates that the field is somewhere in phase 2. Perhaps the number of sessions addressing gender issues during recent ITEA conferences suggests that some leaders might be moving toward phase 3. However, in order to enter phase 4, leaders in technology education will need to confront unsettling ideas about the assumptions that underlie our curriculum, pedagogy, and collegial behavior.

For the most part, the study of technology in our public schools has been a construct of the male psyche and experience. Technology education, as we know it today, gained momentum as a school subject in the United States around the turn of the nineteenth century. At that time it was called manual training and it was designed specifically to prepare boys for adult life in an industrial age (Woodward, 1890). For much of its history, technology education was a subject that was taught exclusively by men for male students. The doors to the technology education classroom and laboratory have only been open to girls and young women for approximately 30 years.

Even today, the ways in which we ask young people to think about technology reflects a male perspective. The topics that are studied, the laboratory activities that are performed, and the examples that are used in class tend to be derived from interests and experiences of men and boys. The challenge facing technology educators today is to reflect on current practices, venture outside of the time-honored traditions of the discipline, and imagine the study of technology from a larger point of view. Once a more inclusive vision becomes clear, the study of technology can be implemented in our schools in a manner that accounts for the unique needs, interests, and thought processes of girls and young women.

A modest body of research suggests men and women do not think about technology the same way (Bank Street College, 1991). Women tended to value and perceive technology as a means of facilitating collaboration, communication, and linkages between people. Men, on the other hand, tended to see technology as a means of extending their control over their physical

environment. Men also tended to identify strongly with the technical details associated with a given technology, while the females were more attentive to its practical applications. Lastly, men often relate to technology through tinkering, while women connect with technology in the context of solving a problem from everyday life.

When asked to define technology, males tended to associate technology with the future and they described technology in the context of work more than the females (Welty, 1996). They also were more likely to equate technology with ideas than their female counterparts. In contrast, female tended to associate technology with computers and electronics more often than the males. Furthermore, they tended to equate technology with science more than males did. They also associated technology with advancements more than the male students. Lastly, both male and female students endorsed the idea that technology makes life easier.

There is also some evidence that suggests men and women have different interests when it comes to studying technology. When asked to describe an impressive technology, female students depicted examples of medical and communication technology far more than the male students. In contrast, the males tended to list examples of information, entertainment, transportation, or military technology more often than their female peers (Welty, 1996).

To better serve the needs of girls and young women, several leaders in gender equity have formulated recommendations for improving instruction (Henes, 1994; Pollina, 1995; Sanders, Koch, & Urso, 1997). Although their recommendations were conceived in the context of mathematics, science, computer literacy, and engineering, they can also be applied to the study of technology. The following list represents a synthesis of their work in the context of technology education.

- Girls and young women are interested in the overall well being of people. In addition to the attention given to the physical technology, teachers should connect the content to people and frame their lessons and learning experiences in the context of everyday life as often as possible.
- The technical terminology and examples used to explain important concepts are often derived from male experiences and have limited meaning for female students. Therefore, teachers should use terms and examples that are consistent with the interests and experiences of girls and young women when appropriate. For example, pushing dough through an open pattern (or die) to make holiday cookies is an excellent example of extrusion that many boys and girls have experienced or observed first hand.
- Many girls prefer to work with one or more peers in a climate that encourages cooperation and collaboration, in contrast to competition and individual achievement. One should use cooperative learning techniques like "numbered heads together" and "think, pair, share" to conduct learning activities that involve students working together.
- Female students will often volunteer for tasks that are consistent with traditional gender roles (taking notes) when confronted with unfamiliar learning activities or assertive lab partners. Hence, one should structure learning activities so female students have rich opportunities to manipulate hardware without undue stress. This can often be achieved by pairing female students together to capitalize on their empathy for one another, as well as an ability to cooperate.

