LIPSTICK, LAPTOPS, LUMBER AND LATHES:

A STUDY OF THE SIGNIFICANCE OF TECHNOLOGY EDUCATION TO FEMALE STUDENTS

by

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Abstract

A survey of 117 females in 13 schools throughout the province of British Columbia examined aspects of technology education programs that females found important, attractive and interesting. Forty-five questions regarding attitudes toward technology were answered on a five point Lickert type scale. Three additional open ended questions focused on the importance of the course in which they were enrolled, the reasons they would choose to take the course again and changes they would suggest. It was found that these female students were interested in understanding technology that affects them, and that using equipment and developing skills to design and make things with different materials are important enough to attract them to technology education.

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Dedication

I dedicate this effort to

my year old granddaughter

Linnée Rianne Doll Peters

in the hope that by the time she reaches that point in her life
when the issues discussed herein affect her conscious choices

at least a few of the barriers in her path will have been removed
as a result of it.

Chapter One
Introduction

Background information

Technology education is a comprehensive program focused on integrating critical thinking, problem solving from a design perspective, group work, applied physics, applied math and technical communication in a "making and doing" context. It provides students with an understanding of the evolution, utilization and the social and cultural impacts of technological development.

As a field of study, technology education has been redefining its content and image for several years. Curriculum revisions within Australia (Maruff and Clarkson, 1988); British Columbia (Fraser, Anderson, Bastone, Doll, Hall, Kenyon, Kewitz, Kovich, Trant and Wilson, 1991); New Jersey, (Commission on technology education for the state of New Jersey, 1987); Northern Ireland, (South Eastern Education and Library Board, 1991); Nova Scotia (Ministry of Education, Province of Nova Scotia, 1990); Ontario (Stief, Houghton, Iron, Kaufman and Morris, 1984); USA (Snyder and Hales, 1981); the United Kingdom (Equal Opportunities Commission, 1983) and the state of Washington (Washington State Technology Education Curriculum Development Project, 1990) are but a few of the efforts that have been made in this direction. Historically, the field grew out of manual arts/industrial arts/industrial education which focused on industrial technology (Zuga, 1991), and its content and appeal were limited by that focus. The move to redefine the field comes out of a need to provide students with the tools and understanding of technological development that will give them the power to both use and criticize the use of these developments (Franklin, 1990). In British Columbia, the publication of the technology education curriculum/assessment framework in March, 1992 was a specific move in this direction. This document states that "[t]he reorganization of our school system determines that the clientele of technology education will include all students from primary to graduation--girls as well as boys, university bound as

well as vocational, special needs as well as mainstream students--every student" (Fraser, et al., 1992, p. 14). Whether or not the provincial government establishes technology education as a required course, the need for students to be technologically literate in today's society remains. [1] One of the most appropriate places for students to gain this literacy is in the technology education classroom. However, the historic association with industrial oriented technology education courses (woodwork, metalwork, drafting, power mechanics, electronics, graphics, etc.) means these courses have addressed skills and activities that have been thought to be more appropriate for boys than for girls. Although in recent years there were efforts to encourage additional students, especially girls, to enroll in these courses, the approach in most of them remains essentially the same even though the name may have changed. Some teachers manage to persuade girls and academic directed students to take woodwork, drafting or graphics in spite of the content and social stereotype, but overall the classes are thought of as lower ability "male" oriented subjects (Kimbell, Stables, Wheeler, Wosniak and Kelly 1991). Without a concerted effort to make changes in the content, environment and perception of the courses, relatively few "new" students seem likely to enroll in technology education. There are various ways to approach such changes. I believe that if technology education is to become relevant to students, it is imperative that educators are aware of the interests and values that students identify as important. With this information, we can develop courses that build on the experiences that students bring to the class as well as address the ever increasing need for a broader base of technological awareness and skill.

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[1] Technological literacy is terminology used to describe one's ability to take in (read and comprehend) and express (write and produce as a result of) knowledge of technology practice. "A technologically literate person has the power and the freedom to use that power to examine and question the issues of importance in sociotechnology" (Fleming, 1989, p. 393). This paper will not attempt to explore the definitions or literature that has been written on this topic.

Rationale

Given the case that technology education courses should change in order to more successfully engage as well as prepare students for the future, I see a need to discern from the students themselves those aspects of a technology education program that they find useful, interesting and attractive. If we expect meaningful change to take place, we need to know the starting points of the students as well as the history of the programs they are experiencing. There are some programs currently operating in our province that appear to be meeting the needs of students. In these programs, the clientele has changed, the enrollment is strong and students are enthusiastic. Determining the interests and attitudes of students in these programs could provide understanding of factors that would bring about relevant change. It is also possible that this information would be useful to technology education teachers who are ready and willing to make the changes necessary to meet the goal of technological literacy.

A second rationale for conducting this study lies in the fact that so little research has been carried out that deals with females' interest or experience in technology education in North America. The literature indicates several studies in science and technology especially in regard to female participation (Becker, 1987; Byrne, Hattie and Fraser, 1987) and several studies conducted in the United Kingdom, the Netherlands and Sweden on student response to technology education courses (Catton, 1986; Chivers, 1986; Granstam, 1988; Kelly, 1988; McCarthy and Moss, 1990; Raat, 1985; Streumer, 1989; Weiner, 1985; Whyte, 1986a) but none in Canada or the United States. A study was carried out by Bame and Dugger (1989a) of Virginia Polytechnic Institute and State University in 1988 but nothing appears to have been published in accessible journals as a result of this study. Personal correspondence with Dugger also failed to give any other leads to work in the US on females and technology in recent years.

Thirdly, the factor of female participation in technology and technological decision making is a critical one (Rothschild, 1989). Female students need to be made aware of the contributions they can make to technological decision making. They also need to learn how to gain access to the system where these decisions are made. The literature as well as my own experience suggest that the approach and content for technology courses need to be changed to include female students. Discovering the interests of female students is a start in this direction.

Personal information

Having established the overall need for this study, I now turn to the focus I will place on it and the reasons for my specific perspective. I chose to collect data from all students in the participating schools[2] but to limit examination of the data to responses from female students for the following reasons. First, being one of very few (three of four to my knowledge) females presently teaching technology education in the public school classrooms of British Columbia (there are 1100 industrial education/ technology education teachers in the province), I am routinely asked by my colleagues, "How do I get girls into my classroom?" Analyzing and addressing female responses may provide some answers to this question. Since these responses are given in a context of the whole class, it will sometimes be necessary to include male responses. However, the graphs will serve to support the findings rather than be the focal point of them. Second, my background of fifteen years as a carpenter/remodeler before entering teaching gave me experience with and understanding of the challenges of breaking into a "male" domain and put me in tune with the social obstacles that females in the program may experience.

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2 The main objective in doing this was to avoid setting the females apart in an environment which has historically been 'out of their domain'. Secondly, I hoped the teachers who administered the questionnaire would be able to gain useful information about their own classrooms. If this was to be the case, it was best to have information from all the students. I have processed all the data collected and have included figures for the two sexes together. I have not given detailed analysis for the male students.

Specific Problem

Technology education programs throughout developed countries have been changing for the past ten to fifteen years. One of the reasons for this is to address the absence of females in these courses. The purpose of this research is to determine those aspects of the course content that female students find interesting and relevant. This purpose will be researched in terms of the following question:

What aspects of technology education courses in British Columbia do female students perceive to be important, attractive and interesting ?

Chapter Two
Review of the Literature

This review of the related literature deals with the relationship between females and technology. It begins with examining the need for change in that relationship, then looks at some causes that have contributed to the need and thirdly, seeks to offer some suggestions of remedies for the problem.

The need for change

The rapid rate of technological change over the past century has created a world in which all citizens need to be aware of the possibilities and impacts of technological development. Technology holds out the promise to alleviate poverty, starvation and human suffering. It also holds the potential to dominate our lives and remove freedom of choice (Down, 1986). Our lives and livelihood have come to depend on the technology around us. Our comforts, contact with the world and potential careers are dependent on understanding and using technology (Cowen, 1979). Our ability to make social or economic contributions and our ability to have a sense of power within society involves technology (Rothschild, 1989; Thompson, Simard, Desbiens, Inkpen, Frize, Georgetti and Payne, 1993; Whyte, 1986b). Our survival in understanding the world around us requires a knowledge of technology (Grant and Harding, 1987). All people need the experience and instruction that enables them to fully appreciate and use whatever technology is available as well as to criticize the use and development of whatever technology is proposed (Franklin, 1990). On the other hand, technology needs the contributions of all people. Considering the social and environmental impact of some technologies, technological development needs a sensitivity and scrutiny that tends to be offered by women (Franklin, 1984; Rothschild, 1989). Considering the complexities of our world, the unique skills, attributes and creativity of women add a valuable depth and diversity to seeking solutions for technological problems (Cowan, 1979; Granstam, 1988; Thompson, et al., 1993).

Given this sense of importance, why are women conspicuously absent from technological fields (Boben and Ray, 1982; Chivers, 1986; Equal Opportunities Commission, 1983 a; Gaskell, J., 1984; Harding, Hildebrand and Klainin, 1988; Thompson, et al., 1993)? The literature offers answers to this question as it looks at the influences of society and education on females. There tends to be far more literature available that deals with females in science and math than with females in technology per se, so some references to related literature from the math/science field are included.

Causes which contribute to the need for change

Early Socialization

The strongest influence affecting females' response to technology, technology education and the related area of science clearly appears to be socialization. Sixty percent of the literature I reviewed refers to this factor and all of the studies, save one, that deal with student choice refer to the affect of society on girls. It is important to understand this influence if we expect to adequately address the changes needed to encourage females into technological fields.

Stereotyping and awareness of allegedly sex appropriate behavior begins at a very early age and is affected by the ways parents handle infants. In our culture, girls are often cuddled and protected while boys are allowed to roam further afield (Brown, 1993). As children grow, the experiences offered to them are often very different. Boys are expected to be interested in building sets and movable toys that can come apart while girls are encouraged in the quieter role of playing "house". This pattern of play gives boys much greater experience with spatial and mechanical concepts than girls and helps to determine their level of scientific [and technical] awareness when they enter school (Granstam, 1986; Smail, 1984b). By the time children enter public school, their role association with occupation is also well

established. These roles are picked up from parents and relatives and reinforced by the media (Farmer, Sidney, Bitters, Brizius, 1986; Siegel, 1977), As early as the ages of 10 or 11 years, identification with specific sex roles is strong (Granstam, 1988) as is the worth of these roles and the activities associated with them later in life. By such an age, attitudes toward scientific and technological activities are linked to roles in ways that determine performance and interest in these subjects (Brown, 1989). It is no surprise, therefore, that "by the time girls are 15 [these attitudes] have become linked to job aspirations and life choices in a very limiting way" (Brown, 1990, p.34) causing teachers in secondary school to deal with the result rather than the cause of the problem.

Most of the articles reviewed describe the negative effects of socialization. However, two articles specifically point out how society can have positive effects on female participation. The first is entirely positive, while the second presents its findings in contrast to the effects of stereotyping. In his review of intervention strategies for girls and women in technological fields in Western Europe, Geoff Chivers (1986) points to Poland as a place where a change of social system and social priorities brought about rapid change in the number of women working in technological fields after Word War II. Chivers refers to a report by Granstam published in 1983 and states that

> At the time of the Second World War, less than 5% of the students of technology were women. By 1981, girls represented over 28% of the students in the technical upper secondary schools. At the higher education level 45% of the students in 2 year programmes and 30% of the students in 4 year programmes at the institute of technology were female (Chivers, 1986, p. 247).

These figures clearly show the kind of change in enrollment that can take place.

In a second article, Sunee Klainin (Harding, Hildebrand and Klainin, 1988) carried out a study in Bangkok to evaluate a senior high school chemistry course and found that girls' performance was equal to or better than boys in chemistry and physics. It is noted that in Thailand, all students are required to study science, as

many women study and work in scientific fields as men and working in these fields has high status (Harding, et al., 1988). In contrast, within this same article, Gaell Hildebrand reported on an intervention program in Australia where a program used to encourage girls to enroll in senior science courses failed to be effective in spite of two years of effort. In trying to discover reasons why the interventions had not had greater effect, it was decided that the option to choose science for half of the grade 10 year "had dramatic negative effects on the enrollment patterns of girls in year 11 physical sciences and [had] reversed the improving trends of previous years". In chemistry the number of girls dropped from 50% to 24% and in physics from 32% to 14% (Harding, et al., 1983, p. 192). The authors concluded that offering a choice of subjects allows social stereotyping to be effective when it exists in a culture. Much more attention will be given to student subject choice later in this paper.

It is important to reiterate that all persons are affected by the expectations of society and that socialization begins early in life. When females are expected to function in technological fields as in Thailand, they do so without any problem. When changes in societal attitude occur as in Poland, changes likewise occur in the relationship between females and technology. Conversely, when social stereotypes tend to work against female participation in science (or technology) as in Australia, it is difficult for girls to "go against the tide".

Ways of Knowing and Learning

Before we turn our attention directly to the educational system that is expected to work with and around the effects of this socialization, it is worthwhile to look at a particular phenomenon that appears to be part of it. This phenomenon is expressed in a theory that females possess different ways of knowing and learning from males. In spite of popular articles and books to the contrary which I have discovered (Gray, 1992; Tanenbaum, 1989), there seems to be no empirical evidence to indicate this theory has any biological basis (Schreiber, 1993), but three convincing sociological perspectives give it support. Belensky, Clenchy, Goldberg and Tarule

conducted an extensive qualitative study of a cross section of women in New England to support their theory that women learn in different ways from men. The group identified women's need for different conditions for learning and encouraged educators to "emphasize connection over separation, understanding and acceptance over assessment, and collaboration over debate" (Belensky, et. al., 1986 p. 229) to facilitate the way women learn. They also encourage teachers to affirm first hand experience as a source of knowledge (1986). This research was built on the foundation set by Carol Gilligan's work in developmental psychology at Harvard University. Gilligan (1977) challenged the prevailing theories of moral development claiming they did not take women's experience into account and declared that feminine experience of social reality offers a distinct "voice" or way of looking at and responding to the world.

Ursula Franklin echoes this different sense of women's world view in her papers on women in technology. Franklin (1984) contrasts a "technological" world view with "women's" world view in the following ways. The "technological" world values efficiency, with a goal of personal achievement at the expense of personal experience while "women's" world values the ability to cope with a variety of circumstances, taking all factors into account. The technological order maximizes "gain" whereas the women's world minimizes "disaster". These perspectives taken by prominent and highly respected women scholars raise serious questions about the way education is delivered in general. They also raise questions about specific approaches to teaching used in the entire educational system which contribute to preventing females from entering technological fields.

It is appropriate to acknowledge that my own experience in school (being refused admittance to the auto shop in high school) and my observation of current teaching practices (allowing male students to dominate the classroom) cause me to be partial to the ideas put forth by these women.

Subject Choice and Pupil Attitude

Literature on the nature of the educational system which relates to this study focuses primarily on subject choice and pupil attitude. A majority of the studies (7 out of 13 cited) have been carried out in the United Kingdom and two in Australia so the nature of the findings is somewhat skewed by one particular culture and it is important to acknowledge this fact. Differences in pupil attitude toward technology around the world have been noted by Raat, de Vries and deKlerk Wolters (1987) as a result of the PATT research but on the whole, conclusions from these studies show similar awareness of concepts and similar attitudes varying mostly in degree of application.

