DOCUMENT RESUME

ED 362 650 CE 064 514

AUTHOR Silverman, Suzanne; Pritchard, Alice M.
TITLE Building Their Future: Girls in Technology Education in Connecticut.
INSTITUTION Vocational Equity Research, Training and Evaluation Center, Hartford, CT.
SPONS AGENCY Connecticut State Dept. of Education, Hartford. Bureau of Applied Curriculum, Technology and Career Information.
PUB DATE Sep 93
NOTE 25p.; For a related document, see CE 064 515.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Career Choice; Career Planning; *Course Selection (Students); Educational Research; Enrollment Influences; Females; High Schools; High School Students; Junior High Schools; Junior High School Students; *Middle Schools; *Nontraditional Occupations; Sex Discrimination; Sex Fairness; *Sex Stereotypes; State Surveys; Student Attitudes; Student Educational Objectives; Technical Occupations; *Technology Education
IDENTIFIERS *Connecticut; Middle School Students

ABSTRACT

A study of the experiences of girls in technology education courses in three Connecticut middle schools examined the impact of these experiences on the students' decisions about whether to take more technology classes in high school. Another focus was girls' attitudes toward careers in technological fields. Five basic types of data were gathered: classroom observations (n=77); focus group interviews with 58 female students in middle school technology education classes; interviews with 13 technology education teachers, 6 principals, and 18 guidance counselors; a survey of 737 high school technology education students; and statewide vocational enrollment data. Findings included the following: (1) girls appeared to enjoy technology education and to have confidence in their abilities, but emerging sexism among peers began to affect participation on the basis of gender; (2) girls were discouraged from taking more technology education in high school due to stereotypes about appropriate careers; and (3) girls who took technology education in high school were willing to challenge stereotypes but had less confidence in their abilities. Recommendations included: placing a high priority on hiring more female technology education teachers; providing opportunities for technology education teachers to discuss gender equity issues; review of the curriculum to make better education-work connections and break down stereotypes about careers for women; and providing better information about options for middle school students. (A paper entitled "Theoretical Interpretation of Cognitive Differences: A Brief Review" is appended.) (YLB)

BUILDING THEIR FUTURE:

GIRLS IN TECHNOLOGY EDUCATION IN CONNECTICUT

by

Suzanne Silverman, Ph.D and Alice M. Pritchard, M.A.

Published by:

the Vocational Equity Research, Training and Evaluation Center (VERTEC)

Funded by:

the State Department of Education,
Bureau of Applied Curriculum, Technology and Career Information

with the assistance of Dr. Agnes Quinones, Gender Equity Consultant and Greg Kane, State Supervisor for Technology Education

September 1993

VERTEC is a project of the Connecticut Women's Education and Legal Fund (CWEALF). The Center is located at the CWEALF office, 135 Broad Street, Hartford, CT 06105-1037.

Acknowledgements

This project was made possible due to the assistance and cooperation of many individuals.

We would like to thank several individuals in the Connecticut State Department of Education, Bureau of Applied Curriculum, Technology and Career Education who were instrumental in guiding and critiquing this project: Leslie Averna, Bureau Chief, Dr. Agnes Quinones, Gender Equity Consultant, and Greg Kane, State Supervisor for Technology Education.

We appreciate the assistance of Bill Choquette of the Connecticut State Department of Education, Department of Research, Evaluation and Assessment, Bureau of Evaluation and Student Assessment in collecting vocational student enrollment data for this project.

We would also like to thank Dr. Jennifer Brown and Diane Goldsmith for their review of our survey instrument and Gail Williams, Katie Bowes, and Lorrie Winter for their assistance in administering and collating the survey data. A special thanks to Gail Williams for her work on the production of this report.

This project could not have been completed without help from the administrators at the schools we studied. Their cooperation and support was greatly appreciated.

Above all we are grateful to the guidance counselors, teachers, administrators and students who participated in our interviews and who spoke honestly and freely about their programs and experiences.

Table of Contents

I. INTRODUCTION

Why do a disproportionate number of girls turn away from math, science and technology in high school? Recent research into the teaching of math and science in schools has identified a number of factors which are critical, but there has been very little research on technology. This report is part of a research project looking at girls in technology education in Connecticut. It examines the teaching of technology education in middle schools and the attitudes of technology education students in high school in order to identify viable strategies to change enrollments and attitudes toward the success of girls and women. Research findings on the role of guidance are reported in *Guidance, Gender Equity and Technology Education* (VERTEC, September, 1993).

Recent studies have indicated that women can be disadvantaged by traditional teaching practices and teacher expectations in math and science classes, as well as being brought up in an environment which identifies certain subjects as "masculine". For a review of the this research and the theoretical background for this report, please see Appendix A.

Since most of these studies focus on the teaching of math and science, we felt a look at the teaching of technology education would be valuable. While participation rates for girls in technology subjects are low and they have traditionally been identified as "masculine" subjects, the teaching methods and classroom atmosphere in technology education differ significantly from math and science classes. We looked at girls' early exposure to technology education in middle school and its impact on decisions about whether to take more technology classes in high school. We were also interested in girls' attitudes toward careers in technological fields.

We examined technology education programs in middle schools in order to determine whether the same factors which tend to discourage girls from pursuing math and science careers were operating in technology education during the girls' early exposure to the subject, at an age when gender differences first begin to appear. We surveyed girls in high school who chose to take more technology education in order to determine the major influences on that choice and their attitude toward technological careers.