- Female students often identify with the context in which a technology is used more than the physical technology itself. Therefore, one should strive to present new technologies with scenarios about how they were originally developed and the role that they play in people's lives. An emphasis should be placed on how the technology in question solves a practical problem or improves the quality of life.
- Many female students have excellent verbal skills. Hence, teachers should design learning activities in a manner that enables female students to capitalize on their verbal strengths as often as possible.
- Female students in non-traditional classes might not participate as openly as their male counterparts. Consequently, it can be more difficult to monitor their understanding of challenging concepts. Therefore, teachers should use frequent and embedded assessment techniques to gather the information needed to check for understanding and to make appropriate adjustments in instruction.
- Female students want to meet the same standards for achievement that are required of male students. Therefore, teachers need to keep their expectations high and provide students frequent feedback about their progress toward meeting established standards. Constructive feedback reinforces the students' belief in their command of the material and builds the confidence needed to achieve higher goals.
- Female students often ask for assistance when they face new challenges without the benefit of prior experience. During socialization, many males have been taught to go out of their way to help females perform difficult tasks. Unfortunately, this assistance can go too far and it can short circuit learning opportunities for girls and young women. Furthermore, girls and young women can exploit this male tendency to expedite their projects and laboratory assignments. Teachers need to recognize this pattern when it comes into view and take steps to ensure female students complete their own work and subsequently, develop a genuine sense of self-esteem from their accomplishments.

The challenge that currently stands before technology education teachers is to rethink traditional curriculum and instruction based on the recognition of an increasingly diverse student population, and the need for all students, especially girls and young women, to understand, use, and manage technology. An examination of the lens through which technology education is being taught will go a long way towards affecting the changes necessary to allow curriculum and instruction to engage girls and young women.

**Role Models, Mentors and Peers**

The twentieth century has seen great strides in the development of technology. Human ingenuity has been characterized as the "mother" of invention during this period of time. In reality, women have made significant contributions to the development of technology, and yet, their perspectives, contributions, and achievements are rarely honored. Myra and David Sadker (1994) found that most students could not name five famous women when they were asked to list twenty. Despite the suspicious absence of women in technological endeavors, there is compelling evidence that suggests women have made significant contributions to the development of technology. The plow and harrow, the automobile windshield wiper, Kevlar©, and Scotchgard© protectant were all invented by women. Yet students, especially girls and young women, aren't being exposed to these creative and successful women.

If girls and young women are exposed to accomplished women in technology at an early age, it can help shape their ideas about technology as well as their career aspirations. Children make important gender role decisions based on the roles that they see women playing in society. Once girls and boys reach puberty, they usually resist thinking outside the gender roles that they have constructed for themselves based on subtle messages from parents, teachers and peers.

Public education plays an important role in preparing girls and young women for citizenship and careers in a technological society. Despite the fact that women receive a majority (78%) of the education degrees, 97% of "industrial arts" teachers are men (National Center for Education Statistics, 1991). The absence of women among the ranks of technology educators reinforces the subliminal misconception that the study of technology education is a male endeavor.

Only 1.7% of female high school seniors expressed an interest in pursuing a career in engineering, in comparison to 8.6% of their male counterparts (NSF, 1993). Once enrolled in an engineering program, women are more likely to drop out of the program than men (Owen, 1993). The women who dropped out of Michigan State University's engineering programs in 1990 reported that they withdrew from their program because they were not taken seriously in class, the labs were dominated by men, and there were few, if any, role models or supportive peer networks.

In a study conducted by the Center for Technology in Education, a team of researchers interviewed 44 women and 22 men who were engaged in careers related to technology (Bank

Street College, 1991). Most of the women reported having fewer experiences with technology during childhood than their male counterparts. Many reported being encouraged to pursue a technical career by a mentor, who was typically male. Ironically, some of the women recounted being inspired to pursue non-traditional careers based on the counsel of others, often teachers, who said they could never succeed because of their gender.

Because of this lack of female role models, both in the public and private sector, girls and young women are reluctant to consider the study of technology and the pursuit of nontraditional occupations among their career options. The absence of women in the ranks of people successful in technology reinforces the misconception that the study of technology is a male endeavor.