Since student attitude and consequently student choice, appears to be affected by the socialization discussed earlier, it seems reasonable to begin this discussion by looking at an important longitudinal study on intervention at the primary school level. This study suggests that classroom experience at an early level does much to influence both attitude and student choice. According to this study, it took four years from first entry into school to raise the level of girls' performance and confidence in constructing models with Lego to match that of the boys (Brown, 1993). (Model construction provided evidence of spatial and technological thinking and learning.) Brown (1990) found that the girls wanted to use the computers and Lego but felt boys would be better at accomplishing tasks with them. Girls also found it difficult to 'get their turn' with tools and materials. It was concluded that the girls were overwhelmed by the challenge to overcome these obstacles so chose to do 'proper' work like writing and drawing instead! In order to address these problems, specific intervention tactics were used such as single sex groupings to insure access to the construction materials and structured teaching worksheets to compensate for lack of previous experience. Until the interventions were made, the classroom experience for girls appears to be an extension of the expectations they brought with them upon entering school. To confirm this possibility, I made a

closer examination of the GIST project (perhaps the largest and most extensive study done in the U. K.) to see what was said about classroom experience.

Judith Whyte was a member of the group who conducted the GIST (Girls Into Science and Technology) study of 2060 students in 10 schools over a four year period to determine the factors that prompted the choice of subject for the last three years of schooling. Whyte (1986 a) describes the experience of girls in science and craft classes as one of being 'pushed out' by the boisterous behavior of the boys and the 'masculinized' lesson content. (England's technology education terminology is Craft, Design & Technology, referred to here as 'craft'.) The girls found themselves being excluded from classroom discussion and having difficulty in accessing materials with which to work. 'Masculinized" content meant that the language used in the classroom rarely included the female pronoun and the content rarely related to female experience. The students in this study were eleven years old when the project began and fifteen by the time it finished. The statements about female experience of 'push-out' and 'masculinizing' over this time period seems to indicate that the patterns of male/female behavior in the areas of science and technology tend to be reinforced by the educational system and that sex bias increases as students progress through school. [3]

By the time young people are in grade eight and are expected to make their own educational choices, a strong set of experiences and associations are in place (Brown, 1990; Gaskell, J., 1984; Granstam, 1988). The GIST project was designed to

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[3] Taking a broader look at the experience of girls in the classroom, the Equal Opportunities Commission in England (1983 b)noted the physical environment of most facilities where technology has been taught to be a factor in discouraging females. Besides having the boys 'hog' the tools and materials as mentioned by Whyte, the colorless, often dirty and distinctly industrial atmosphere of many of the rooms did much to dissuade the girls' attraction to the subject. That the learning environment plays a part in students' experience was borne out in a study conducted by Byrne, Hattie and Fraser (1987) of 1675 students from 18 schools in New South Wales, Australia. This study found that overall, girls value harmony in the classroom while boys prefer competition though preferences are determined by age as well as gender. There have been several studies on physical and learning environments but as this research has focused on content, it must suffice to simply acknowledge physical and social environment as significant factors in female students' experience in technology education.

acknowledge this fact and to try to intervene with strategies to change the perceptions and attitudes of the girls, enabling them to choose a path that would open up future opportunities in technological fields. The outcome as assessed by this study was that some student attitudes and perceptions were changed but not the choices of subjects to be taken. Whyte (1986 a) explains this by stating that the "hidden curriculum" of the social expectations experienced at school "apparently exercise[s] a very powerful influence on subject choice and [is] among the major cause[s] of female underachievement in science and technology"(p. 7). This explanation is supported by Harding, Hildebrand and Klainin (1988) who indicate three factors which influence female involvement in science and technology. These factors are: first and foremost, the society's gender expectation; followed by the objectives and organization of education; and finally, the images of science and technology in the culture. However one article indicated that it is possible to address the problem successfully. Margaret Emmerson (1984) is a teacher who set up a course in technology at a single sex school in London because the girls lacked experience and familiarity with tools and materials which prevented them from taking technology courses at examination level. Emmerson's article outlines some very practical ways to set up a "foundation" course to provide this experience. In her concluding remarks, Emmerson states that

> Girls enjoy the process of designing and making every bit as much as boys do and when not patronised or made to feel inferior, they work with the same open enthusiasm.

However, students see themselves as making their own choices (Gaskell, P. J., McLaren, Oberg and Eyre, 1990; Kelly, 1988). Allison Kelly (1988), who was another member of the GIST team, pointed out that the statistics indicated teachers and parents to be significant factors in pupil choice but students claimed otherwise. The students said that preparation for employment, personal interest and their performance determined the courses they took. The J. P. Gaskell study (Gaskell, J. P., et al. 1990), which focused on student choices in math and science and

involved schools throughout British Columbia, states similar reasons given by students for course choice. These reasons were stated as: past success or failure; difficulty of subject, and requirement for university or future employment. One wonders if these students, like those in the GIST study, are unaware of the social influences on their choices. Since the focal point of Gaskell's study was to investigate gender issues in student choice, many questions were raised about gender. The responses showed widespread ambivalence among students, teachers, counselors and administrators on the existence of gender as an issue or of gender as a factor in subject choice suggesting a definite lack of awareness of social influences in the classroom (Gaskell, J. P. et al., 1990).

Two studies carried out in the U.K. barely mention the societal factor in subject choice. McCarthy and Moss (1990) don't mention it at all and the Nash, Alsop and Woolnough (1984) study, carried out by the Oxford Educational Research Group mentions the factor only in passing. My awareness of this exclusion is likely an indication of my particular bias as I review the literature. Both of these studies were carried out on small groups of students in only one setting so are by nature restricted in their interpretation. However, the findings of subject choice being determined by usefulness (Nash, et al., 1984) and employment value (McCarthy and Moss, 1990) are consistent with other studies. Nash, et al. state that, in addition, choice of subjects was related to parental influence and knowledge of the course ("non-opters" were unaware of what the course entailed so chose other courses offered in the time slot). This later finding prompts Nash, Allsop and Woolnough to advocate an introduction of technology in primary school to remedy the situation. The reasons are different but the recommendation supports the position of both Brown (1993) and Granstam (1986). McCarthy and Moss state academic credibility as the second reason for choice but this factor was not found in any other study in this review which involved technology. Studies on math and science deal with academic orientation but only those that deal with science and technology

together even mention it, and then it is in reference to science. Perhaps this is a reflection on general attitudes toward technology as a subject.

Attitudes are definitely factors that influence student involvement in technology. In an attempt to develop course material based on the realities of student attitudes as well as student concepts of technology, Raat and deVries (1986) carried out a study of pupil attitudes in the Netherlands (Raat, J. H., 1985). They found that the majority of pupils of both genders were interested in technology and generally saw it as valuable. They also found that students whose parent's worked in technology were more familiar with concepts of technology and overall, pupils varied in their ability to recognize it in their daily life (Raat, J. H., 1985). In 1986 the First International Pupil Attitude Toward Technology Conference was held in Eindhoven, Netherlands where this study evolved into an international gathering of information on pupil concepts and attitudes toward technology . The twelve countries which participated in the follow-up work included: Australia, Belgium, Denmark, France, India, Italy, Kenya, Mexico, the Netherlands, Nigeria, Poland and the UK (Raat , de Vries & deKlerk Wolters, 1987). Results from studies carried out in these countries indicated that pupils have a fairly positive attitude toward technology; they have trouble seeing how technology relates to society or science; there are significant differences between boys and girls on all scales;[4] pupils from different cultures have different ideas of technology in spite of several similarities; and in Western Europe there was a significant positive correlation between concepts of technology and attitude toward technology. It is interesting to note, considering the Chivers article (1986), that Poland was the one exception in the PATT results where pupils scored high on all scales and the differences between male and female answers were not significant.

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[4] The differences are "mostly to the disadvantage of girls. This means that girls have a less positive attitude towards technology than boys and that their concept of technology is not so good as that of boys" (Raat , de Vries & deKlerk Wolters, 1987, p. 97).

At the fourth PATT conference, Bame and Dugger (1989a) reported on the first phase of the PATT-USA studies. Phase one started in 1987 with a pilot to establish the US version of the survey. This instrument was used in schools from seven states in 1988 and 1989 but since the study is designed as a longitudinal and possible nation-wide study, there appear to have been no further articles published as a result of this work. The PATT-USA, New Jersey Study, (Bame & Dugger, 1989b) indicates gender differences on all attitude subscales except Attitude Toward Technology. Boys showed greater interest and saw technology as having more positive consequences than girls. Girls saw technology as being an activity for both genders more often than boys and there appeared no difference between boys and girls on their knowledge about technology. These findings parallel many of those found in other studies in this review though equal knowledge about technology among the males and females appears to be a difference. One interesting finding in this study not specifically indicated in other studies is the affect of technical toys in the home. "The existence of technical toys in the home had a significantly positive impact on the general interest in technology, the attitude toward technology, and the view of the consequences of technology. [These toys]. . . also had a significant effect on the knowledge about technology that students have." (p. 40). Having a technical workshop in the home appeared to have a similar but not as strong an influence on knowledge and attitude toward technology. It seems appropriate to point out that this is the only study cited that has been conducted in North America.

Two other smaller studies on student attitudes were carried out in the U. K. at about the same time. Omerod and Waller (1988) administered attitude and information questionnaires to 405 students in seven comprehensive schools and discovered that girls enjoyed Craft, Technology and Design and found it relaxing. They also found that girls had support to take the course from family members with technical skills but received no support to pursue a technological career. On the other hand, boys demanded more from the course and were more likely to continue

with technical work after leaving school. In the second study, entitled GATE (Girls and Technology Education), Grant and Harding (1987) challenged the interpretation of studies that indicate that girls have a negative attitude toward technology. They conducted a study of 142 students in their fourth year at a London comprehensive school who had all completed three uninterrupted years of design and technology. A Likert-type test was used to measure attitudes but while analyzing the data they decided to "explore alternative methods of analysis" (Grant and Harding, 1987, p. 337). The result of this decision was to discover that girls responded to many of the questions with 'not sure' or 'don't know'. Instead of interpreting these answers as negative as others have done, Grant and Harding sought to find out *why* the students were unsure by interviewing some of them. They also gathered answers to the question of why it is important to know about science and technology. They found that <u>not sure</u> almost universally meant "It depends on what you mean by technology" (Grant and Harding, 1987, p. 338) and three times as many girls as boys answered the <u>importance to know</u> question with statements indicating that science and technology helped them to understand their surroundings and what was going on in the world around them. The conclusion that is presented as a result of this approach is that girls are not "wrong" for having "negative" attitudes toward technology but that:

> Girls, we believe, have got it right: they are not sure. One needs to consider and to measure the values embodied in science and technology and the uses to which they are put, against our human values and aspirations.
>
> To be critical is to be positive. This does not prevent an intense delight in the processes of science and its power to interpret aspects of the world to us, nor does it suppress the enjoyment of tackling and solving problems. To be unquestioning and to exclude human values from the study of science and technology is to be negative, for it excludes many and stores up potential hazards for society from those who respond to a more limited science and technology 'object' (Grant and Harding, 1987, p. 342).

Although Grant and Harding appear to be contradicting other researchers, Franklin (1984) and Rothschild (1989) certainly echo their position from a different vantage point.

When we consider attitudes, it is important to look not only at the attitudes about technology that students bring to the situation but also at the attitudes of classmates and teachers that they encounter when they get to the classroom. Several of the studies and articles reviewed have pointed out the importance of the teachers' role in facilitating change in female access to technology (Boben and Ray, 1982; Brand and Roelofs, 1989; Equal Opportunities Commission, 1983b; Farris, 1980; Granstam, 1986; Standards for Industrial Arts Program Project, 1981). Both Boben and Ray (1982) and Brand and Roelofs (1989) make very strong statements that teacher attitudes in particular are crucial to the process of providing positive technological experiences for females. Brand and Roelofs (1989) go on to discuss teacher awareness and behavior in class with emphasis on the need for in-service training to address the issues. Whyte (1986a) pointed out the fact that the schools where the GIST intervention was most successful were those where the teachers and senior staff held positive attitudes and made positive commitments to the aims of the project.

Suggestions of Possible Remedies

Now the critical question becomes: How do we counteract the social and educational forces working against females in relationship to technology?

Fortunately for those teachers and administrative personnel who want to bring about change, there are a number of strategies and suggestions to help work toward solutions. Both the United States and the United Kingdom have passed legislation that addresses the need for equal opportunity (Equal Opportunities Commission, 1983b; Standards for Industrial Arts Program Project, 1981). These laws may prove useful in some instances but it is the accompanying guidelines and checklists that are helpful references to understanding sex equity and stereotyping

and discovering ways to make changes. One such checklist for ways to make changes was adapted by the Oregon State Department of Education in A Guide for Teachers (1984) and is included in appendix A.

In terms of classroom strategies, several authors suggest introducing a core of technology in the primary grades to counterbalance societal conditioning and discrepancies in early practical experiences (Brown, 1989, 1990, 1991; Granstam, 1986; Farmer, H. S., Sidney, J. S., Bitters, B. A., and Brizius, 1985; Nash, Allsop and Woolnough, 1984). Farmer, et al. (1985) review several programs and products designed specifically for primary schools in the United States which seem to be available upon request. They do not detail the content of these programs in their article. The suggestions for setting up a structure so females have equal access to tools and materials (Brown, 1990) and designing specific activities to promote technological learning that applies to one's level of technological knowledge (Granstam, 1986) seem to be appropriate for any age, not just primary learners. These strategies provide opportunities for positive experiences which are seen to be central to success (Gaskell, J. P. et al., 1993).

There is a strong message in the U.K. studies that addressing the context of the technological concepts helps female students relate to the subject (Catton, 1986; Chivers, 1986; Grant, 1986; Kimbell, Stables, Wheeler, Wosniak, and Kelly, 1991). Catton (1986) interprets this focus as making projects that relate to the needs of society and the quality of life. Such projects as designing an activity center for a blind child or a writing aid for someone with severe arthritis would fall into this category. Contexualized learning is a topic far too broad to address in this paper but Cole and Griffin (1987) deal directly with this idea in regard to females in math and science. They give strong support to this position when they say " a fundamental way of changing the requirements for success on a particular task is to *recontextualize* the task as presented to, and understood by, the learner." (page 23). Chivers (1986) speaks of this idea when he notes that women engineers in a study in

Norway expressed a desire to have degree courses contain more work on social and environmental aspects of technology. For Grant (1986), this means specifically teaching the subject through solving problems that arise from social issues. Selby (1989) is far more definite in her description of the technological contexts with which females are likely to be familiar. She speaks of work with tools on the farm, in the kitchen, the arts, the workplace and the nursery. There are undoubtedly as many "neutral" settings of technology from these areas as there are from industry, business, finance and trades work.

De Klerk Wolters (1989), in his review of the implications of the PATT research, points to a strategy similar to contextualizing when he refers to knowing and understanding the attitudes and concepts that students [girls] have of technology when they start the courses. This information can indicate the concepts and contexts girls associate with technology and help teachers to develop lessons that start with what students do know and move toward ideas about technology that are more in line with what students *need* to know in order to fully function in our society.