Our study examined the following questions: What is the impact of teaching methods, classroom organization and atmosphere, and teacher interaction on girls in technology education classes in middle school? Why do students decide to follow up their exploratory programs in middle school by taking further technology education classes in high school? Are there significant differences between girls and boys in their attitude toward technology education and technological careers?

Technology education until recent years was called industrial arts and was taught almost exclusively to boys. The new vision for technology education is an experience-based program involving the application of math and science concepts in technological systems. One of the main differences between the new technology education and the old classes in industrial arts is an emphasis on thinking processes and problem solving, rather than developing particular skills. Students learn to use tools and machinery, but now teachers use these hands-on projects to introduce ways to approach new situations, apply their skills, and solve problems.

In Connecticut, the introduction of "exploratory" subjects in middle school to mixed classes was designed to give both boys and girls a chance to try different subjects and be exposed to a variety of new ideas. These subjects include such areas as woodworking, which used to be taught only to boys in industrial arts, and cooking, which used to be taught only to girls in home economics.

The exploratory subjects are generally taught on a rotating basis for a fixed period, in some cases as little as 20 days. Technology education in middle school is divided into a number of subject areas, which vary in different school districts, although it generally includes some drafting and measurement, some building of bridges, cars or simple machines and some graphic arts and design. Technology education in high school involves a much broader selection of subjects.

II. METHODOLOGY

The research project involved technology education classes in one middle school and the high school associated with it in three school districts in different parts of the state. We wanted to look at a variety of school districts and were able to gain access to one rural, one suburban and one urban district. The student population in the rural district was predominately White, in the urban district predominately African-American and Latino/a and in the suburban district the student population was racially mixed.

We gathered 5 basic types of data:

(1) Classroom Observation

We decided that classroom observation would provide one source of information about teaching methods, classroom organization and atmosphere and teacher interaction. While students and teachers were aware that we were in the classroom, we attempted to minimize the interaction of observers, spending our time recording as much as possible of what was going on.

We observed from 2 to 4 technology education classes in each of the 3 middle schools for a period of 3 weeks, for a total of 77 observations. For each class the observer kept a log of what was happening in the classroom in chronological order. She described how the class was organized and what the teacher and students were doing. She also filled out a rating for each class concerning the content, atmosphere in the classroom, student participation, and teacher expectations and attitudes.

The technology education classes were offered as exploratory sessions of varying length, in one school as short as 20 days. We observed 6th, 7th and 8th grade classes in a range of different subjects, including construction, manufacturing, communication, woodworking, and drafting.

(2) Focus Group Interviews with Female Students in Middle School Technology Education Classes

In addition to observing classes, the researchers conducted focus group interviews with the girls in each of these middle school classes. We interviewed a total of 58 girls in these focus groups. We asked girls how they felt about their technology education classes and the possibility of a career in a technological field. We asked girls whether they felt there were differences in ability between girls and boys and about what subjects they liked the best.

(3) Interviews with Middle and High School Teachers, Guidance Counselors, and Principals

We also interviewed teachers and other school staff, at the middle and high school level. We interviewed 13 technology education teachers, 6 principals and 18 guidance counselors. We were interested in how teachers felt about the recent changes in technology education and whether the curriculum was related to students' experiences and the real world of work. We asked whether girls responded differently to various teaching methods and the kind of atmosphere the teachers wanted to create in the classroom.

(4) Survey of High School Technology Education Students

In the three high schools associated with the middle schools in the study, we conducted a survey of all technology education students. We surveyed a total of 737 students, including 133 girls and 604 boys in grades 9-12. The questions centered around the reasons for their choice of technology education, the major influences on that decision and some information about their attitude toward technological careers. The students were quite evenly mixed in terms of grade level, with 22 percent in 9th grade, 24 percent in 10th grade, 23 percent in 11th grade and 30 percent in 12th grade.

(5) Statewide Vocational Enrollment Data

We also looked at enrollment data for technology education across the state. This data is presented in Table 1 and is based on vocational enrollment data by gender and course which is collected by the State Department of Education.

III. RESULTS

Result 1:

In middle school, girls appear to enjoy technology education and have confidence in their abilities, but emerging sexism among peers begins to differentially effect participation on the basis of gender. Girls may also respond more positively to some projects and be more interested in some aspects of their technology education classes which include gender neutral or traditionally female-identified activities.

The Attraction of Hands-On Projects

We were encouraged to find that the girls we observed and interviewed appeared to enjoy the hands-on projects and to have confidence in their abilities in technology education classes. These findings differ from the conclusions of recent research looking at girls in math and science classes (for further discussion of recent research see Appendix A).

The content and teaching methods in technology education are quite different from those in traditional math and sciences classes. As opposed to abstract concepts being presented by the teacher, most technology education classes are taught in a lab setting involving hands-on projects, where students move around the room sharing materials and equipment. There are group as well as individual projects, some of which involve competition, but in a different context from the kind of competitive tests common in science and math classes.

We found through classroom observation and focus group interviews that hands-on activities were very attractive to the girls. They seemed to enjoy the projects in general, with complaints centering around the need to do the paperwork involved in planning a project or the repetitive nature of projects where everyone had to build the same object.

Where girls were given the chance to choose their own project and use their creativity, they often expressed pride in what they were making and looked forward to taking it home to show their parents. Girls seemed to have confidence in their ability to use tools and power machines. When interviewed girls said they were just as good as boys not only in technology education, but in math and science as well.

- One girl in our focus group interviews said, "It used to be that boys were better at tech ed and girls were better at home ec, but that's not the case now."