Research indicates that role models and mentors, especially family members, have a powerful influence on females who pursue careers in technology. Careful attention must be paid to how role models and mentors can be used to open up technological careers to young women. Girls and young women still see mostly men teaching classes related to mathematics, science, and technology. Although these male teachers work hard to be inclusive, there is still a perception that the absence of women means that women are not as welcome to pursue technology (Owen, 1998).

"Exposing children to successful women in technology can provide inspiration and role models for young women" (Dorman, 1998, p.2). These role models can provide the inspiration they need to entertain nontraditional classes and career paths. Seeing other women making a difference in technology suggests to girls and young women that technology education isn't "just for boys."

Girls and young women need to be introduced to women who have successful careers in technical fields. However, some experts recommend avoiding placing too much emphasis on the "heroines of technology" (McIntosh, 1984; Rosser, 1986, 1990 & 1994; Sanders, 1994). Girls and young women are being told that they can have a career and a family. Some of the women featured in the popular press and in recruitment campaigns have dedicated their lives to their careers and have not made time for families. These leaders argue that these role models can be counterproductive because they suggest to girls and young women that they have to make significant sacrifices to become accomplished technologists. Therefore, instead of relying on people that might be perceived as "super women," these leaders recommend using women from the community who have careers in technology and lead ordinary lives. Hence, some of the more promising role models are the architects, engineers, computer programmers, and plant managers that live in one's community and just happen to be women.

*"For every one of us that succeeds, it's because there's somebody there to show you the way out. The light doesn't necessarily have to be in your family; for me it was teachers and school."*
*Oprah Winfrey*

Technology is creating a global economy that is increasingly diverse. With this in mind, attention should also be given to providing role models from various cultures. Because culture plays such an important role in the development of a child's identity, it is critical for girls and

young women to see women from their own race being successful in technology, especially if they are members of under-served and under-represented groups.

Mentoring has also become a popular concept among teachers who are interested in supporting girls and young women in the study of technology. Like many important ideas in education, the concept of mentoring has many definitions. Terms like advocate, guide, teacher, master, sponsor, promoter, confidant, consultant, and counselor can all be used to describe the roles that mentors play in the development of talented and promising students (Anderson & Shannon, 1988; Odell, 1990; Sandler, 1993; Shea, 1994).

According to Sandler (1993), the word mentor was used to characterize nurturing relationships between men until it was adopted by people trying to advance the status of women in the 1960's. Today, both men and women are being identified as mentors and protégés or protégées.

Ironically, people can be role models, sponsors, master teachers, and career counselors without being mentors. What makes these roles special in the context of mentoring is the fact that these skills are being focused on the specific needs of a protégée. A protégée is a young woman whose growth and development is being furthered by a person of experience, prominence, or influence.

Teachers aspiring to be mentors need to be important sources of knowledge, experience, and wisdom. However, in contrast to disseminating information freely, an effective mentor uses his or her knowledge of the protégée's background and learning style to help the protégée construct knowledge for herself. More specifically, the mentor uses a Socratic dialog to help his or her protégée define problems, identify information resources, engage in disciplined inquiries, reflect on experiences, and formulate understandings.

Just like a role model, an effective mentor does a lot of his or her teaching by example (Lave & Wenger, 1991). More specifically, the mentor models what it means to be a master student and a life-long learner on a daily basis. The mentor deliberately tries to make some of his or her thought processes and attitudes as overt as possible. The protégée, in turn, studies the mentor's behavior and tries to integrate her mentor's values and cognitive strategies into her own. In a manner of speaking, the mentor adopts a teaching style that is similar to that used by a master craftsperson passing on a trade to a promising apprentice. However, instead of teaching trade skills, the mentor is passing on generalizable concepts, disciplined thought processes, career skills, and much more. Lastly, a good mentor is aware of the career opportunities in technology, understands the protégée's strengths and weaknesses, and is able to help his or her protégée identify appropriate career goals and identify strategies for achieving those goals (Shea, 1994).