One of the most important strategies is to make females feel included and valued in the classroom. Teacher awareness is key to this strategy. If teachers acknowledge the early and continued socialization of females (Granstam, 1986), they will have a much better chance of addressing the needs of those students , encouraging them to succeed (Brown, 1993) and making them feel they belong. All too often, teachers offering a choice of activity to students tend to believe they are offering equal opportunity without taking into account the background experiences of those students (Brown, 1990; Gaskell, J. P. et al., 1990; Tetreault and Thompson, 1986). Acknowledging different learning styles, different experiences and the need for different contexts, then designing ways to address them (Thompson, et al., 1993) is a strategy that tends to make all students feel included. Understanding female experience and accepting it as a valuable contribution (Rothschild, 1989; Tetreault

and Thompson, 1986) to the classroom is a critical part of this strategy. Part of this understanding can be obtained from references to female interest and preference found in the research. For instance, Brown's work (1989) indicates that girls prefer to work in pairs rather than alone which reflects back to the positions of Gilligan (1977) and Belensky, et al. (1986) who suggest that females learn in relational environments. Grant (1986) suggests that girls respond to the personal, the needs of society and the value component of a problem. Brand and Roelofs (1989) give a much more detailed list of both male and female interests and disinterest that were discovered in research in the Netherlands. This work indicates female interest to be in the areas related to society, the human body, safety and medical technical applications. A complete citation of this list can be found in Appendix A.

It is important to note that understanding female experience goes beyond awareness of interest and preference to include the "mind-set" or socialization brought to the classroom spoken of earlier. Catton's work (1982) with a mixed group of students using specific strategies to include the female students is significant here as it shows exceptional sensitivity and insight reflective of this further awareness. After clearly describing the strategies he used, Catton suggests that it is the way subject matter is taught rather than the content itself that makes the difference.

The object of all of these strategies is to encourage females to enter the technology classroom and to motivate them to continue in technological fields. The need for women to understand and use technology has been established (Cowen, 1979; Grant and Harding, 1987; Franklin, 1984; Rothschild, 1989; Thompson, et al., 1993). The contributions women make to technology have been pointed out (Cowen, 1979; Franklin, 1984; Granstam, 1988; Rothschild, 1989; Thompson, et al., 1993). The influences of society and education on women's presence in fields of technology have been presented. An finally, some suggestions have been given that may help females feel included and valued in the technology classroom.

This study offers the responses of female students to technology education from a Canadian, and more specifically, British Colombian perspective whose experiences have been positive. I have intentionally selected schools whose programs are using a technology education approach (defined in the next chapter) and include a high percentage of female students. Based on the high percentage (52%) of female students in the study who would select technology education for further study, I consider these classes to be successful in capturing the interest of female students. The literature has provided an understanding of the socialization of females and the educational influences in student choice of subjects. According to the studies reviewed, female student choice is influenced by student attitude toward technology, the educational environment and the importance of teachers attitude toward and responsiveness to female students. As it is too large a task to deal with all of these factors at once, I have focused on female student attitudes toward technology as it is revealed in their evaluation of the content of the courses in which they are enrolled. One question for study has been posed as a means of ascertaining this information.

What aspects of technology education courses in British Columbia do female students perceive to be important, attractive and interesting?

Chapter Three
Research Methodology

In order to answer the research question, I chose to administer questionnaires to student enrolled in technology education classes in schools throughout the province. This task involved (a) selection of sample schools, (b) development and pilot of the questionnaire (c) administration and collection of the questionnaire and letters of permission and (d) analysis of data.

Selection of sample schools

The first step was to establish the criteria by which a program would be considered to be teaching technology education. In consultation with Prof. Bill Logan, Coordinator of Technology Studies Education at the University of British Columbia, the following criteria were established. First, components of technology education which appear consistently in programs throughout the world (see references in the introduction) should be present. These include: a) use of design; b) use of problem solving as a method of delivery; c) a focus on critical thinking; d) a hands-on setting; e) the student as center of the program with teacher as facilitator; f) social awareness as a component of the program. Second, the program should exhibit evidence that teachers understand and are applying the Provincial Curriculum Intentions of the Technology Education Curriculum /Assessment Framework (1992) in an effort to change from an industrial education to a technology education emphasis. (This document specifies intentions that include the international set of criteria as well as a discussion of the background and need for a change in emphasis.) From his numerous visits to schools throughout the province, Prof. Logan was in a strong position to know the nature and location of various programs that would meet these criteria.

I then published a short description of the research project (Doll, 1993) in the British Columbia Technology Education Association publication, View. (Appendix

B) After a brief explanation of the nature and intent of the study, I asked teachers to contact me if they were interested in participating. A third resource was my personal association with teachers in the field through my educational experience. As a result of studies at BCIT and UBC over the past eight years, I have worked with a number of teachers whom I know to be seeking an understanding of meaningful technology education programs and are among those who are developing programs that meet the criteria listed above. I was aware of the potential of bias if I used those teachers whom I know personally and who responded to the study because of personal connections. In an effort to minimize possible bias I consulted with Prof. Logan regarding the schools to be studied and used all of the schools that responded within a given time to my requests to do research .

As a result of this consultation and the responses received from the View article a list of twenty one schools was formed. The final sample was based on the following criteria: (a) The sample would consist of between ten and fifteen schools. I felt this would be a large enough sample to give a fair indication of student response to technology education programs in the province yet be within my ability to research and report. (b) The program in the school would include the international criteria listed above that were deemed to be the essence of technology education (whether it is called by that name or not) and use of the provincial curriculum intentions. These are the criteria we established to determine if the program was teaching "technology education". Some programs in the province meet these criteria but are called by traditional industrial education names. (c) The program had an enrollment of at least 35% females. In order to view the program as successfully including females, a figure of approximately one-third of the class as female was chosen. (d) No more than half of the sample was represented by schools from the urban center of the lower mainland. This basis for selection was included to insure a broader representation of programs throughout the province.

Permission was sought from all twenty one districts on the list. Initial contact was made by way of a letter of application to do research in the district with an indication of the school where the research would likely take place. This request was followed up by a phone call to discern the appropriate contact person and clarify the procedures specific to each district. Due to the timeline I set for collecting data and various demands on the teachers who would be asked to participate, a total of thirteen school districts were able to respond positively. A letter was then sent to teachers through the school principals to inform them of the specific expectations I had of them and to obtain willingness on the part of the teachers and permission on the part of the administration to have students participate in the study. A phone call was made to each teacher for whom district permission had been given but who had not returned the participation consent form and program questionnaire which had been sent to the schools. This procedure resulted in a final list of thirteen schools representing a fairly wide variety of technology education programs. A few are programs which include a strong computer base, all include design, problem solving, group work and hands-on activities. Many of the programs are taught in traditional industrial education facilities (wood, metal, drafting or electronics shops); some are taught in new technology education facilities (likely to be a dust free design area with an accompanying general shop area which includes various machines and equipment); a couple are taught in more of a classroom setting. All classes include both male and female students, ranging in proportion from two female students out of twenty-four to fifteen female students out of twenty nine. The teachers see themselves acting as facilitators in a student-centered environment. Each of the teachers answered questions regarding their programs that gave an indication of the extent to which the program met the criteria set forth at the beginning of the selection process (see Appendix C). Based on consultation with Professor Logan, I believe the various degrees of design, problem solving and cooperative education activity is representative of the technology education

programs throughout the province. The desire to have at least 35% female students in the classes was not able to be met. Several of the teachers surveyed the grade eight classes so as to maximize the female responses but not all classes surveyed have this percentage of female students. (In some schools technology education is a required course in grade eight, in others it is a popular elective so grade eight courses often have an even mix of male and female students.) The thirteen schools represent five from metropolitan Vancouver, one from the Fraser Valley, one from Vancouver Island, one from the Sechelt peninsula, and five from the rest of the province including the North, the East Kootenays and the Okanagan Valley. I believe the sample to be representative of the technology education programs that are taking place in the province.

Eight of the teachers were able to administer the questionnaire the first week of January as originally planned. Five others requested to carry out the survey in the first two weeks of May. I acknowledge that administering the questionnaire at different times of the school year may influence responses, and data were kept separate for an initial analysis to determine if any variations seemed apparent. No differences were noted in the data collected from different times. Some students responding in January who were enrolled in year-long courses made comments that indicated the answers might have been different if those courses had been surveyed in May or June, but overall there was no difference between those students who answered in January and those who answered in June.

Creation of the questionnaire

The questionnaire for students was based on the results of two "conversational" interviews with female students of a successful technology program coupled with the content and attitudes questionnaires used in the PATT research (Raat, de Vries and de Klerk, 1987). District permission was secured to conduct the conversational interview, and a colleague in the greater Vancouver area arranged for me to meet with former female students in his classroom one day

at lunch time. At this meeting, I was introduced to the students, I gave an overview of the research I wanted to do and asked if they were interested and willing to participate in a conversation with me. Seven of thirteen girls present agreed to participate and returned letters of parental permission. I met with these students as two different groups on two different occasions at a public pizza parlor of their choice to talk about their perceptions of and responses to the program they had taken. General questions were used to turn the conversation from their general school life to a discussion of the technology education course. These questions included such queries as: "What was the most important thing you learned in the course?", "Do you think the experience helped you in any other part of your life?" and "What did you like most about the course?" Probing for depth of response was used to gain insight into appropriate questions for the questionnaire. These interviews were taped and reviewed carefully but not transcribed verbatim. Several areas were identified in the review of the tapes, including use of machines, the importance of safety, usefulness of skills, and a sense of self confidence as a result of accomplishment in the class. Using this information, I studied the questions on the PATT questionnaire (Raat, de Vries and de Klerk, 1987) and made sure that the concerns and expectations of the girls along with some of their wording were included in a questionnaire that was to be administered to the students in the study.

The PATT questionnaire is an instrument that has been carefully designed, piloted in 12 countries throughout the world, and refined by members of two international PATT conferences. Part of the refinement involved checking for validity and reliability when processing the data from the various countries. Reliability for data was measured by 'Cronbach's alpha' scale. In the cases of English speaking countries, "the alpha-values were well over 80"(Raat, de Vries and de Klerk Wolters, 1987, p.19). Adaptation of the questionnaire has been encouraged by the authors as noted in de Klerk Wolters (1989) when he states, "To use PATT for

practical purposes, the instruments should be adapted to the specific situation of the user" (p. 303).

A pilot of the questionnaire used in this study was given to forty-eight Grade 8 students to establish the length of time needed to complete the exercise and to check for clarity of the questions. Several questions were reworded as a result of this pilot.

Administration and follow up procedures

Once the list of participants was established and the questionnaire was developed, the procedure for administering the data was clarified and organized. A package containing questionnaires, answer sheets and letters of parental permission for at least one class was sent to each participating school so it would arrive during the first week of January. A list of instructions for the teacher with regard to administering the questionnaire was included (Appendix C) and teachers were encouraged to copy the necessary documentation if they wanted to include more than one class. I then phoned the teachers at the end of that week to confirm that the package had arrived, to clarify instructions for the open ended questions and answer any questions that the teachers had. The first group of questionnaires from eight schools were all returned by the first of February. Upon examination of these returns, several schools had failed to include a letter of parental permission for each questionnaire returned. This required further contact with the teachers, sending more permission forms and further clarification of UBC policy on use of data without parental permission. Fortunately, all participating teachers were willing to put in the extra effort needed to meet this requirement.

Since materials had been sent to all of the schools in January, a letter was sent in the last week of April reminding the teachers in the delayed group of the administration date. This was followed by a phone call to confirm the possibility of carrying out the task and to clarify the date changes needed on the letters to parents. It took longer to have the second set of data returned due to the fact that a few of the

teachers took the time to insure parental permission had been given for the entire class and this proved to be a difficult task. In the end, all thirteen schools returned the questionnaires and necessary parental permission forms which resulted in 117 female responses and 129 male responses for a total of 246 student responses.

Analysis of the data

The questionnaire of forty-five questions with responses on a Likert type scale (see Appendix C) was answered on standard computer scan sheets. These sheets were scanned and the data organized by computer technology. Fourteen areas of questions were determined at the writing of the questionnaire and were used to organize analysis of these answers. Three open ended, hand written questions were included at the end of the list of forty-five questions. These were separated by school and gender and hand sorted into categories that were determined from the responses. A colleague who is a student counselor and has no background in technology education assisted in categorizing the responses. This helped to insure that the categories were developed from the data rather than my own predisposition and familiarity with technology education. The interrater reliability was about ninety-five percent.

The purpose of the study has been to learn from students themselves those aspects of the technology courses that were important, interesting and attractive to them. Importance and attractiveness were revealed in responses to the open ended questions while interest and attitude were more clearly indicated on the formalized questions. Consequently, analysis of the data that follows deals with the open ended answers and is supported by the formalized questions. This approach seems to be more faithful to the purpose in that it allows the "student voice" to predominate.

Chapter 4
Results

This chapter provides a descriptive analysis of the written answers to the three open ended questions on the questionnaire. Included in these descriptions will be pertinent information from the forty-five closed questions which made up the first part of the questionnaire.

Students responded to the open ended questions in terms of the specific program content they had experienced. Variations in response reflected variations in programs. For instance, one participating school surveyed students whose context for technology education was a drafting class. This fact influenced the kind of answers that were given. Instead of simply stating that drafting was important, these students gave the following kinds of answers.

> "The most important thing I've learned in this class is to work efficently [sic]. How important it is to be neat in work habits. How much drafting effects [sic] the world, and when it changes all the jobs in this field. How useful it can be. It's a challenge. To demincin [sic], and scale things. Everything in drafting was new and I've learned a lot."

> "I have learned how to shade houses, and objects, Front [sic] back and side of an object. I have learned to be precise in my measurements so everything matches up."

Likewise, those classes which had computers available and were using them as an integral part of the program reflected this fact in the responses given as is evident in the quotations included with the analysis. Excerpts represent the full range of schools except where indicated at the time of the quote.

Responses to the three open-ended questions are summarized, together with supporting data from the forty-five closed questions.