All of the teachers we interviewed felt that while girls may have initially been reluctant to use some of the tools or equipment, once the teachers demonstrated how to use them safely, girls seemed to gain confidence and do as well as the boys.

- One teacher said that some of the girls started off worrying about getting dirty, breaking a nail, or getting hurt, but they overcame this reluctance with experience, with rare exceptions. He also pointed out that some of the boys displayed this same reluctance. When he used to teach industrial arts, classes involved much more use of heavy, dirty or noisy machinery. With the transition to technology education the machines are generally quieter and easier to use and students work with computers and kits as well.

Most of the teachers we interviewed felt that the transition from industrial arts to technology education makes the subject more attractive to girls. While girls may come into the class with less experience using tools and machinery than the boys, they learn quickly and do not seem to be at a disadvantage.

We also found that girls seemed to have an advantage over boys in terms of concentration, patience and attention to detail. Because girls start to mature at an earlier age than boys, girls in middle school tend to be both physically and emotionally more mature. Many of the teachers reported that the girls seemed to have more patience and concentration than the boys.

- One teacher felt that the girls were more likely to take their time and not rush. Boys tend to be anxious to get it done so they may rush and the quality of their work may suffer. Many of the better products are turned out by the girls.

- Another teacher found that girls tend to pay more attention to details and to follow through with his instructions.

- A teacher at another school felt that when students were working individually at the computers the girls seemed to be more willing to put pressure on themselves, try to accomplish more than the boys. The boys have less patience and get frustrated more quickly.

- Another teacher also felt that girls are more attentive and concerned with the quality of their work.

In our classroom observations girls did seem to have confidence in their ability to succeed in technology education and this was confirmed in focus group interviews. We did not find evidence that teachers called on boys more often. Since most of the class time is spent at worktables engaged in hands-on projects, teachers must move around the room helping each individual or group who needs it. While many students had to wait for the teacher to come, we did not observe that teachers gave more help to the boys or took less interest in the girls' work.

The Emergence of Sexism Among Peers

Because students engaged in building projects must move around the room to get materials and use machinery, the atmosphere in these classrooms is clearly different from the atmosphere in classes where students basically remain at their desks. Whether students are working in groups or as individuals, they are encouraged to help each other and must share tools and equipment. In the lab setting teachers allow students to talk and move around and the students seem to enjoy the informal atmosphere in all the classes we observed.

In this kind of informal atmosphere, however, the dynamics of boy/girl interactions can cause problems if the teacher does not establish clear guidelines and rules for behavior. We found evidence of growing sexism among peers.

- Girls complained that the boys were always trying to take over. They said that the boys are always the ones who rush off to get supplies and this was confirmed in classroom observations. The girls said that the boys make fun of girls trying to use the equipment, and the teacher sometimes lets them get away with it. They said the boys would laugh at their ideas or give them a hard time for making small mistakes.

- One girl said, "The boys don't like to be beaten by girls because their friends will make fun of them".

- Girls in all three focus groups at one school felt that teachers treated girls differently than boys. They said that the teacher expected more of the girls, particularly in terms of behavior. They complained that at home as well as at school, boys got away with a lot more and the girls resented this kind of double standard.

The culture of the school and the attitude of teachers is clearly important in insuring that boys do not get away with sexist behavior and girls are not forced into stereotyped roles. The dynamics of boy/girl interactions are complicated by the fact that at this age boys and girls are becoming attracted to each other. Boys appear to feel threatened by girls and try to dominate them by taking over the work of mixed groups or making fun of the girls.

Teachers have not necessarily thought about the best way to deal with this problem and its impact on their choice of teaching methods. We encountered teachers who were aware of the need to control sexist behavior but didn't know how.

- In focus groups interviews at one school we were told that girls who are good at wood working get a hard time from the boys. In fact, they get a hard time for being better than boys at anything.

- In one class we observed, students worked individually on building cars and they shared work tables with four places. It happened that alphabetical distribution resulted in one table with all girls, one table with all boys and two mixed tables. In the three week period of observation the all-girl and all-boy tables seemed to work with good concentration, while boys and girls at the mixed tables seemed much more prone to distraction and to giving each other a hard time.

The use of competition can have unexpected consequences. If there is group competition and the groups are mixed, then the boys and girls have to learn to get along for the groups to succeed. If there is individual competition the girls may be reluctant to compete against the boys.

- In one class where students raced metric dragsters it was noticeable than in one-to-one races boys raced against boys and girls against girls. Teachers need to set up ground rules which are understood by all students to insure that gender stereotypes are not being reinforced. Teachers need to be sensitive to the impact that decisions about individual versus group projects or different kinds of competitions can have on boy/girl interactions.

The Choice of Projects

The projects students undertake in technology education can teach important skills such as taking responsibility for your own work, learning to work with others, and working through problems. Nearly all the teachers we interviewed stressed the importance of problem-solving as a major aspect of their technology education classes.

In our classroom observations and focus group interviews we found evidence that girls may respond more positively to some projects and be more interested in some aspects of their technology education classes. We did not observe these differences between boys and girls in all classes, but we did notice that girls found the design aspects of their projects appealing.

While some teachers spoke of projects which were "gender neutral", many of the objects being built were more likely to be attractive to boys. Because of differences in early socialization boys are often more interested in cars, planes and bridges. In classes where students could choose their own projects, girls most often made mirror stands or decorative objects and they seemed to take great interest and pride in what they were making.

One teacher had students build houses, giving them some leeway from a basic design and letting them go on to decorate it if there was time. The principals of technology could be learned as well from building a house as from building a bridge, but the girls seemed to be more attracted to building the house.