It is important for young women to be able to identify with women from the mainstream of society who became leaders in technological endeavors. An ideal scenario for developing a new generation of female technologists would be to pair talented young women with established professional women. Unfortunately, there is a shortage of potential female mentors due to the modest number of women who hold leadership positions in male dominated fields, including

technology education. Therefore, many of the young women interested in studying technology will find themselves seeking the support of a male mentor (Sandler, 1993; Vetter, 1993).

*"I think having a mentor or someone I could talk to about different career choices would have helped me a lot. I did not know what I wanted to do with my life and I was not aware of the variety of career choices that were available. Also, meeting professional women in non-traditional careers would have provided me with some inspiration and self-confidence to pursue studies/classes dominated by males. " Gloria Yamauchi (NASA Aerospace Engineer)*

It is important to note that males may have different mentoring styles than their female counterparts. A study by Mokros, Erut, and Spichiger (1981) suggests male mentors tend to provide their protégées with specific directions for performing tasks that are intended to foster their growth and development. Male mentors also tend to be task-oriented and somewhat detached from their protégée's activities outside of school. In contrast, female mentors tend to guide their protégée's activities with examples and encouragement. Furthermore, they often take a genuine interest in their protégée's personal lives. A healthy balance between these two approaches to mentoring is likely to have the greatest impact on a protégée.

The following ideas can be used to help girls and young women recognize that they can study and learn about the technology, and possibly pursue a technical career.

- Girls and young women need to see women actively engaged in technological endeavors. Furthermore, they need to see women in leadership roles. Review course materials like textbooks, multimedia programs, and videotapes to ensure that they depict women in technical situations and in a positive light. Be especially attentive to materials that can help compensate for the current male bias in society and the workplace.
- Local businesses and industries often have talented women in positions that require an understanding of technology. Invite these women to serve as guest speakers during appropriate units of instruction. Do not limit your choices to just women in specific careers. Consider inviting women that can talk about how their firm works even though their job does not fit a given stereotype. For example, a woman who writes proposals for a civil engineering firm can speak very intelligently about civil engineering projects even though she is not a civil engineer.
- Women have made significant contributions to the development of technology. At appropriate times in the curriculum, weave in stories about creative women who invented new technologies or have influenced how we practice technology today. For example, one could introduce students to the work of Lillian and Frank Gilbreth during a unit on production planning, material handling, or production tooling. They pioneered the use of time and motion studies in manufacturing firms to increase productivity and employee morale.
- Girls and young women often feel more comfortable pursuing an interest in technology with other girls and without the watchful eyes of their male peers. Consider establishing a club for young women in technology. Provide club members access to laboratory resources outside of class. Use the context of the club to mentor promising young women with technical aptitudes and career aspirations.

Since social contacts play such an important role in the development of female identity, it not surprising that role models, mentors, and peers can influence the choices that girls and young women make about their lives and how they relate to the world around them. Providing appropriate role models, mentors, and peer networks for girls and young women is extremely important. Together, they can encourage and support participation in technology education and ultimately, the pursuit of technical careers.

**Messages from Counselors**

Information, or the lack thereof, significantly impacts the impressions that children form about the world around them, and the decisions they make about the potential roles that they will play in this world. The American Association of University Women indicates that girls still choose jobs and careers based on stereotypes (Greene, 1998). These stereotypes are developed early in a child's development, and it is more difficult to persuade a student to step out of these stereotypes as they grow older. In response to social pressure, girls 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 (Greene, 1998). Counselors must act specifically and strategically to counter these stereotypes and ensure young women consider their options thoughtfully.