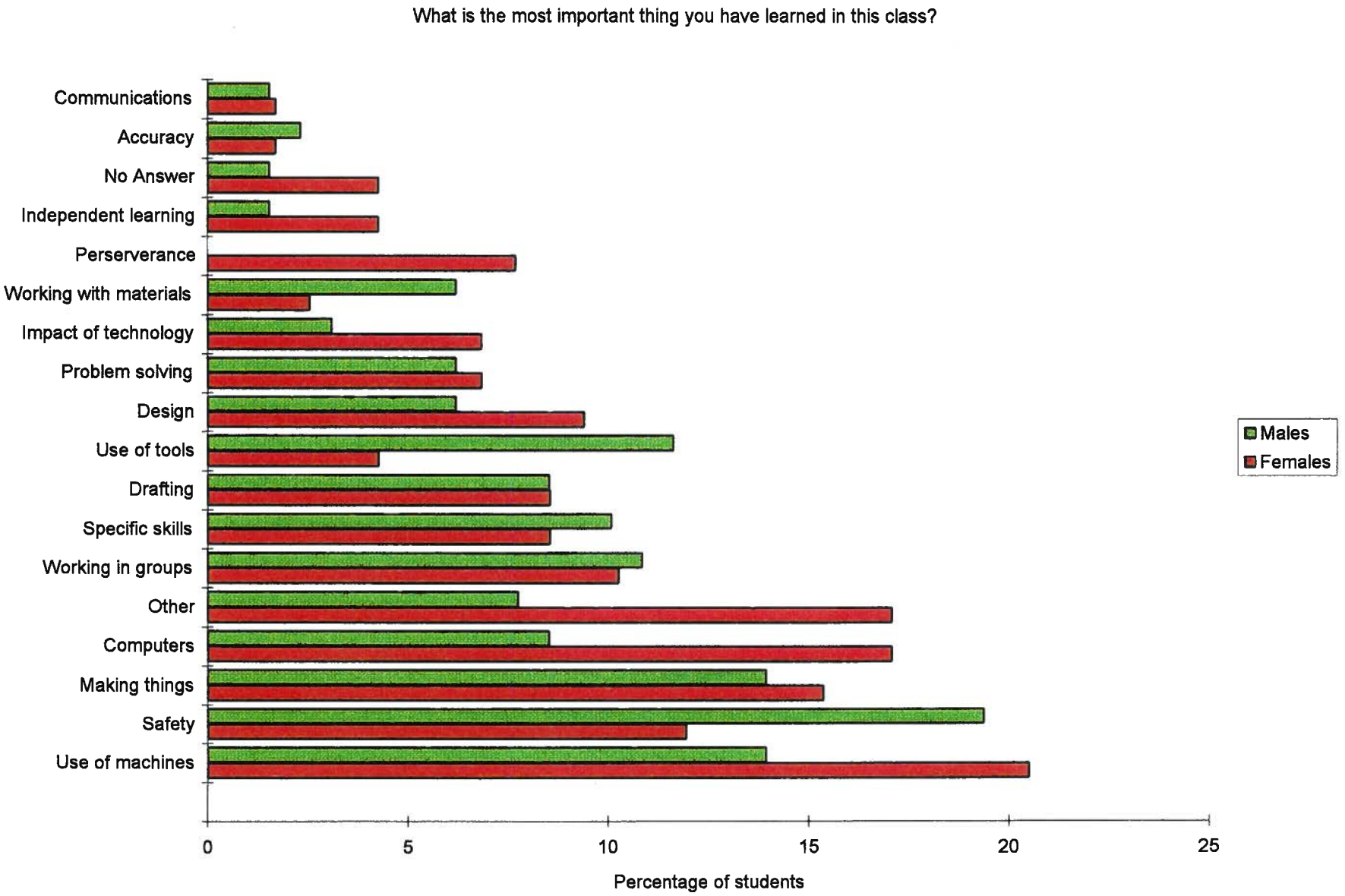
Question 1: What is the most important thing you have learned in this class?

Obvious similarities exist between the categories that make up the most important things students say they have learned in the technology classes and the areas of technology raised in the forty-five closed questions. It could be argued that the students were influenced in their written responses by the questions they had just finished answering. This is likely, although the written answers are so candid in comparison to the formalized wording of the closed questions that the responses reflect a much broader sense of the categories than was included in these questions. There is also the possibility that in spite of my conscious efforts to counteract the tendency to create similar categories, I did so.

It is important to note that several students gave more than one response to this question. Rather than conclude that the first response was the most important thing learned, I included all answers given. Consequently there are 186 responses to this question from 117 female students and 172 responses from 126 male students. Percentages have been calculated based on the number of students rather than the number of responses. This means I have divided the number of students into the number of responses for a given category to arrive at the percentage stated. The numbers in parentheses indicate the number of students who gave a specific response.

Use of machines and equipment

Learning how to use machines and equipment was the most frequent response to the question of what was the most important thing female students learned in technology education classes. Female students from nine out of the thirteen schools gave this response. As can be seen on Figure 1, twenty and one half percent (24) of the 117 female students included this component. The responses range from rather simple and straight forward to quite inclusive and sophisticated. Most of them connect machines to other experiences. The simple ones included such answers as:


What is the most important thing you have learned in this class?
Communications
Accuracy
No Answer
Independent learning
Perserverance
Working with materials
Impact of technology
Problem solving
Design
Use of tools
Drafting
Specific skills
Working in groups
Other
Computers
Making things
Safety
Use of machines
Males
Females
0
5
10
15
20
25
Percentage of students

"I learned how to operate the machines."

"Probably how to use different machines."

"I learn [sic] to use some of the machines that I never use [sic] before in my life."

Some students linked machinery with safety;

"learning how to use the machines properly & safely & with care."

"I have learned how to use the equipment properly and saftley [sic] . (I think that's the most important)."

while other students linked machinery with making things:

"How to run machinery and build things."

"The most important thing that I have learned is how to work machines and how to make different things."

"I learned how to use lots of machines & build certain simple things to use in a house."

The inclusive responses gave evidence of more linkages such as:

"I learned how to use stuff, like machines, tools ect.... [sic] I also learned how I can make things 3 times better & cheaper than what I buy in stores."

"I have learned that using machinery is not very difficult, but precision is very important. Attention to detail and calmness are "absolute" "musts" in the tech ed lab. I've discovered that you really MUST think things through and plan ahead (with drawings, sketches, plans, etc.) before beginning."

"The most important thing I've learned in this class is the process through which I can turn an idea into a design and a finished product. I've learned practical concepts of drafting, trial and error, working w/ materials, machinery tools [sic] efficiently - and of technology [sic]."

The fact that use of machines and equipment drew the largest number of responses from female students takes on even more meaning when it is pointed out

that only fourteen percent (18) of the male students declared that learning the use of machines was most important. This brings us to realize that it is more important to females than males to learn to use machinery. This is not a finding that I expected to come out of this study. In my experience I have found that most people assume that females are reluctant to work with large, noisy machines. For the students in this study, this is not the case. Perhaps females realize that learning to use machinery gives them options for jobs or avocational activity that they had not thought available to them. Looking at the closed questions for further information, we find that seventy percent of the female students gave a positive response to questions regarding this issue (see Figure 2). In response to specific questions about machinery and equipment, as indicated on Figure 3, fifty-one percent (60) of the female students answered "yes" to question number 3: "I like learning how to use the equipment". Another twenty-nine percent (34) answered "Probably" to the same question. Conversely, when asked to respond to the statement in question number 15: "I am frightened by large, noisy machines and /or equipment", forty-six percent (54) of the female students answered "No" and another twenty-eight percent (33) answered "not really". These data are consistent with the written responses. Interestingly, the number of "I don't know" answers given by one school to all questions about machines and equipment indicates a strong possibility that the students at that school hadn't had much opportunity to use machines or equipment at the time of the survey.

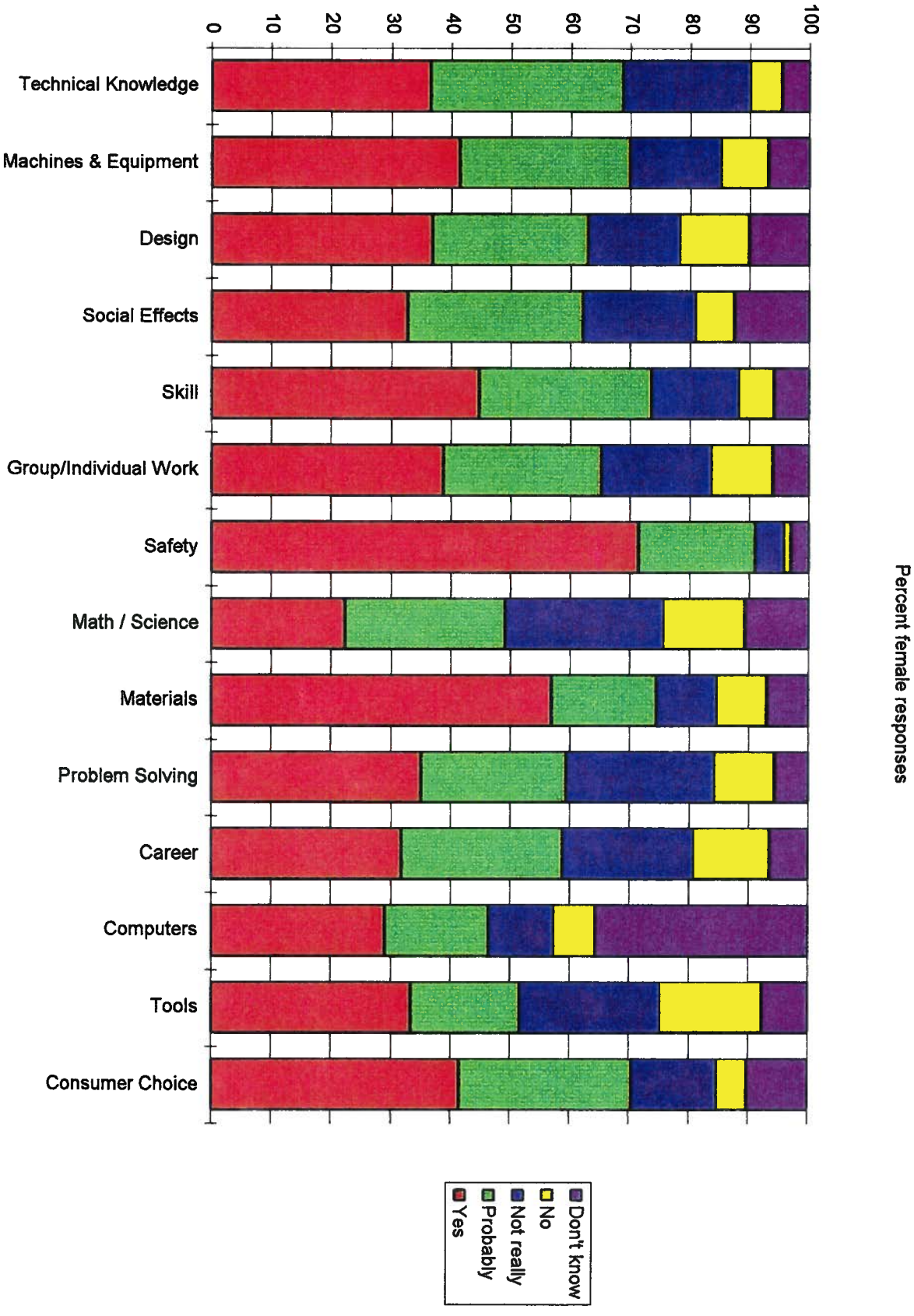

0
10
20
30
40
50
60
70
80
90
100
Technical Knowledge
Machines & Equipment
Design
Social Effects
Skill
Group/Individual Work
Safety
Math / Science
Materials
Problem Solving
Career
Computers
Tools
Consumer Choice
Yes
Probably
Not really
No
Don't know
Percent female responses

Figure 3.

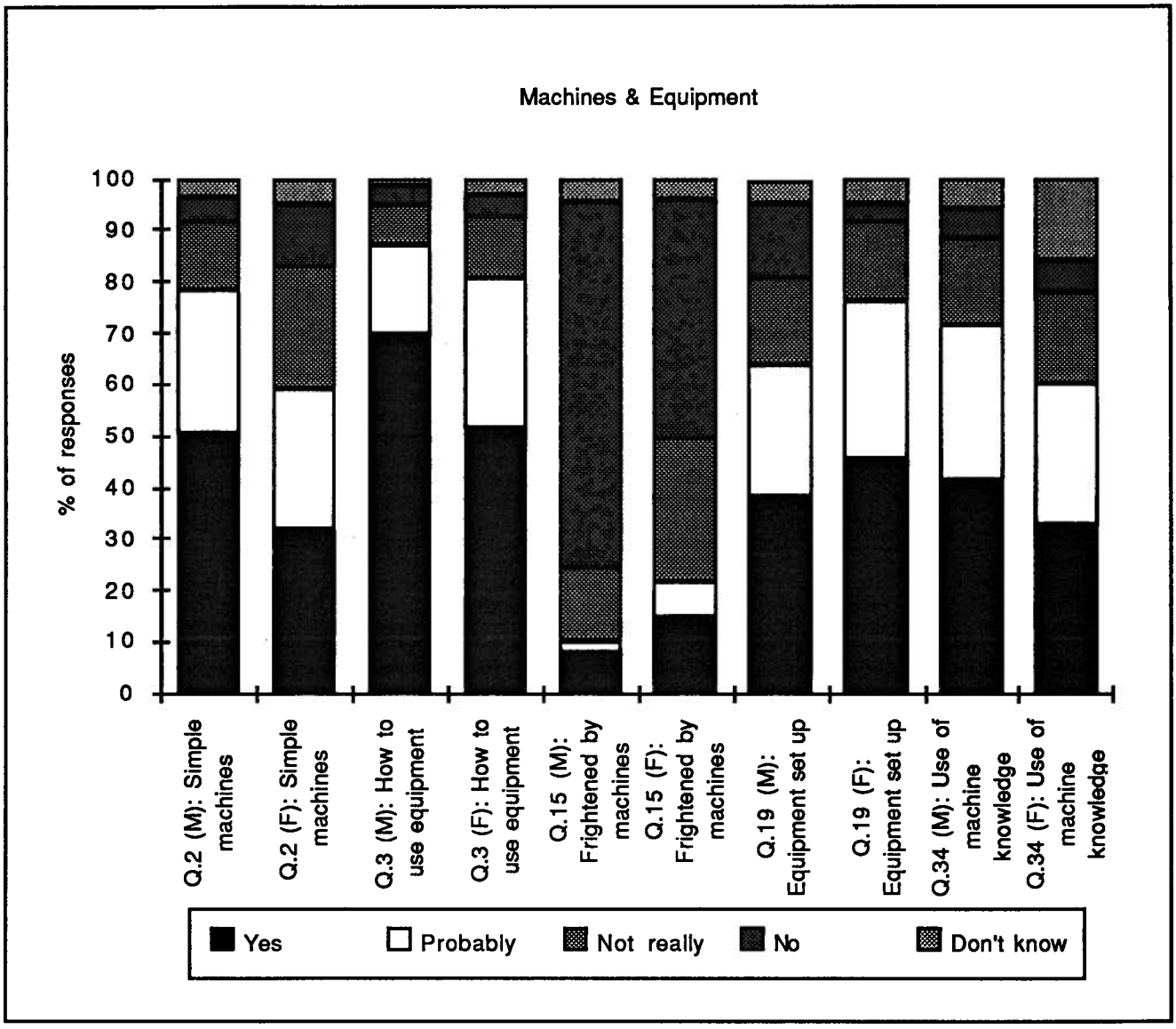


Figure 3. Responses to individual closed questions in the Machines & Equipment category.

Computers

I am choosing to list computers in a separate category for two reasons. First, it appeared that some programs had enough computers available to make them a significant part of the program while others did not. This led to one of the variations that showed up in the study. Responses from students in the programs that have computers seem to indicate that they spend less time on machinery so learning the use of the computer would constitute a comparable activity. Second, the number of responses was high even though availability throughout was low (students from only four schools said computers were the most important thing learned). This seems to signify that students who have the option to use computers find it an especially important thing to learn. Seventeen percent (20) of the female students indicated that learning the use of computers was the most important thing they learned in class (Figure 1). As a matter of fact, as with learning to use machines, learning computer skills was more important to the females than to the male students (eight percent indicating computers as most important). It is reasonable to speculate that females realize the value in gaining computer skills which can provide opportunities for the future and they are learning these skills in these classes. This was specifically stated by some of the students (who were writing by hand so didn't have a spell check!):

> "I've learned how valuable it is to know computer skills."
>
> "Using the cameras [video] and computers are imorpant [sic] for any job."
>
> "How to use the computer and understand the different terms or concepts used in the class. I know that whatever I have learned and will learn will probably help me in the future."
>
> "Probably how to get along with the computer and how to work with it, understand it. Everyday there is something new that I learn. Everything that I learn is important to use."