Many of the projects in technology education involve building objects and testing them for speed and strength. The object of these competitions is to demonstrate how design can affect performance - the more aerodynamic the car the faster it will go. In addition to speed, however, durability and aesthetics are factors in the design process and can be crucial to a product's success.

- In our observation of classes where students were building cars and bridges, the girls spent more time on decoration - designing the color scheme of cars or painting their bridges - than the boys. For the metric dragsters, the boys expressed more interest in whether their cars would be fast enough to win the race rather than how they looked and their durability.

These contrasting interests became clearer when the competition phase took place. When the cars were tested on the track, the girls were concerned that they would crash and be ruined. For the class where bridges would be tested to see how much weight they could stand, the girls were concerned that their bridges would be broken during the test. In focus group interviews both these groups of girls were concerned about whether their creations would survive the test unscathed.

Because technology education has traditionally been such a male-oriented subject teachers need to be aware of the differing interests of girls and consider ways of making the environment and the subject attractive to them. Decisions about what kind of objects to build and what aspects of technology should be considered valid are important for attracting the interests of both boys and girls.

Result 2:

Girls are discouraged from taking more technology education in high school because stereotypes about appropriate careers for women are still operating, girls don't know enough about technological careers, don't connect what they are learning in the classroom with careers and are uninformed about economic realities and the world of work.

Enrollment in Technology Education by Gender

Given our finding that girls generally liked their exploratory classes in technology education in middle school and came out with confidence in their ability, one might expect enrollments in high school to be soaring. However, while numbers of girls choosing technology education as an elective in high school may be rising, the enrollment numbers remain low.

Looking at 1990-91 vocational education enrollment at local education agencies in Connecticut by programs and gender, we can see that participation rates for girls in technology education are much lower than for boys, although some programs have considerably higher proportions of girls than others.

ENROLLMENT IN TECHNOLOGY EDUCATION

Program	Males	Females	Total Enrollment	Percentage Female
1. Construction	5,138	1,044	6,182	16.8
2. Transportation Power and Engineering	4,35	306	4,657	6.5
3. Communication	8,626	2,624	11,250	23.3
4. Manufacturing	2,908	738	3,646	20.2
5. Carpentry	542	22	564	3.9
6. Auto Repair	752	32	784	4.1
7. Graphic Communication	696	214	910	23.5
8. Machine Tool	838	82	920	8.9
9. Welding	134	7	141	4.9
TOTAL	23,985	5,069	29,054	17.4

SOURCE: State Department of Education, Bureau of Evaluation and Student Assessment, CVEIS Tables for 1990-91.

The table shows that although all girls are required to take exploratory classes in middle school and our research indicates that many had positive experiences, by high school the proportion of girls taking technology education has dropped to less than one-quarter in any particular program and 17.4 percent overall. The highest concentrations of female students are in the areas of communication and manufacturing, where numbers get close to 25 percent. These areas include classes in computer-aided drafting and graphic arts.

These statistics reflect what we learned from our interviews with girls in middle school. While they generally seemed to enjoy their experiences in technology education classes and did not seem to lack confidence in their abilities, they expressed little interest in technological careers or in taking further technology education classes in high school.

The Operation of Stereotypes and Lack of Information

We found two major factors which tend to reinforce each other in discouraging girls from following up their experiences in technology education in middle school. First, technology has until recently been a field dominated by men. Not long ago, industrial arts was taught only to boys and nearly all technology education teachers are still men.

We found evidence that traditional stereotypes about male/female occupations are still operating and are strong enough to overcome girls' positive feelings about their experiences in technology education classes.

- When asked about construction, most girls in one school were not interested and a few said that those careers are for guys. One girl said her husband would do that type of stuff and laughed.

Second, we found that girls were uninformed about economic realities and the world of work. They lacked basic information about careers, including any sense of salaries, promotion prospects or the amount of education and training needed to pursue different occupations. While boys and girls may share this lack of information, for girls it is combined with stereotypes about technology as a male occupation which reinforces their reluctance to consider nontraditional occupations.

- Girls interviewed in our focus groups had thought about careers in a variety of different areas. They want to be doctors, veterinarians, or lawyers, but do not know how many years of college would be required. Girls who wanted to be models or T.V. broadcasters were not aware of the difficulties of breaking into these kind of professions. While nearly all the girls expected to go to college, few had thought about how they would pay for tuition and living expenses. A student would say she wanted to be a veterinarian and at the same time admitting that she was not doing very well in school.

- When we asked about careers that might require less college preparation than doctors or lawyers, very few alternatives were suggested. Only a few girls interested in fields like architecture were considering technological careers.

Lack of Connection Between the Classroom and the World of Work

Middle school students are not at an age where they are inclined to think realistically about future careers. The prospect of finishing school and having to support themselves is too remote to have much reality for them. As a result, it is difficult for teachers to get students to make connections between classroom instruction and the real world of work.

- Although many of the girls we interviewed liked their technology education classes, very few expressed interest in taking further technology education classes in high school. Most seemed uninformed about the range of technology classes that were available in high school.

- When we asked girls about the kind of career advice they got from their parents, most said their parents wanted them to go to college, but few mentioned specific advice on careers. Nearly all the girls were concerned that they would find a job earning a good salary, but they were uninformed about salary levels or promotion prospects in their areas of interest.

The teachers and principals we interviewed agreed that middle school students are not prone to think seriously about careers. While some would like to see students better informed, they did not necessarily feel that investing a lot of time and energy would pay off. One middle school principal felt that time was better spent giving students hands-on experience, as long as they are exposed to all the different areas.