The world of work is demanding a greater understanding of technology (United States Department of Labor, Bureau of Labor Statistics, 1999), yet a large sector of Americans has been classified as technological illiterates (Gilberti, 1991). Many of the people under this classification are girls and women. In 1992, it was discovered that only 12.1% of female students were enrolled in technology education classes. That is a decline of over half the number of female students that participated in such courses over 20 years ago (Staff, 1994). In 1998-99, only 17% of the students enrolled in technology education in Wisconsin's secondary schools were female. Furthermore, their enrollment was concentrated in printing, drafting, and design classes. These figures are especially significant because of the dramatic increase in the use of a wide range of technologies in the workplace and in society in general.

In its latest employment predictions, the United States Department of Labor (1999) projects that 5.3 million jobs will be added in professional specialty areas by 2008. The fastest growth occupations will employ engineers, technicians, and related support personnel. The largest numbers of positions projected to be added are in the area of information technology.

The significance of these statistics is more apparent when labor force demographics are also considered. The number of women in the work force, in nearly all age groups, will increase faster than that of men and is projected to reach a high of 48 percent by 2008. The USDL (1999) also predicts that the number of Asian and Hispanic members of the labor force will increase faster than other groups (40 percent and 37 percent, respectively) because of immigration and higher than average birth rates. The African American labor force is expected to grow to 20 percent, which is twice as fast as the 10 percent growth rate for the white labor force.

Parents, as well as students, need more information. Since parents play a significant role in their student's career selection process, it is important for parents to understand the options that are available to their child. Broadening parents' perspectives can be very challenging because they grew up with the stereotypes that narrow perceptions and may have followed traditional career paths themselves.

Middle school girls are uninformed about the various technology education classes that are available to them at the high school level that could encourage pursuit of a nontraditional career. This lack of awareness of technology education class options encourages female students to follow traditional tracks when they enroll in elective classes.

*"Women share with the men the need for personal success, even the taste for power, and no longer are we willing to satisfy those needs through the achievements of surrogates, whether husbands, children, or merely role models." Elizabeth Dole*

Silverman and Pritchard (1993) found that girls in middle school did not make "connections between what they are learning in technology education classrooms and careers in technology fields" (p. 4). Students are also at a stage in their development where they "find it difficult to imagine themselves working in the real world" (Silverman & Pritchard, 1993, p. 4). Therefore, girls and young women often do not recognize the relevance and benefits of technical knowledge without a rich exposure to the world of work and the economic realities of everyday life.

To make informed decisions about the future, girls and young women need to recognize the breadth of career opportunities that are available and how they are impacted by technology. Their career awareness needs to include the educational requirements, working conditions, opportunities for advancement, and the average salaries associated with the occupations that are consistent with their talents, interests, and career expectations. In addition to school career fairs, this kind of career information needs to be integrated into classroom instruction and laboratory activities. Furthermore, it is important that this instruction address more than the classic careers that have been highlighted in technology education curricula for years. Recent developments in technology have increased the number of salient career options dramatically. An articulated collaboration between guidance counselors and technology education faculty can attack and dispel occupational stereotypes and encourage female students to explore and entertain nontraditional careers.

The use of role models and special initiatives like summer technology camps can bridge the connection gap between women and technology. Both Sandler (1993) and Pedras, Oaks, and Vail (1994) reported female role models, especially those serving as female technology education teachers, could go a long way in breaking down the barriers that keep girls and young women from technological careers.

Providing opportunities for job shadowing and youth apprenticeships in local industries and businesses can also serve as a link to connect women and technology. This can provide female students direct experience with the knowledge required in technological careers. It can

help young women begin developing a support network that includes professional women working in technical careers. Lastly, a link with local industries and businesses can also provide guidance counselors and teachers alike the information and resources needed to offer students up-to-date career experiences.

Technology education is typically viewed as peripheral to the core curriculum, in contrast to being an integral part of the general education curriculum. Consequently, guidance counselors can be reluctant to recommend technology courses for college bound students because universities do not require these classes. This reluctance is often reinforced when the curriculum offered under the auspices of technology education is very attentive to the needs of male students preparing for entry-level work, in contrast to occupations that require some form of education beyond high school. Ironically, contemporary technology education classes target key concepts and skills that provide an intellectual foundation for careers in design, engineering, and architecture. Furthermore, up-to-date technology education programs have made addressing the technological literacy of all students their primary mission. Given this focus, they strive to address content standards that have been endorsed by the American Association for the Advancement of Science, the National Research Council, and the International Technology Education Association. However, without a strong connection to the general education curriculum or a college preparatory program, many young women will continue to be reluctant to enroll in technology education classes.