> "The most important thing I've learned in this class is how to be creative with the computer. I use [sic] to think that drawing things on computer meant printing out a picture that was already programed [sic] into the comp. But I see you can do a lot of design on the computer."

If learning the use of computers (which of course is a machine) had been included in the previous category, a total of thirty-eight percent of female students (44) would have said that learning how to use machinery and equipment was the most important thing they had learned in the class. In light of the literature, the socialization of females, the history of industrial education/technology education, and the variety of responses given, this is a significant finding.

A look at the closed questions regarding computers seems to confirm the possibility that several of the programs did not have computers to use. The number of "I don't know" responses to questions about computers as a category tallied at about thirty six percent for the females (see Figure 2) and at about twenty-five percent for the males (Figure 2A in Appendix D). Not having computers available made two of the three questions on computers irrelevant (see Figure 4). Even so, awareness of the importance of using computers was relatively high. Forty-three percent (50) of the female students answered "Yes" to question number 39: "Learning to use the computer in the tech ed lab is important" while another sixteen percent (19) answered "Probably".

Making things (tools and materials)

Making things received about fifteen percent of the female responses. It is worthwhile to note that the same number of females (18) as males found making things in technology education to be most important (see Figure 1). The socialization factors described in the literature review concerning spatial and mechanical familiarity (Brown, 1989) would imply that this would not have been the case. The historical association with this area as being a male domain (Kimbell, et. al., 1991) would also tend to make this finding unexpected. However, making things fits with females' selection of use of machines and equipment as most important. As

Figure 4

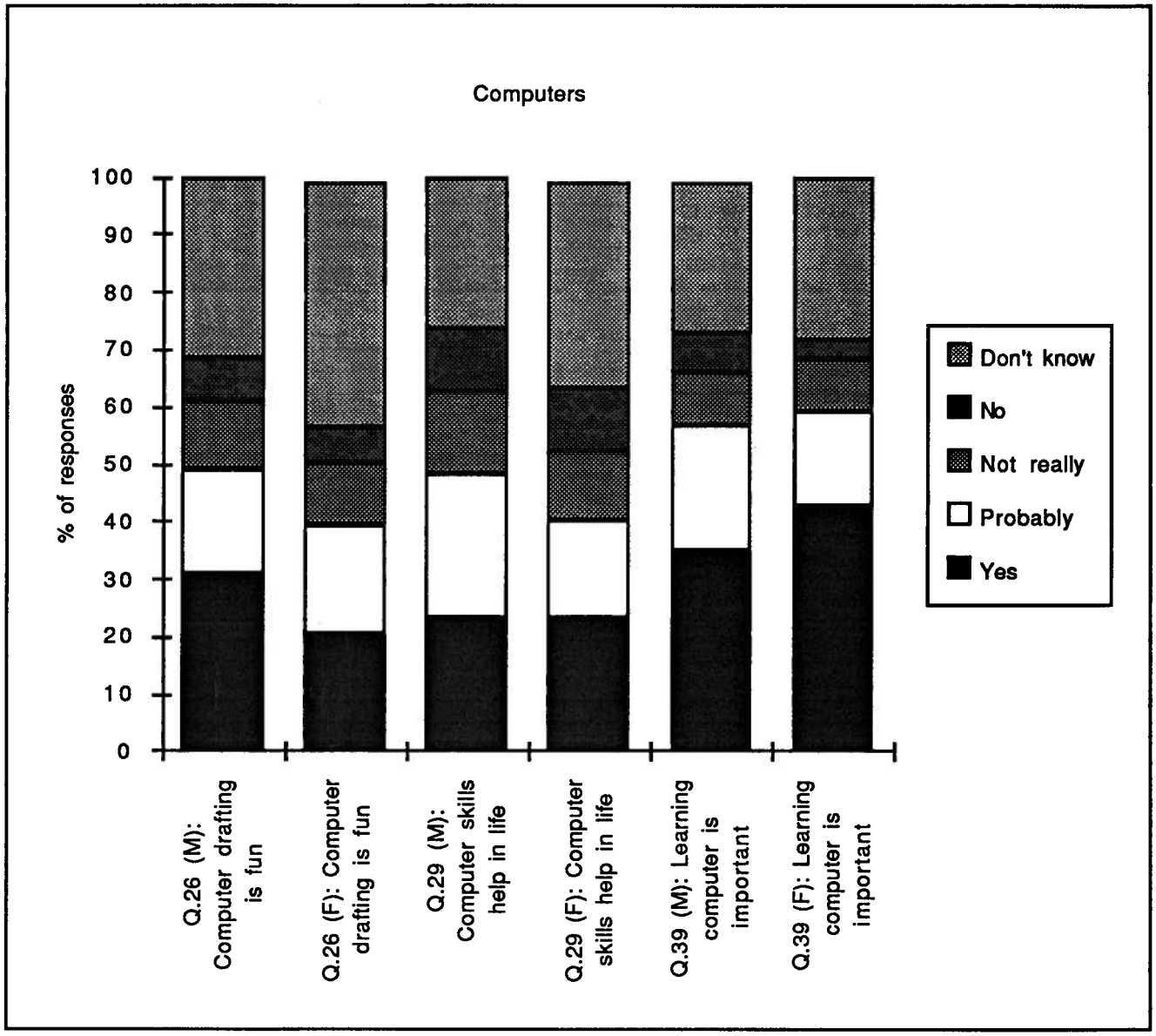


Figure 4. Responses to individual closed questions in the Computer category.

indicated earlier, the students often made the connection between using machines and making things. Responses in this category reflected a sense of pride and usefulness associated with making things (see also student responses to use of machinery and equipment):

> "that I can make things that are useful to me."
>
> "How to build things really strong."
>
> "How to make things that will help me out in life."
>
> "How to figure out how to make things without being given plans" [design].
>
> "I have learned how to do a project from design and plan (start) to final product (finish) and this is helpful to make my own furniture etc. . . I save lots of money and I know how to make every day repairs."

Questions about making things occur in the Skills category of the closed section of the questionnaire. In response to the statement: "I can use skills I have learned in this class to make things just for fun", sixty-one and one half percent (72) of the females answered "Yes". Another twenty two percent (26) answered "Probably" to this question. These responses tend to support the idea that female students are interested in making things.

Connections were not made by any of the students between making things, using machines and equipment and tools or materials. The open ended responses to the importance of the use of tools and materials seem to be a contradiction. Only four percent (5) of the female students included the use of tools as most important and only two and one half percent (3) included use of materials. Perhaps it is the "givenness" of using tools and materials to make things that explains this anomaly. It does not appear to be an indication of negative thinking since a look at the closed questions regarding materials (Figure 2), indicates that females gave a positive response to their use (58% "Yes" and 18% "Probably"). And regarding tools, in response to question number 43 which reads: "It makes me feel good to know how

to identify and use tools", the female responses were likewise positive - forty-four percent (52) "Yes" and nineteen percent (22) "Probably" (Figure 5).

Safety

Safety is important to mention because of the relatively low number of written answers that claim its importance. Only 12% of female students (14) said safety was the most important thing learned in class whereas 19.8% of the male students (25) claimed it as most important. Given the amount of attention paid to safety in technology education courses which use dangerous equipment, this is an unusual response. Different observations can be made based on this information. One is that the female students feel they aren't likely to use the tools and equipment in a career so do not place it with high importance. The second observation is that the female students enter the class with a greater awareness of the need for safety and stronger patterns of safe conduct so females don't see safety as a lesson they are learning in this situation. A third is that the inexperience of the females causes them to be unaware of the dangers of the equipment. My experience in the tech lab is that the females are very cautious and safety conscious even when they get familiar with the equipment. I am constantly reminding the male students about safety but I rarely have to remind the female students to be safe. Answers to the questions about safety in the closed section tend to indicate that the second observation is likely the case (Figure 6). Ninety six percent (82.9 + 12.8) of the female students said "Yes" to the statement "It is important to know how to work safely in the tech ed lab". Not one female student answered "No" to this question whereas four male students did. Eighty-seven percent of the female students affirmed the statement: "Knowing how to use tools and equipment safely helps me feel confident in the tech ed lab." with another five percent answering "I don't know" perhaps indicating they have not been exposed to tools and equipment.

Figure 5.

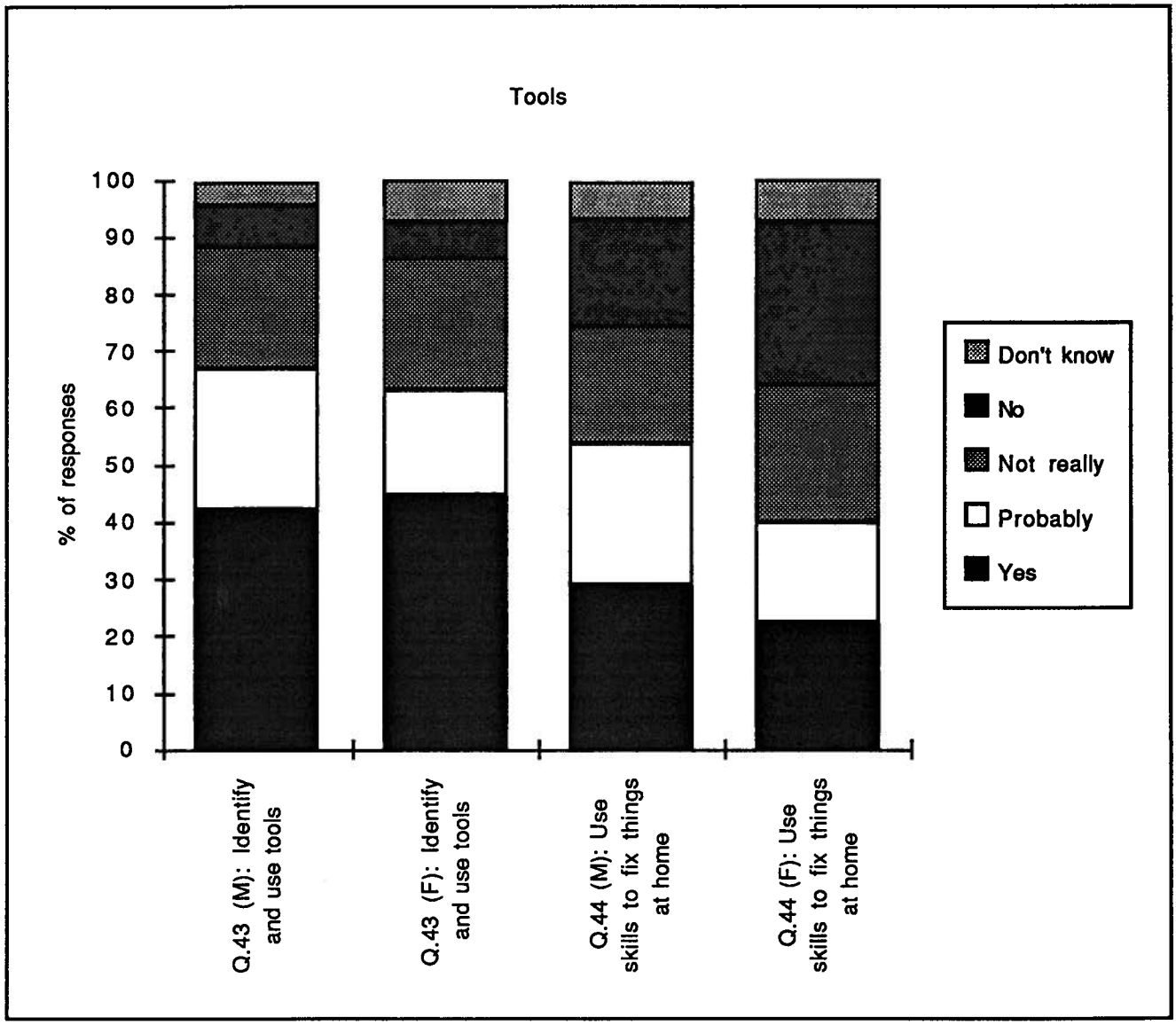


Figure 5. Responses to individual closed questions in the Tools category.

Figure 6.

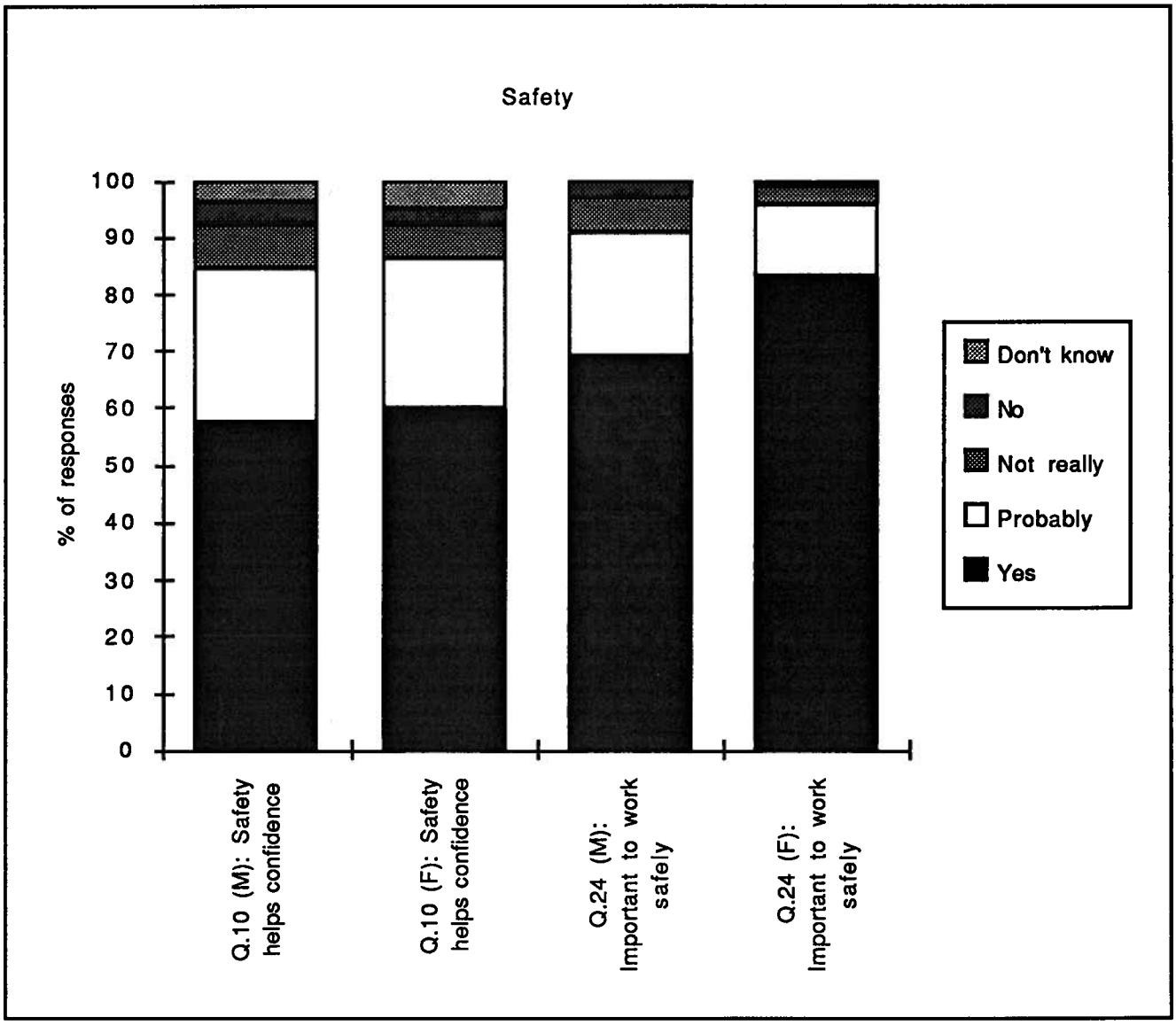


Figure 6. Responses to individual closed questions in the Safety category.