In our focus group interviews girls did not reveal a lack of confidence in their ability to do any kind of career. The girls who spoke up said they were just as good as the boys in all areas including math, science and technology. When asked what subjects they liked best, these three subjects came up just as often as English or social studies. But if girls by 8th grade are not informed about the requirements of different careers, don't make the connection between what they are doing in the classroom and the world of work, and are unaware of the kinds of technology classes they can take in high school, they may close off options that might have led to viable careers for them.

Other Factors Which Discourage Students from Taking Technology Education

There are a number of factors which make it less likely for all students to choose to take technology education in high school. While these factors may affect boys as well as girls, they can have a cumulative effect on girls who are already facing stereotypes about technology as a male-dominated field.

The classification of technology education as different from core subjects like English or math points to one of these factors. If school systems require all 9th graders to take core subjects and leave only 1 or 2 electives to be chosen by the student, there is a lot of competition for those electives.

If "college-bound" students are expected to take a foreign language and an arts class, such as music, there is no room for subjects like technology. This tendency to see technology as a marginal subject is reinforced by weighting systems in some school districts which give less credit for vocational subjects like technology education than they give to traditional academic subjects.

Formerly, when technology education was industrial arts, it was geared toward students who expected to get a job immediately after finishing high school. While they might get apprenticeships or on-the-job training, they didn't expect to go to college. Traditional guidance, therefore, saw industrial arts as less of an "academic" subject and not likely to be recommended by counselors to "college-bound" students.

The change from industrial arts to technology education is more than a change in curriculum. It should reflect the changes in the labor market which now requires technologically competent employees, most of whom need some kind of post-secondary training whether in community or technical colleges or trade schools. Since most high school graduates will be expected to go on to some form of further training, the line between vocational and academic subjects has become blurred.

To the extent that technology education can prepare students for good careers in technological fields, it should not be seen as a dumping ground for students with poor academic records or disciplinary problems. For students who don't want to make the kind of investment in college required for careers like medicine or law, technology can be an alternative capable of providing jobs with reasonable salaries and promotion prospects.

School districts which have made the necessary investment to upgrade industrial arts to technology education have also found it necessary to change the attitude of guidance counselors and teachers in non-vocational areas. They have revised the structure of choices students make to include more emphasis on career readiness, which may include vocational subjects like technology education.

The change from industrial arts to technology education involves the introduction of a whole new range of technological skills, many involving the use of computers in design and manufacturing. In school districts which have committed themselves to making these changes, much of the old heavy machinery has been replaced by computers set up to teach computer-aided drafting and design or graphic arts.

In high schools it is precisely in these areas that the largest proportion of female students can be found. This is not surprising considering our evidence from the middle schools that girls are often interested in design and the fact that working with computers is popular.

In some of the classes we observed girls seemed enthusiastic about using computers and this was reinforced in focus groups interviews as a positive aspect of the class for many girls. Since many emerging technological careers involve the use of computers, the change from industrial arts to technology education would appear to make the subject more attractive to girls.

The resources available to school districts to make these changes, however, varies enormously. At one extreme, one middle school had recently invested heavily in new computer equipment. Students in all three grades would spend at least some time in each rotation using computers in modules involving drafting and graphic arts. Laser printers were available to generate their products.

At the other extreme, one school had no computer workstations available to students and no printer to use for student projects. While the high school we visited in this district had computers for its drafting and graphic arts classes, the students in middle school were not exposed to this kind of work in their technology education classes.

Between these two extremes, the other school had one computer with a printer available on the teacher's desk for computer-aided design (CAD). The high school had many computers available for graphics, CAD and drafting classes.

- One of the teachers we interviewed pointed out that the advantages of working with computers in middle school goes beyond the computer literacy and specific skills gained by students. By using computers to generate a design for some note paper, for example, students can see the whole cycle of the manufacturing process. They can start with an idea and follow it through to the finished product. Because students are able to see the whole process, it is easier to make the connection between what the students are doing and possible careers in the graphic industry.

Result 3:

The high school survey suggests that while girls who take technology education in high school are willing to challenge stereotypes about technology as a male occupation, they have less confidence in their abilities and are thinking less in terms of well-paid jobs than the boys in their classes.

We surveyed students taking technology education classes in the three high schools associated with the middle schools in the study. The purpose of the high school survey was to examine why students decided to follow up their exploratory programs in middle school by taking further technology education classes in high school. The questions centered around the reasons for their choice of technology education, the major influences on that decision and information about their attitudes toward technological careers.

We surveyed both male and female students in order to identify any significant differences in attitudes and included all grade levels. We surveyed a total of 737 students, including 133 girls and 604 boys. Girls therefore made up 18 percent of the sample, which is in line with overall levels of enrollments statewide (17.4 percent). The students were quite evenly mixed in terms of grade level, with 22 percent in 9th grade, 24 percent in 10th grade, 23 percent in 11th grade and 30 percent in 12th grade.

While the survey questions were multiple choice, we allowed students the option of writing in their own answer if none of the suggested replies reflected their experiences. They were also given the option of picking more than one response, so the percentages discussed below will add up to more than 100 percent for any particular question.

Question 1

The first question asked students to identify the person or persons who most encouraged them to take technology education. The results are reported below:

ANSWER	ALL STUDENTS	BOYS	GIRLS
1) My mother	11%	11%	11%
2) My father	16%	16%	14%
3) My brothers/sisters	7%	6%	10%
4) My friends	17%	16%	21%
5) My teachers	11%	10%	14%
6) My guidance counselor	25%	24%	27%
7) Other	43%	42%	47%

Of the 43% of all students who chose to write in an answer under "other", the most common answer was "myself". While some students wrote in "myself" as well as choosing one of the first six answers, a surprising number of girls (28%) chose to write in "myself" as the sole response.