Guidance counselors can play an important role in helping technology education faculty understand the career options that are available to young people and the academic expectations associated with these options. Furthermore, technology education teachers need the support of guidance counselors in aligning their curricula with post-secondary education options, including professional programs at 4- year universities. Lastly, technology education teachers often need more information about the needs and interests of college bound students in order to play a greater role in their career education and academic preparation.

*"Parents, teachers and guidance counselors must encourage girls that they can do science, math and engineering and push them to excel." Gina Ferrera, Electrical Engineer*

Silverman and Pritchard (1993, p. 8) offered ten valuable ideas for counselors on how they can encourage gender equity in technology education.

- Guidance programs (in coordination with technology education teachers) should provide more information to both students and parents about the salaries, necessary preparation, and promotion prospects of various kinds of technological careers.
- Gender equity needs to be a clear focus in activities such as career days or career fairs at schools. Counselors must make an effort to attract female role models working in nontraditional occupations to talk to students and insure that presentations are balanced.
- Middle school students could visit technology education labs at high schools to see the kind of equipment and classes available.
- High school teachers could visit middle school classrooms, or there could be elective "fairs" where they discuss the kind of programs available at the high school.

- Guidance counselors could work with technology education teachers in the classroom to get more information to students and help make the connection between what students are doing in class and technological careers.
- Guest speakers (with significant representation of females) can be brought into technology education classes to discuss the world of work.
- Schools need to develop links with local business/industry to provide guest speakers, opportunities for field trips, job shadowing or internships.
- Course structures could be made more flexible, with more opportunities for students to take vocational subjects. These opportunities could be part of a career exploration guidance program.
- Career centers could be introduced in middle schools to provide students with more opportunities for exploration.
- Interdisciplinary courses between technology education and other academic departments could be developed.

Because we need girls and young women in technologically related fields, it is imperative that guidance counselors work with teachers, administrators, parents, and students to provide more information about the relevance of technology education to the world of work for girls and young women. Access to this information, especially at an early age, is essential if girls and young women are going to begin envisioning themselves as active participants in a world inundated with technology. This information can also encourage girls and young women to develop the knowledge and skills needed to succeed in the technological careers of tomorrow.

## Summary

The study of technology in public education has undergone many changes since the inception of manual training. The laboratory facilities, courses of study, and teaching methods associated with exemplary practice today have very little in common with those used a hundred years ago. However, despite these advancements, an overwhelming majority of the students participating in technology education are still males. We espouse to be an integral part of the general education of all students, yet we seem to specialize in preparing young men for life in a technologically sophisticated society (Brusic, 1990).

To truly attract and subsequently serve the technological literacy needs of young women, the discipline needs to empower both pre-service and in-service teachers to integrate the perspectives, contributions, and learning styles of women into the technology education curriculum. An increase in the voluntary participation of girls and young women at the middle school and secondary school levels will enrich and help balance technology education classes. The participation of girls and young women in our classrooms and laboratories will reap many benefits, not the least of which will be to inspire future technology education teachers. Analogous reforms in mathematics and science education are also reducing the barriers that stifle young women from entertaining nontraditional careers.

*"The challenges of change are always hard. It is important that we begin to unpack those challenges that confront this nation and realize that we each have a role that requires us to change and become more responsible for shaping our own future." Hillary Rodham Clinton*

The near future promises to require even greater levels of technological literacy from its citizens to function in an increasingly technologically sophisticated society. The spirit of Athena resides in the young women of this nation. In order for girls and young women to participate in our technological society, classroom teachers, guidance counselors, and administrators need to act on the recommendations outlined in this monograph.

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