Other

Study of Figure 1 shows an "other" category had seventeen percent (20) of the female responses. Included here were considerations that had one, two or three responses each so were not deemed to be a separate category. Due to the number of answers that have been put into this category, it seems appropriate to give a sample of the student's thinking. Though there is some latitude to the perimeters of the established categories, none of these answers seemed to match well enough to be included. I have looked for a possible bias in categorization but find that some of the answers match areas of focus in technology education, there just aren't enough of them to constitute a separate category. For instance, there are two responses that find communication (one of the provincial curriculum intentions), the most important thing the students learned,

> "The most important thing I have learned in this class is how to communicate with my teacher."

> "Communicate with others"

and a couple could be designated as reflecting course integration, (another of the provincial curriculum intentions),

> "I can sometimes apply these skills (observing and drawing objects & using tools) to other things."

> "Through drafting I have also gained a better view of how science, math, technology etc. . connect and interact (in idea & the world)."

Others are simply unusual or one of a kind, indicating evasiveness,

> "I'm not sure"

> "I have learned many things but I can't think of one right now"

self-evaluation,

> "How to evaluate my work truthfully."

awareness,

> "The most important thing I have learn [sic] is that on paper things don't always look like they would in real life.

accomplishment,

> "I enjoyed the feeling of getting something accomplished"

or sexism,

> "It also means that woodworking, fixing etc. . . is not only a mans [sic] area but a womans [sic] as well!!!"

> "that I can be as good as guys in this area, and girls can do anything guys can do."

Thus it is not that categories did not exist but that few students repeated similar answers so they were placed here.

Perseverance/self discovery

Perseverance/self discovery is singled out because it is a category that only the female students mentioned. It must also be pointed out that these students were also from only one school whose program includes more students from the academic stream. This offers at least a couple of explanations why such an important learning experience is not mentioned more often. First, these students are more likely to persevere at all subjects. Second, academically oriented students often have to persevere with hands-on activities in order to succeed and would be more likely to identify that need. The fact that they feel they have succeeded in this class is a credit to the teacher. The academic orientation is reflected in many of the responses to the open ended questions, some of which have already been quoted, at least in part. The sense of self reliance and perseverance is clear in the responses given below. The value of this lesson in this context cannot be denied, especially for females in relation to technology. As the students put it:

" I have learned a lot in this class, including how to work things through to the best you can because it will be better at the end. This class has given me a lot of confidence, now I know I can do things myself no help needed."

"The most important thing is to work hard and not drop it if I get to a problem."

"The most important thing I've learned is not give up on my project when a problem occurs. . . . it is the most important thing I have learned that will probably help me for the rest of my life."

"The most important thing I have learned in this class is that you can do anything you want if you put your mind to it."

"I have learned to use my head in putting things together as I would anywhere."

"I learned that the ability to make quality items is not such an impossible goal, and that the guided experienced manipulation of your hands is almost as useful a skill as rationalizing, etc.

"The ability to do things with my hands any time I want to. I can do thing [sic] in real life (3-D) rather than on paper (2-D)."

"The most important thing I've learned in this class is learning how to use my brain in ways other than those in my life before. Because I feel it is important for me as a girl to learn technology for life when I am on my own."

Question 2: Do you plan to take technology education next year? If so, why? If not, why not?

Fifty-two percent of the female responses to this question were yes with an additional ten percent who answered maybe! This response verifies the fact that the programs selected for study are meeting the needs of female students otherwise they wouldn't be signing up again. It contradicts the studies reviewed in the literature which indicated that even with intervention strategies, female students failed to sign up for higher level courses. And it says that technology education can be made

attractive to females in spite of the patterns of the past. (The male students are even more definite with a rate of 79% yes + 5% maybe.) The reasons given for these choices can be seen by referring to Figure 7.

There are only three more responses than female students for this question which indicates that very few students gave more than one answer. The method of calculating percentage is the same as that used for question number one.

Yes, because its fun

The main reason for choosing to take technology education again was because the students had fun and enjoyed the class. Twenty-two percent (26) of the female students gave this answer. Many students simply said it was fun but a number added further comments such as:

"Yes. I would because it is fun and neat to learn new things."

"Yes I am. Because it's fun and you learn a lot."

"Yes, It is fun and helpful."

"Yes, Because it is an awsem [sic] course."

"Yes. I injoy [sic] it very much and would like to learn more."

"Yes I do, this is because I thought this year was fun and interesting. Hopefully next year will be the same, I'm sure it will."

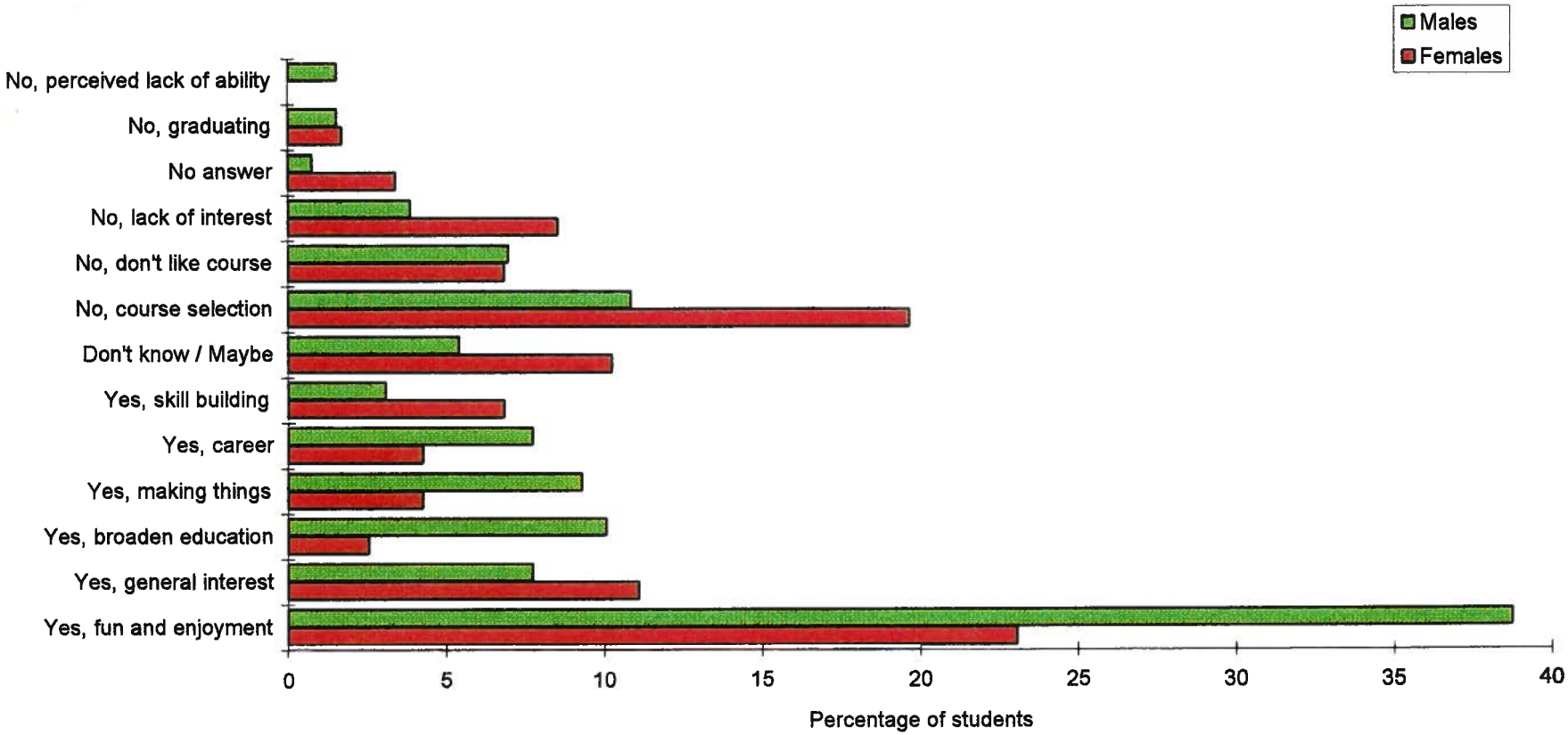
"Yes, because I enjoy making things with wood and my teacher is cool."

"Yes. I enjoy it very much, I have learned a lot and I had fun at the same time. I want to know more, its like a drug you get hooked and want more."

"Yes, because it's fun to work with wood, mind and hands at the same time. It's challenging."

"Yes because I enjoy making things and learning processes."

Do you plan to take technology education next year?



These responses are a compliment to the teachers and the nature of the programs they are delivering.

Yes, because of general interest

Half as many female students (13) would take technology education again because they are generally interested in the course or see it as valuable. One student expressed herself by saying:

> "Yes, because right now I don't know what I would take as a course when I graduate from high school, and the more knowledge & experients [sic] you have, the better choice you'll have."

A second student says simply:

> "Yes, cause I really like it. Technology is around us. We have to learn it."

and a third student expresses a more pragmatic approach when she writes:

> "Yes, I think I will be taking technology next year because it will help me later and its fun!! My dad works in demolition and I help him sometimes so its good for me to know lots in technology."

The importance of general knowledge about technology came through much more strongly on the closed questionnaire (see Figure 8). More than eighty percent of the females answered with a positive response ("yes" or "probably") to question number 1, "I like knowing about the various kinds of technology that I use every day." and question number 9, "Technology is all around us so we should learn about it and understand how it affects us." The question (number 31) dealing with application of that knowledge, "Technology Education has helped me to understand the world around me." is not nearly so convincing (only 41% positive). It appears that our programs need to make stronger connections between the classroom and the world outside.

Figure 8.

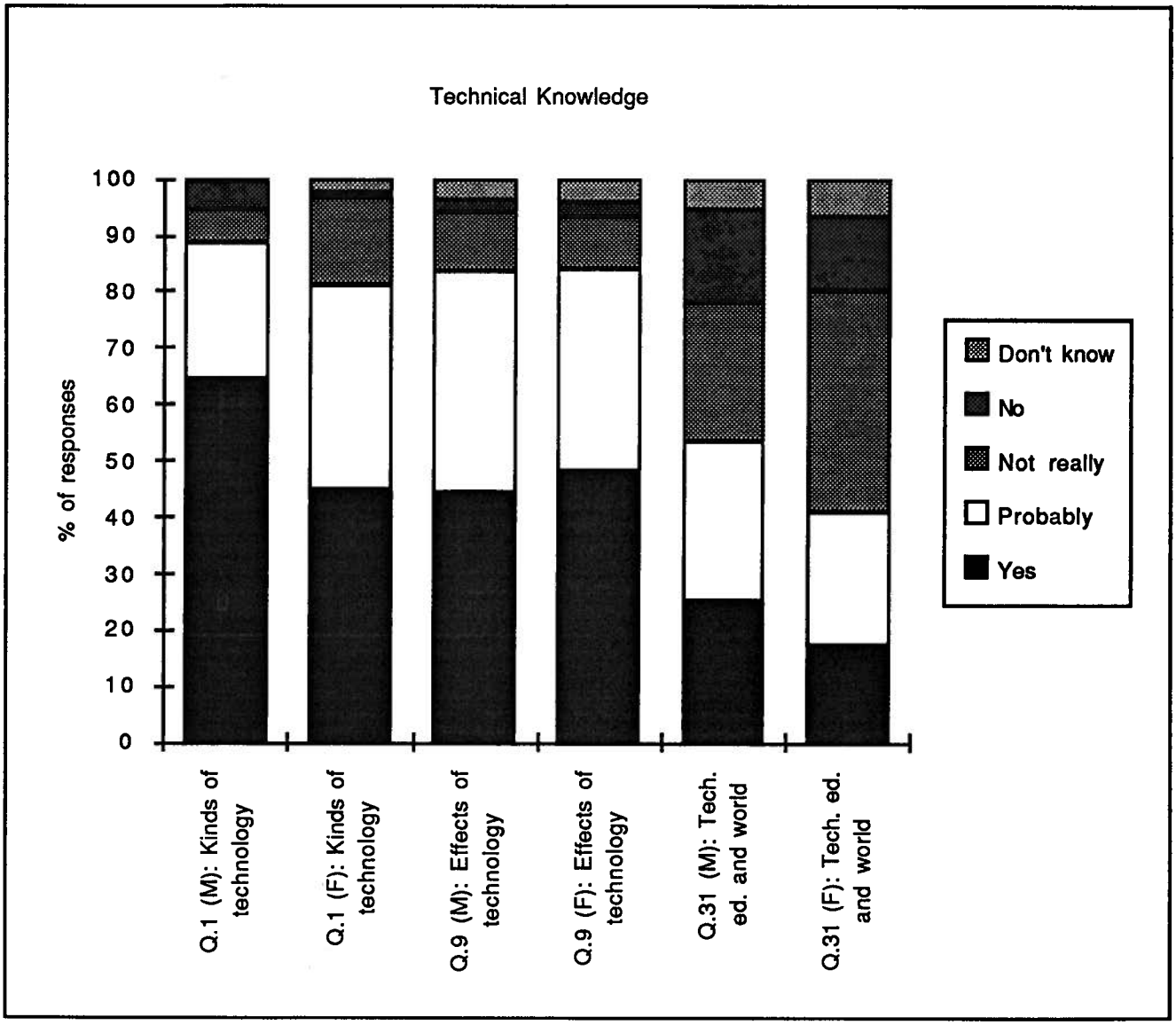


Figure 8. Responses to individual closed questions in the Technical Knowledge category.

Career

The connection between technology education and career does not appear to be very clear. None of the students mentioned career in relation to (open ended) question one and few indicate that the reason they would take technology education again is because it would contribute to their career (only four percent [5]). Another 2.6% of the students (3) said they would not take technology because it would not contribute to their career. Given the pervasiveness of technology in our society it is naive, to say the least, to think that any career will not involve technical knowledge. It is true that course selection at the ages of 13 and 14 is not nearly as critical to future options in North America as it is in Europe but the socialization around careers is prevalent here also (see J. Gaskell, 1984). Technology education is a general course that is not designed to lead directly to a career but as such, essential non sex-biased discussion of careers within the course is appropriate and possible. One of the Provincial Curriculum Intentions (see Appendix E) specifically addresses including careers and it does not appear that this is happening. Even the students who mentioned career are divided on how technology education will help:

> "I plan to take it next year because I think It [sic] will be needed for the career I plan to pursue. The skills may be important."
>
> "Yes I do want to take a technology course because it may help me to get the job I want (Fx artist) and I also find it interesting."
>
> "Yes, i [sic] do plan to take technology education next year because i [sic] enjoy it and in my future this is the catagory [sic] i [sic] plan to study and have a job in!"
>
> "Probably if I graduate I will go to the University of the Cariboo [sic]. Because I enjoy using these kinds of machines and I like working with wood."