The differences between boys and girls in their answers to the first question are relatively minor with slightly more girls indicating that siblings and friends encouraged them to take technology classes. It is interesting that while only 36% of all students mentioned either teachers or guidance counselors as important influences, many students believe that they made the decision to take technology education on their own.

Question 2

The second question asked students why they decided to take technology education. The results are reported below:

ANSWER	ALL	BOYS	GIRLS
1) I wanted a career in a technology-related field	32%	31%	35%
2) I liked my tech ed classes at the middle school	12%	13%	8%
3) I am good at it	22%	24%	11%
4) I wanted a job that pays well	22%	24%	14%
5) It fit into my schedule	17%	16%	23%
6) My friends are taking it	6%	6%	8%
7) My guidance counselor said I should take it	9%	9%	10%
8) Other	19%	16%	35%

Looking at these findings, we found significant statistical differences between girls and boys in three areas: Only 11% of the girls (compared to 24% of boys) chose "I am good at it" and 14% (compared to 24% of boys) chose "I wanted a job that pays well." The number who chose an "other" response was also statistically significant. These findings would suggest that girls may not feel as confident about their abilities in technology education as boys by high school and that fewer girls think of technology in terms of finding a well-paid career.

Looking at the "other" responses of the girls, however, suggests more positive feelings about the subject. Out of 133 girls, 21 (16%) wrote that they thought the technology education class would be interesting or enjoyable. Another 14 girls (10%) wrote that they wanted to try something different, learn new things, or prepare for the future. There were 7 girls (5%) who wanted to learn specific skills, such as taking pictures or working with wood. This made a total of 31% of the girls who had positive feelings about technology education, out of a total of 35% who wrote in "other" responses.

Question 3

The third question asked students whether anyone discouraged them from taking technology education. For all students, 93 percent maintained that no one discouraged them. The remainder listed a number of different people who had discouraged them, including peers, sisters, teachers, counselors and parents.

Looking at the girls' responses, we find 9% (compared to 6% overall) who were discouraged from taking technology education. This finding is enough to cause some concern, especially since only girls who chose to take technology education are represented in the survey.

Question 4

The fourth question asks students directly about their experiences in technology education classes in middle school. The results are reported below:

ANSWER	ALL STUDENTS	BOYS	GIRLS
1) encouraged me to take more tech ed	35%	38%	23%
2) were boring	17%	17%	17%
3) had no effect on my decision to take more tech ed	35%	32%	50%
4) other	14%	13%	17%

From these findings we can see that while an equal percentage of girls and boys reported being bored by their middle schools classes, fewer girls were encouraged to take more technology education and more girls reported that their middle school classes had no effect on their decision. Looking at the "other" answers, we found that students most commonly wrote in that technology education was not offered in their middle school.

Question 5

The fifth question was intended to get a sense of how students felt about different careers. They were asked to rate careers in terms of whether they would really like such a job when they finish school, might like such a job or would never like such a job. We were particularly interested in whether girls were thinking in terms of traditional jobs for women, like secretaries or nurses, or whether they were considering fields such as computer technology or drafting, which are taught in technology education.

We found that, in general, girls taking technology education in high school were not thinking stereotypically about careers. Of the 133 girls surveyed, 25 (19%) ranked secretarial jobs and 27 (20%) ranked nursing/health care jobs as something they would really like to do after finishing school. Of these, almost half (25 out of 52) also ranked either computer technology, drafting, chemistry or construction work as something they would really like to do. A total of 32 girls (24%) ranked computer technology as something they would really like to do.

These findings are supported by the fact that 69 girls (53%) rated either secretarial or nursing/ health care as jobs which they would never like. In comparison, 59 girls (44%) rated either drafting or computer technology as jobs which they would never like.

Question 6

The last question asked students to speculate about their future after high school. For all students, 62% saw a job as a way to work at something they liked and 57% saw it as a way to support themselves and/or their families. We were particularly interested in whether girls would be more likely to choose the response that a job was something to do before marriage, but in fact only 4% of girls chose that response.

This finding is supported by our interviews with girls in middle school, who in general expressed interest in getting married and having families at some point, but maintained that they first wanted to pursue careers and support themselves. There was little vocal support for the old-fashioned ideal of the wife staying home and being dependent on her husband to support the family.

Discussion

From the findings of the last two questions, we can speculate that girls who go on to take technology education in high school are ready to challenge the traditional identification of technology as a male occupation and are willing to try something different. This positive attitude is also reflected in the "other" answers for Question 2, where most girls wrote in answers expressing the desire to learn new things or other positive feelings about technology education.

Findings from the other questions are less encouraging. Answers to the first three questions suggest that while girls who chose to take technology education in high school are interested in technological careers, they have less confidence in their abilities and are thinking less in terms of well-paid careers than the boys in their classes. More girls than boys report being discouraged from taking technology education and a surprising number of girls believe they have made the decision on their own. Teachers and guidance counselors are mentioned by a total of only 36 percent of all students, despite their defined role in discussing career alternatives with students.

Findings from Question 4 suggest that fewer girls were encouraged by their middle school experiences than boys, with more girls indicating that their classes in middle school had no effect on their decision to take further technology education in high school.

IV. RECOMMENDATIONS

Based on the findings of this research project, we feel that actions can be taken to improve enrollments of girls in technology education and change attitudes about careers for girls and women in technological fields. Since this research project concentrated on girls' early exposure to technology education in middle school, these recommendations relate to middle school teachers, administrators and guidance counselors. **As a first step, we believe schools must put a high priority on hiring more female technology education teachers.**

Teacher Training

We recommend that technology education teachers have the opportunity to discuss gender equity issues through a number of different forums, including workshops with outside facilitators and in-school meetings to discuss guidelines.

These forums should include sensitivity training to understand the differing needs and interests of boys and girls, leading to discussions about:

- *the affect of different kinds of competitions, whether there should be group or individual projects, etc.*
- *guidelines and ground rules on acceptable behavior for both boys and girls to insure that girls play an equal role in the classroom and are not forced to take stereotyped roles, boys are not allowed to take over, etc.*
- *how to make the classroom and subject matter more attractive to girls, including choices about what kind of projects to pick, whether design and decoration can be given credit on a project along with mechanical aspects.*

Curriculum

We recommend that the curriculum be reviewed to look for ways to make better connections with the world of work and break down stereotypes about careers for women. Suggestions include:

- *providing information to students and their parents about the world of work designed to chalienge stereotypes about careers for women.*
- *exposing students to more role models of successful women in nontraditional occupations, through visits to classrooms or school career fairs by such women or by student trips to industrial or commercial workplaces.*
- *including more information about careers in technology education classrooms videos and other materials designed to show students how the skills they are learning are used in the workplace.*
- *discussing economic realities as part of the technology education curriculum. These discussions could be developed as interdisciplinary programs with social studies or other departments.*
- *reviewing technology education classes to insure that they have sufficient equipment and materials to provide up-to-date programs, particularly in regard to computer related fields.*

Guidance

We recommend that middle school students be better informed about the options available to them, particularly in regard to high school classes in technology education:

- *establishing clear links between guidance programs in middle schools and high schools.*
- *arranging visits for middle school students to technology education labs at the high school to see the kind of equipment and classes available.*
- *scheduling middle schools presentations by high school teachers to students and staff to discuss the kind of programs they offer.*
- *providing more information to both students and parents about the necessary preparation and promotion prospects of various kinds of technological careers.*
- *working with technology education teachers in the classroom to get more information to students and make the connection between what students are doing in the class and technological careers.*

Appendix A

Theoretical Interpretation of Cognitive Differences: A Brief Review

In their review of recent research, the authors of the AAUW Report, *How Schools Shortchange Girls*, found that despite the fact that there was no evidence of any innate difference in ability between men and women, there were significant differences in participation and achievement rates in math and science (AAUW, 1992).

How do we explain these differences? One factor which has generated considerable interest is cognitive differences or styles. Recent studies have expanded on the work of Witkin (1950), who introduced the idea that individuals have different learning styles. A number of scholars have related different learning styles to differences in race, class or gender. When analyzing such differences, we must stress that they are generalizations based on social factors, not inevitable characteristics of particular groups.

Ramirez and Castaneda (1974) applied the concept of learning styles to different ethnic groups. They maintained that cognitive development is associated with the culture and/or language of students. They found that Mexican-American students tend to be what they called "field-sensitive" in their learning styles, based on their exposure to more than one language and culture. "Field-sensitive" learners like to work with others to achieve a common goal and tend to be sensitive to the feelings and opinions of others. "Field-independent" learners tend to be task-oriented, inattentive to their social environment when working and prefer to work alone. Because the curriculum is oriented toward "field-independent" students, teachers tend to assign them higher grades.

Other studies found that different styles of thinking are produced by the kind of families and groups into which students are socialized (Cohen, 1969). Differences in learning styles can be related to gender as well as race or ethnic group. If traditional teaching practices and classroom structures have been designed by and for men, it is possible that women may find it harder to learn in those disciplinary environments.

In her book, *A Different Voice*, Carol Gilligan rejects the notion that women's learning styles and values are inferior to those of men. She maintains that while women tend to have different values than men, the definitions of maturity and success are defined in men's terms. Stereotypes that relegate expressive capacities to women, "reflect separateness of individual self over connection to others, and lean[ing] more toward an autonomous life of work than toward the interdependence of love and care" (Gilligan, 1982:17).

Gilligan is not surprised that women show anxiety about competitive achievement, but she questions the assumption that male behavior is the preferred norm and female behavior some kind of deviation from that norm. Instead, we might begin to ask "not why women have conflicts about competitive success, but why men show such readiness to adopt and celebrate a rather narrow vision of success" (Gilligan, 1982:16).

When we examine the kind of differences in learning related to gender, we can understand why certain subjects tend to be less attractive to women. Furthermore, we cannot look simply at cognitive differences in how various groups think. Learning is related to such factors as emotions and self-confidence as well as intellectual ability.

In *Making Connections*, Caine and Caine (1991) maintain that traditional teaching practices, classroom organization and performance testing fails to acknowledge the impact of emotions on the ability to learn. They stress the importance of connecting what is taught to the lives and interests of students.

While such interconnectedness is important for all students, the authors of *Women's Ways of Knowing* contend that women are particularly disadvantaged by teaching methods that are not connected. They found that women respond better to teaching which relates to their own lives and gave them encouragement about their own abilities (Belensky, Clinchy, Goldberger and Tarule, 1989).

In trying to explain gender differences in mathematics, Fennema and Peterson (1985) seek to explain why males surpass females in high-level cognitive skills, the type that problem-solving tests measure. They contend that to develop these skills an individual must participate in autonomous learning behaviors (ALB). These behaviors include choosing to do high-level tasks, working independently on tasks, persisting on them and achieving success. Relating these findings to the research on cognitive differences, it appears that women tend to be more "field-sensitive" than men.