> "Yes, I do, I think it's important for drafting & technology skills to be learned. I would like to become something with this field. I will take 'drafting' in my later years. It's what I plan for my career."

Answers to the closed questions on career tend to reinforce the idea that careers are not being discussed in the classroom (see Figure 9). Question number 21 reads: "The concepts and skills I have learned in Tech Ed will help me decide what kind of work I would like to do when I finish school". Only 32% of the females answered "Yes", followed by 20% answering "Probably". That leaves nearly half the class that don't think technology education will help decide on careers or else don't know. Responses to question number 37 (31% "Yes" and 34% "Probably") are more encouraging but this question reflects student awareness of necessary job skills more than job opportunities. This question reads: "The things we are learning in Tech Ed will probably help me get a job".

Don't know

All responses that were put into the "I don't know" category which constituted ten percent of the female total were strictly "not sure", "maybe' or "I don't know" answers with little elaboration. Five students expressed the following thoughts, " I might, but it depends on what my other choices are." These answers were included here rather than in the course selection category because they were more positive than negative in tone. One student didn't know about next year but didn't close her options when she answered:

> " I haven't decided yet, but if I don't take it next year I can take the same course the year after".

No, because of course selection

Of the reasons given not to take further technology courses, course selection ranks the highest. Twenty-three female students (19.6% of responses) gave this as their reason. In my experience, it has often been true that music students or French

Figure 9.

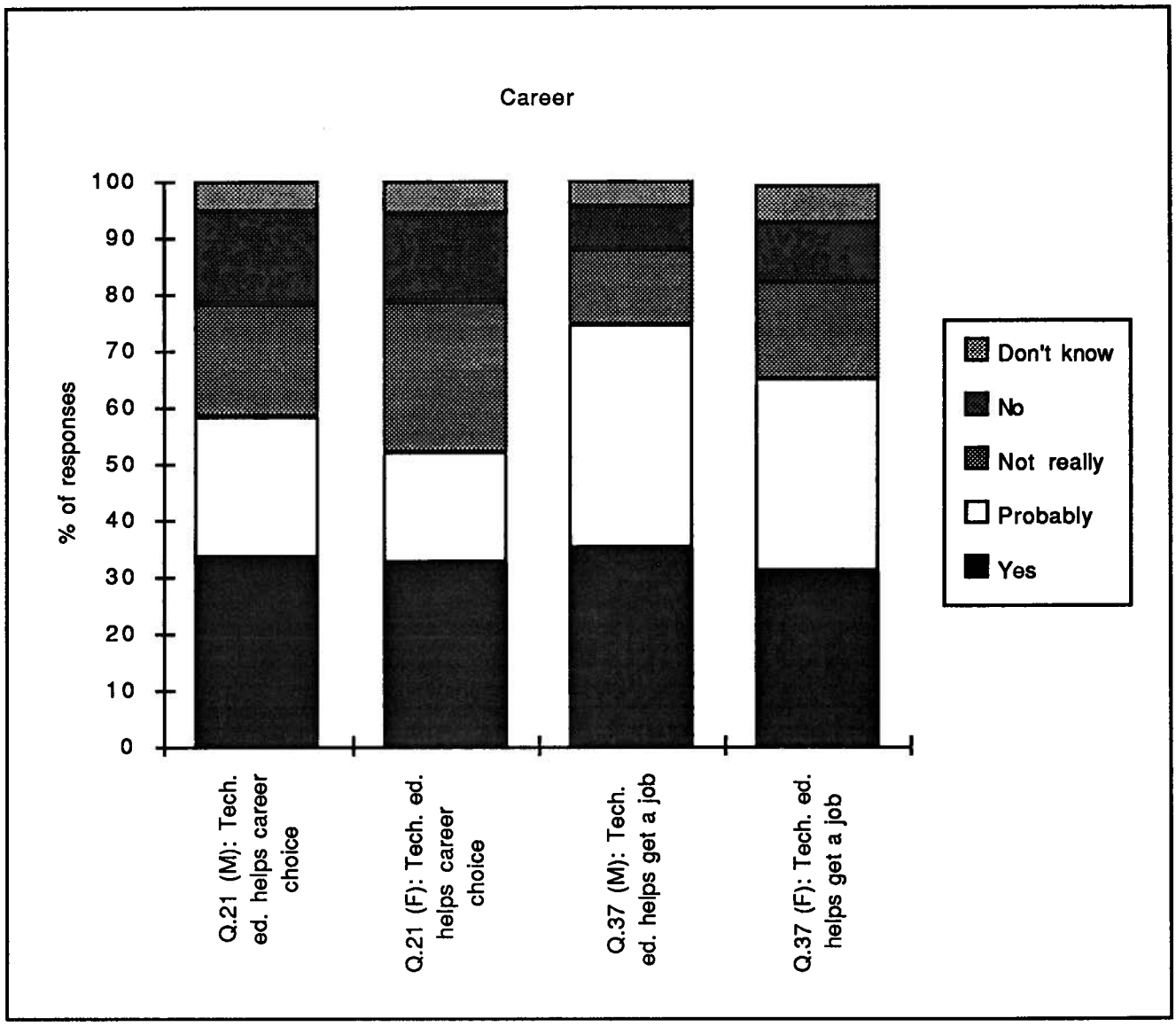


Figure 9. Responses to individual closed questions in the Career category.

students simply do not have room in their schedules to include a technology course. However, it is difficult to know how many of the students who gave this answer choose other courses because of lack of interest in technology education. The students themselves reflect this ambivalence:

> "Probably not. I would like to, but I will only have two electives and I want to try lots of other courses."
>
> "No, mainly because I don't have enough electives to take this course again. If I had five electives to choose, I probably would."
>
> "No, I would but there are too many required courses and in my one or two electives I'm picking things that interest me the most ie. psycology [sic] and history."

The percentage of students not taking technology education because of course conflict is actually surprisingly low considering the number of required courses students must take coupled with our school system's emphasis on university qualifying subjects.

Lack of interest

Ten of the females stated that they would not take technology education because they were not interested in the subject or didn't feel it would contribute to their careers. Some students said directly:

> "No, because this is not really what I want to do."
>
> "I am not taking technology next year because I would like to try something else next year."
>
> " I do not plan to take technology ed. next year. This is because I do not plan a job using this, and I am not interested in technology as much as I am in arts. I don't like building things."
>
> "No, I don't think so. I will learn enough this year, [sic] so that I can do things with my dad's tools & machines at home. I won't be making a career out of this. I will take courses that will be beneficial to me."

Another student was more evasive when she said:

"I'm not taking it next year because I personally think its just not for me."

No, because of perceived lack of ability

It seems appropriate to mention the listing that appears at the top of Figure 7. There is no "other" grouping for this question as all answers but these two, logically fell into the categories listed. Two male students indicated the following sentiments.

"No, because I'm more of an academic student and I was never good at building things with my hands."

"Probably not, because I'm not that creative."

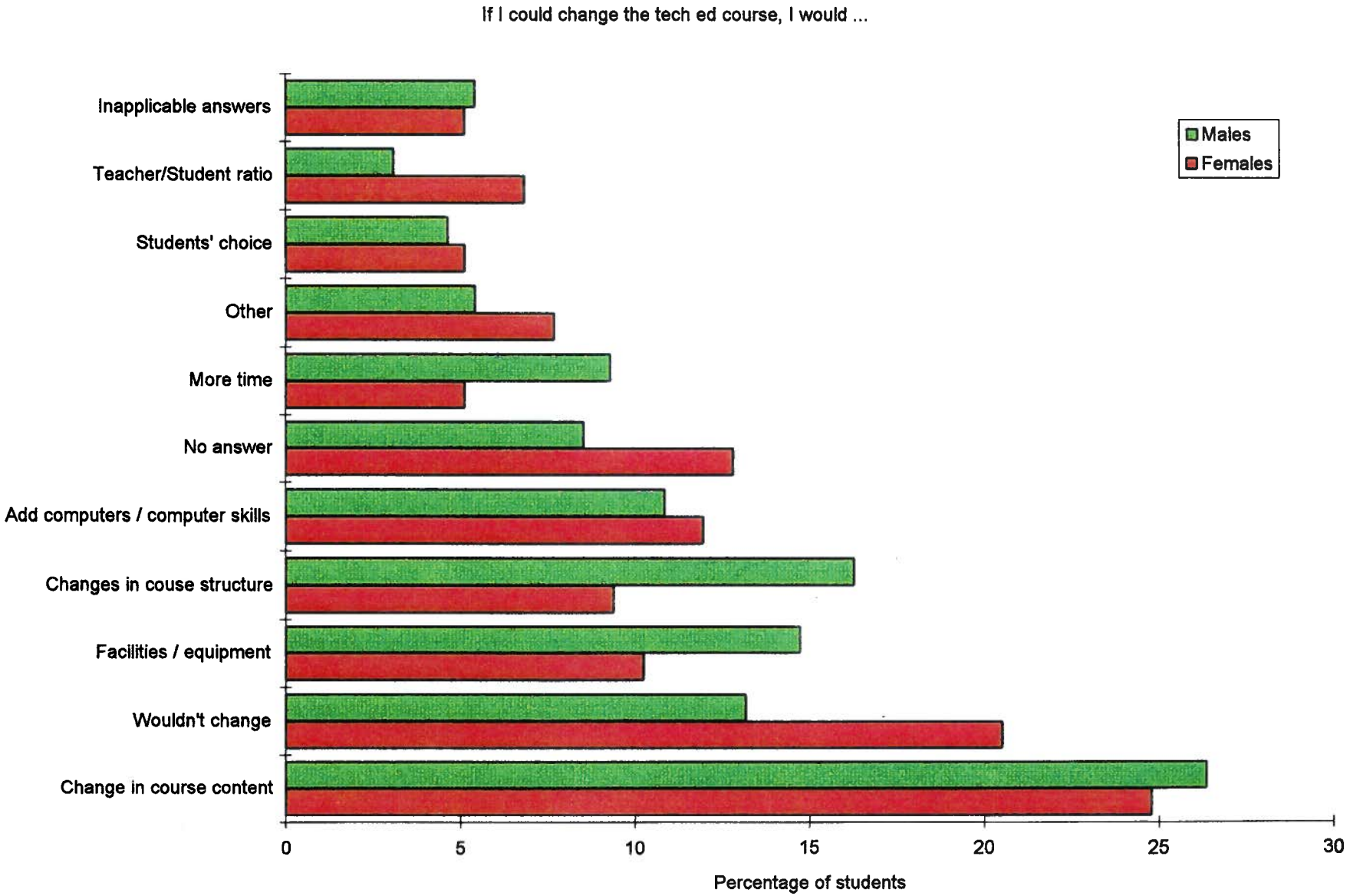
It is interesting that none of the female students expressed these attitudes since the socialization process stated in the literature tends to make us believe it would be females who would hold them.

Question 3: If I could change the tech ed course, I would. . .

This question was intended to give the students an opportunity to offer some constructive criticism of the course as well as indicate areas of interest that might not have been covered by the closed questions or the way the first question was worded. Most of the students took advantage of this opportunity to criticize while some indicated areas of special interest. Many students gave more than one answer. The categories of responses are shown in Figure 10. Calculation of percentage follows the pattern set for the former questions.

Change in course content

This category includes the most responses and covers a wide variety of suggestions. Overall, students wanted to eliminate book work and journal writing, increase the hands-on work (more projects) and increase time in a given area according to specific interest such as electronics or working with wood. There was a


If I could change the tech ed course, I would ...
Inapplicable answers
Teacher/Student ratio
Students' choice
Other
More time
No answer
Add computers / computer skills
Changes in couse structure
Facilities / equipment
Wouldn't change
Change in course content
Males
Females
0
5
10
15
20
25
30
Percentage of students

difference between male and female answers in that the males would be inclined to work with mechanics and the females did not mention this area at all. Several female students (10) agreed with the student who said,

> "do more projects and have this subject more longer [sic] in the year."

Five students expressed a desire to lengthen the time spent on a specific part of the program that they found particularly interesting. One student suggested we might,

> "ask some professionals to come to my classroom."

This student did not indicate the advantage of that professional being female though the GIST study made a point of doing just that. Other suggestions include:

> "have poster of designs we are assigned to make or want to make."

> "make it a more hands-on class, like knowing how to fix a VCR, radio, or stero [sic]. Like taking them apart and putting it [sic] back together. That's more fun than sitting in class all day taking notes."

and a multifaceted suggestion that we

> "reinforce the ideals of kids teaching kids and of drafting & hands on work as equally important (and all around education of technology-past/present/future should be a small 'side-course' within courses - but not the focus)."

Wouldn't change

Figure 10 indicates that 20.5% (24) of the female students would not change the course. If we were to interpret the "no answer" category as a vote for no change, this figure would jump to 33% (39). It appears that many of our students are happy with the programs they are being offered. As a matter of fact, a closer look at Figure 10 reveals that the female students are happier than their male counterparts. This is verification that the programs studied are encouraging a change in clientele to include the female students. Students expressed themselves in the following ways:

If I could change the tech ed course, I would "not know what I would change. I like this course the way it is. Our teacher has made it a fun course but he is also teaching us at the same time."

"No, there's really nothing I would like changed, except working with different people. Whether [sic] smart or dumb."

If I could change the tech ed course, I would "not because it is fun to work with machines and computers."

If I could change the tech ed course I would "do nothing because we have the best technology school in B.C."

If I could change the tech ed course I would "not. I like it the way it is. Probably because of the teacher and the way he works with us. He is fair to everyone and he is a friend to us. He makes the course fun even though there are some boring parts."

"If I could change the tech ed course I wouldn't because I think its [sic] great as it is. I have gained lot's [sic] due to it."

"I don't think I would change anything about this course because once you get into a higher grade you are learning a whole bunch of new stuff and your [sic] doing neat things on the computer."

Add computers and computer skills

This category could have been included in the topic of changes in facilities and equipment but it was significantly large enough and specific enough to let stand on its own. Given our society's use of computers, it is not surprising that students who do not presently have the opportunity to work with them would request to do so. As many as seven students from one school responded with the idea that their change to the tech ed course would:

"make it so that we could work and design on computers." or

"Also our Tech Ed course needs to encorporate [sic]some computer designing into it. The computer and design skills would be very helpful in tec-ed [sic] and in the future."

In another school three students mentioned getting computers with one of them going so far as to say,

> If I could change the tech ed course, I would " make more computer skills, animation skills. [sic] more visual stuff, a more broader [sic] outlook on this field."

Areas of interest in closed questions not yet addressed

There are four areas of interest that were included on the closed questions and deserve attention but have not been discussed as part of the open-ended responses. Three of the areas, design, problem solving and social awareness are considered core concepts in technology education and as such need to be addressed. The fourth, skills, deals with the value of the "hands-on" component (a hallmark of industrial education/technology education), its transferability and the broader range of skills included in technology education (communication and self evaluation).

Design

Design was certainly acknowledged in the open ended questions but it did not emerge as most important for very many students, a reason for taking the course again or something students would add to the course. This does not mean students were not interested in design or did not understand its merit. A glance at Figure 2 shows that female students were sixty percent positive about design as a whole, and study of Figure 11 tells us that 86.9% of the females gave positive answers to question 40: "It is important for me to know how to design and make things". In response to question 4: "I like being able to design the project I am supposed to make", 76% of the female students gave a positive answer. Fewer females like to draw out their ideas (question 6) (I have found in my experience that they would rather use trial and error with the materials), and some apparently have not done prototyping (question 22) as the number of "I don't know" responses is at 35%. The

Figure 11.