Fennema and Peterson propose that males have more opportunities than females to pursue ALBs. Conditions outside the classroom give them greater practice, but in-school experiences also affect chances for independent action. In-school experiences include the nature of contact between teacher and students, particularly teacher expectations about different groups of students.

The authors also found that the internal motivational beliefs of boys and girls tend to be different. What one believes about oneself in relation to the learning of mathematics (or any subject) influences what one does as one learns mathematics. Several factors are important: self-esteem and confidence, beliefs about the usefulness of mathematics, and attributional style (boys tend to attribute their success at mathematics to skill, while girls attribute it to luck).

The importance of beliefs about mathematics, science and technology has been identified as an important factor in the decision of girls not to take advanced courses or pursue such subjects as careers, despite their proven their ability in these subjects . Alma Lantz (1985) identifies three variables which are seen to directly influence girls in their choice of which courses to take. These include:

- Cognitive Beliefs - feelings about the usefulness or utility of mathematics for the individual's educational and career aspirations
- Affect - confidence, anxiety, liking, etc. for mathematics
- Ability or achievement: spacial and verbal ability, math achievement, grades, etc.

A further factor is the age when important choices about what courses to take are first offered to students. Even for girls who are good at math, science and technology and interested in these careers, adolescence can lead them to turn away. Several factors are operating, including heightened pressure to conform to sex roles during adolescence, negative attitudes of peers about girls who do well in math and science and "fear of success" in male fields (Skolnick, Langbort and Day, 1982).

Poor career education, as well as expectations and biases of parents and counselors can also be important factors. Some girls may feel that plans for future family life conflict with careers in math, science and technology because these fields require time commitments that will interfere with bringing up children (Skolnick, Langbort and Day, 1982).

A final factor which may influence the participation and achievement rates of girls in math and science relates to the expectations of teachers and differences in teacher-student interactions. Two recent studies find teacher-student interactions in science classes particularly biased in favor of boys (Kahle, 1990; Lee, 1991).

The AAUW Report found that research spanning the past twenty years consistently reveals that males receive more teacher attention than do females (AAUW, 1992). The issue is broader than the inequitable distribution of teacher contacts with male and female students; it also includes the inequitable content of teacher comments. Myra and David Sadker conducted a three-year study which found that while males received more teacher comments than females, the difference favoring boys was greatest in the more useful teacher reactions of praise, criticism and remediation (Sadker and Sadker, 1984)

Looking at studies of both teacher-student interaction and cognitive styles, it becomes clear that women have disadvantages in terms of traditional teaching methods and teacher expectations. Women tend to be more "field-sensitive", which can be a particular problem for math and science classes taught in an unconnected way in a competitive atmosphere. Teacher expectations may be lower for women and they may have less meaningful contact with teachers.

REFERENCES

American Association of University Women. 1992. How Schools Shortchange Girls: A Study of Major Findings on Girls and Education. Washington, D.C.

Belensky, M., G. Clinchy, N. Goldberger and J. Tarule. 1989. Womens' Ways of Knowing. New York: Basic Books.

Caine, R. and G. Caine. 1991. Making Connections: Teaching and the Human Brain. Virginia: Association for Supervision and Curriculum Development

Cohen, R.A. 1969. "Conceptual Styles, Cultural Conflict and Nonverbal Tests of Intelligence". American Anthropologist, 71:828-856 cited in Banks, James A. 1988. "Ethnicity, Class, Cognitive and Motivational Styles: Research and Teaching Implications". The Journal of Negro Education. 57(4):452-466.

Fennema, E. and Peterson. 1985. "Autonomous Learning Behaviors: A Possible Explanation of Gender-Related Differences in Mathematics", in Wilkinson, L.C. and C.B. Marrett, Gender Influences in Classroom Interaction. New York: Academic Press.

Gilligan, Carol. 1982. In a Different Voice. Cambridge: Harvard University Press.

Kahle, J. 1990. "Why Girls Don't Know" in What Research Says to the Science Teacher the Process of Knowing. M. Rowe, ed. Washington D.C.: National Science Testing Association, cited in American Association of University Women. 1992. How Schools Shortchange Girls: A Study of Major Findings on Girls and Education. Washington, D.C.

Lantz, Alma. 1985. "Increasing Mathematics Enrollment", in Chipman, S., L. Brush and D. Wilson, Women and Mathematics: Balancing the Equation, New Jersey: LEA Publishers.

Lee, V. 1991. "Sexism in Single-Sex and Coeducational Secondary School Classrooms", paper presented at the annual meeting of the American Sociological Association, Cincinnati, OH, cited in American Association of University Women. 1992. How Schools Shortchange Girls: A Study of Major Findings on Girls and Education. Washington, D.C.

Ramirez, M. and A. Castaneda. 1974. Cultural Democracy: Bicognitive Development and Education. New York: Academic Press.

Sadker, M. and D. Sadker. 1984. Year 3: Final Report, Promoting Effectiveness in Classroom Instruction. Washington D.C.: National Institute of Education.

Skolnick, J., C. Langbort and L. Day. How to Encourage Girls in Math and Science. New Jersey: Prentice Hall.

Witkin, H.A. 1962. Psychological Differentiation. New York: Wiley cited in Banks, James A. 1988. "Ethnicity, Class, Cognitive and Motivational Styles: Research and Teaching Implications". The Journal of Negro Education, 57(4):452-466.