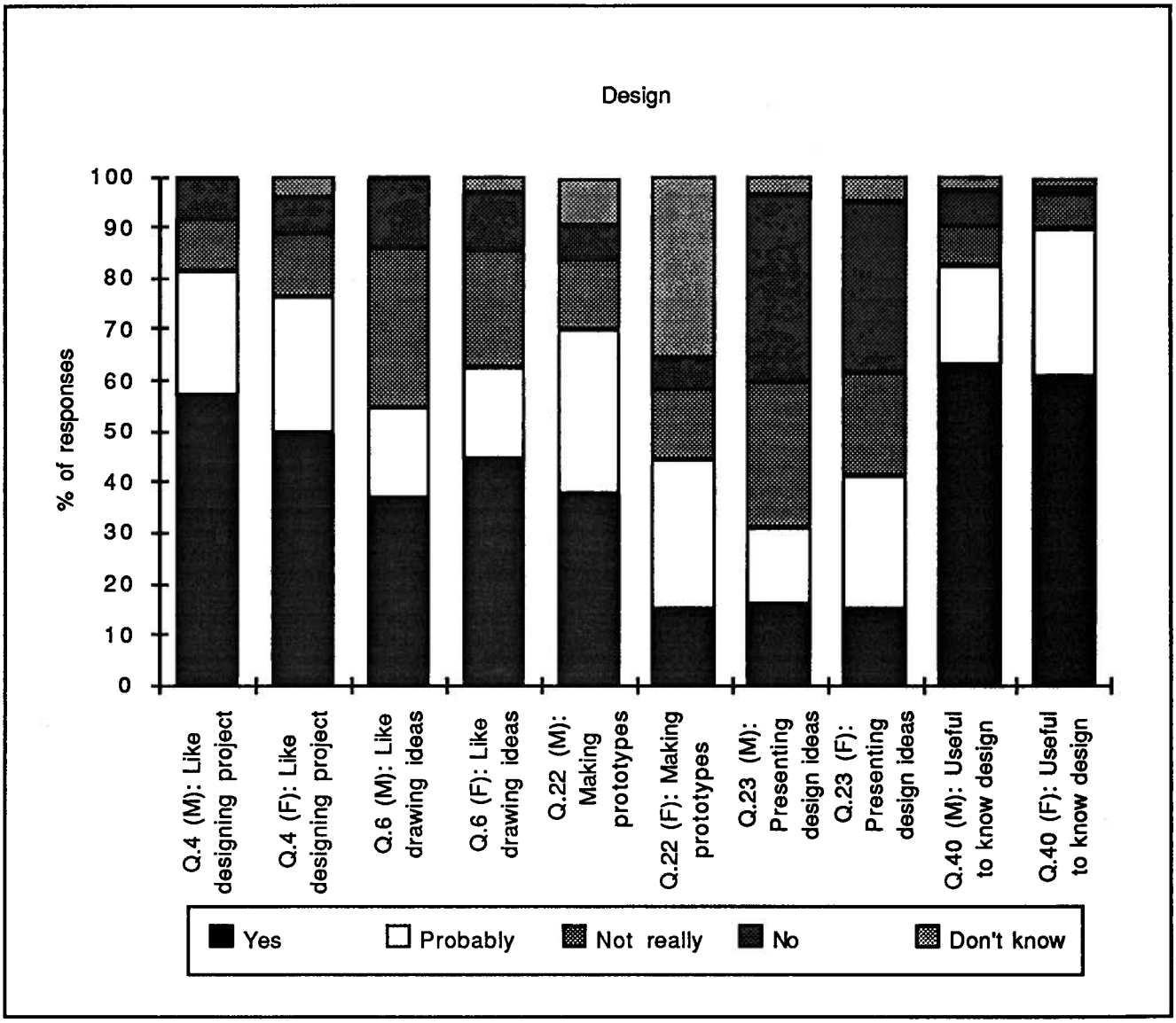


Figure 11. Responses to individual closed questions in the Design category.

one thing students didn't like about the design process was presenting their ideas to the class (question 23). Sixty five percent of the male students and fifty-four percent of the female students gave negative responses to this question.

Problem solving

Problem solving as a method of delivering technology education is suggested to be the "keystone" of the program in British Columbia (Fraser et. al, 1992). Use of problem solving in the program is one of the criteria by which a course was considered to be teaching technology education. Yet very few (8 female and 8 male) students mentioned it as most important. In attempting to understand why this was so, I realized that the questions in the closed list dealing with problem solving attempted to place it in the context of a hands-on setting. Question 14 reads: "I enjoy solving problems that require using my hands", and question 32 says: "Solving problems by making things is exciting". Although the answers are positive for the most part (Figure 12), it is possible that students were responding to the making rather than the problem solving portion of the question. Consequently it is difficult to know if students recognize the value of problem solving or think it is an interesting way to approach the course.

Social effects of technology

Recognizing the social effect of technology is another core concept of the revised BC curriculum. However, it is one that did not get mentioned very often (8 female responses and 4 male responses) on the open ended questions. More female students (32% "Yes" and 30% "Probably" on Figure 2) seem to realize the significance of the social effects of technology than those that don't, but that leaves 38% who don't think there is a problem or else don't know the effects of technology on society. Given the position stated in the literature that females are more likely to be sensitive to these issues, it is interesting that these percentages are the very same for the male students (Figure 2a). Some differences show up when looking at the individual questions (Figure 13) but the differences are small. It is notable that only

Figure 12.

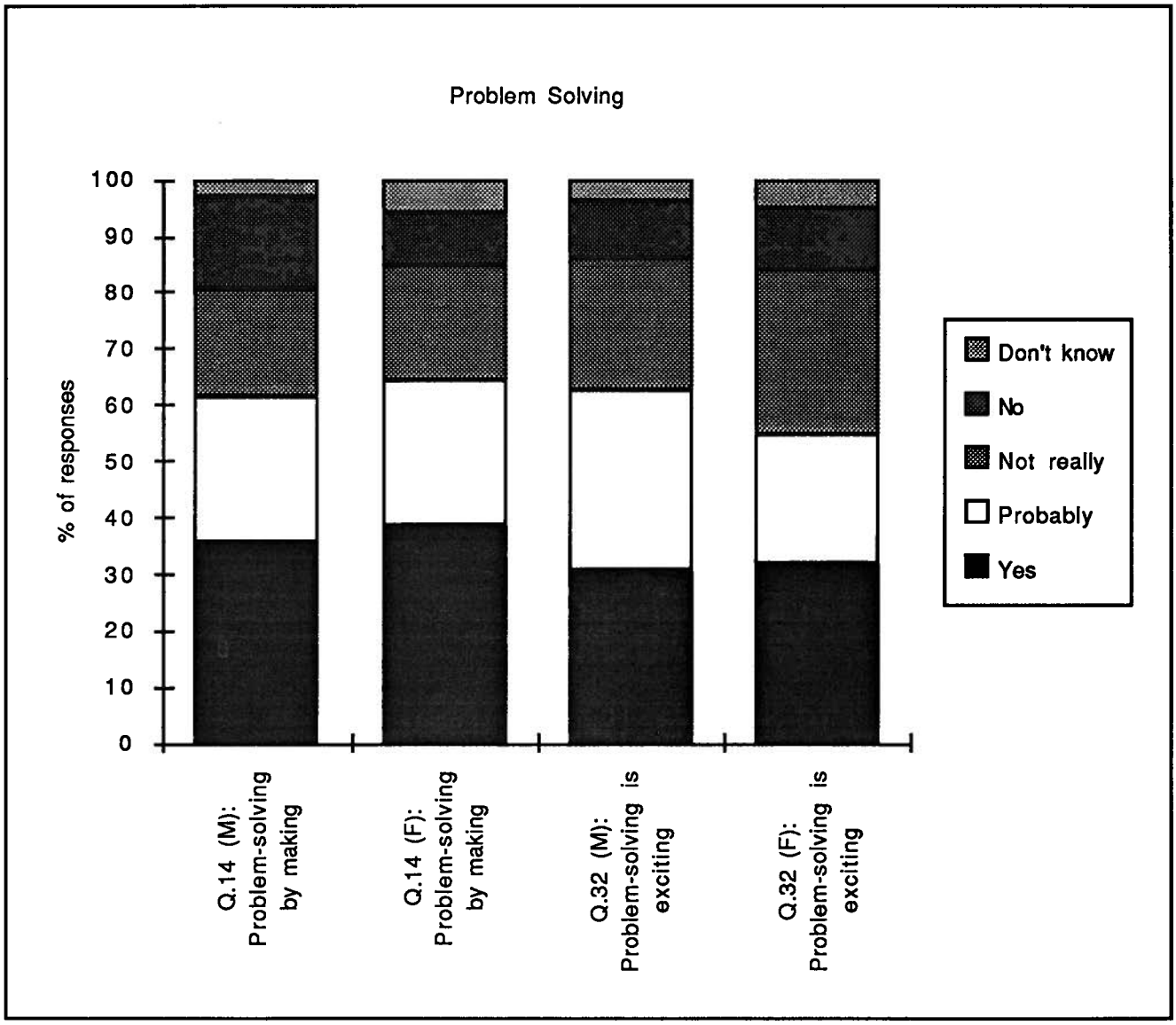


Figure 12. Responses to individual closed questions in the Problem Solving category.

about 38% of the female students answered positively to question 33, "Studying the history of technology helps me understand the ways technology influences my life". The male percentage is higher (about 50%) but this information causes me to wonder how well our programs are addressing social issues. It also causes me to wonder how well our programs are making connections between the classroom and the daily lives of the students.

Skills

The opportunity to integrate the broad range of skills that make up technology education programs (interpersonal skills, communication skills, problem solving skills and critical thinking skills along with hands-on skills) may be the most significant contribution the field has to offer students. Students, were more likely to focus on a single skill than the sense of integration but their answers indicate the variety of skills offered in the programs. Some students said the most important thing they had learned in the class was a specific skill,

"In this class I learned how to use the router."

"How to make a movie"

"How to use the video camera"

Other students chose to take the course again so they could increase their skill level. This awareness is reflected in the following answers:

"Yes, so that I will continue to use my skills for as long as I can. The longer I take tech ed the longer I will remember."

"Yes, I do plan to take this next year because I enjoy drawing things and it improves the way I draw and will help me in my further schooling."

Comments on skill, in connection to making things were made earlier but that dealt with only one of the questions in this category. A look at the usefulness

Figure 13.

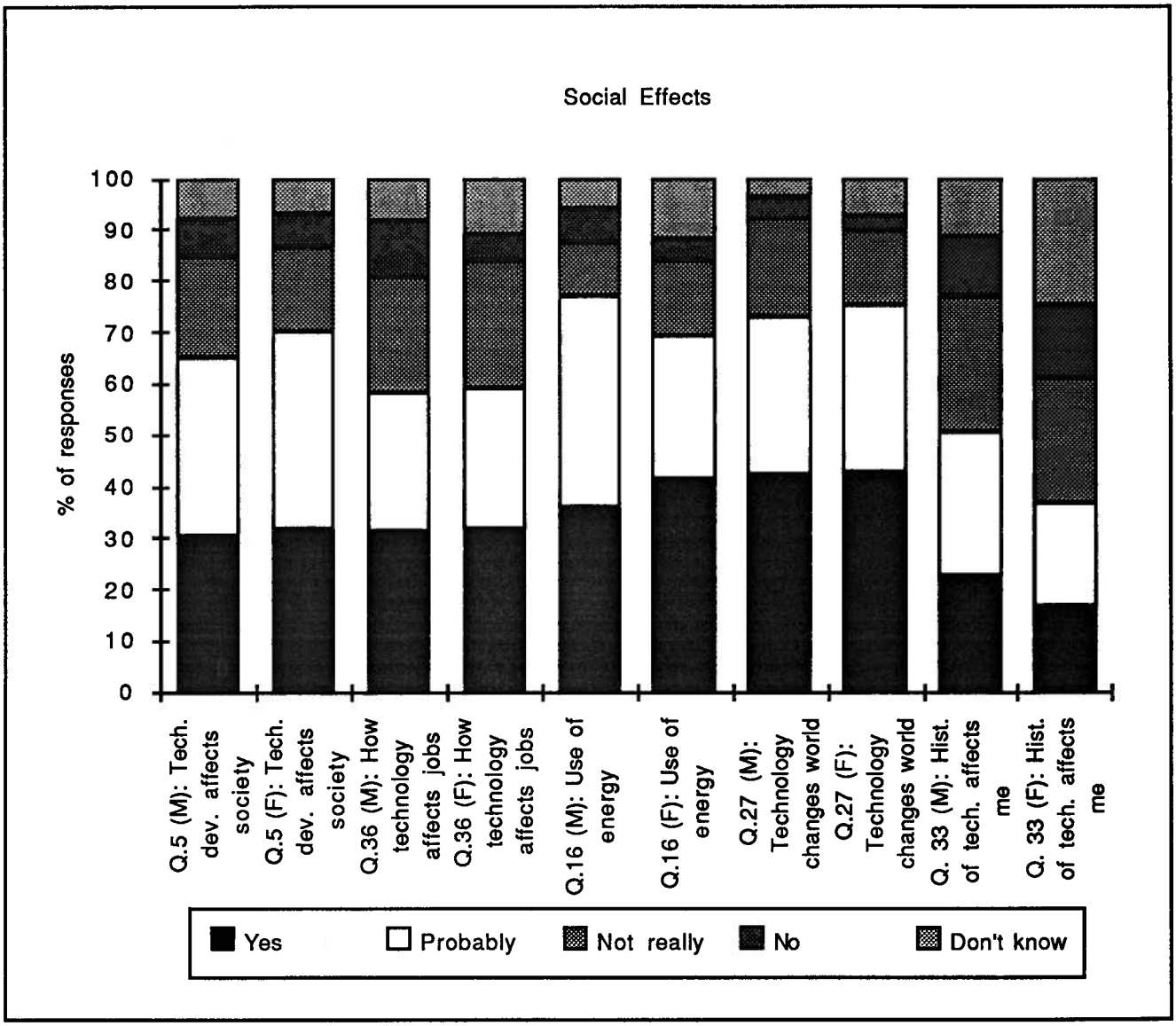


Figure 13. Responses to individual closed questions in the Social Effects category.

and transferability of the skills learned in the program (about 75% positive response for each). Some variations occur when one looks at the individual questions but these are as great or greater between questions than they are between sexes (Figure 14). Neither sex thinks the concepts and skills learned in tech ed will provide alternatives for hobbies (question 28) but females are even less convinced (36% "Yes" and 36% "Probably"). On the other hand, the strongest positive response on the Figure is from females who affirm use of skills to make things just for fun (72%)! They seem to have missed a connection there somehow. More of the females (81% positive response) than males (75% positive) think the skills learned in tech ed are useful to all students (question 7). This question was intentionally not put in terms of gender so it is hoped the students answered it in relation to all types of students, i.e. academic, challenged or ethnic. For the most part, female students felt they were gaining technical skills that could be used in other parts of their life (79% positive on question 25), but in two schools, not one female student answered "Yes" to this question while in one other, eighty-six percent of the female students answered "Yes". Perhaps this is a bit of evidence of the variation among the participating programs in terms of the skills they taught as well as the interpretation female students gave their usefulness.

Figure 14.

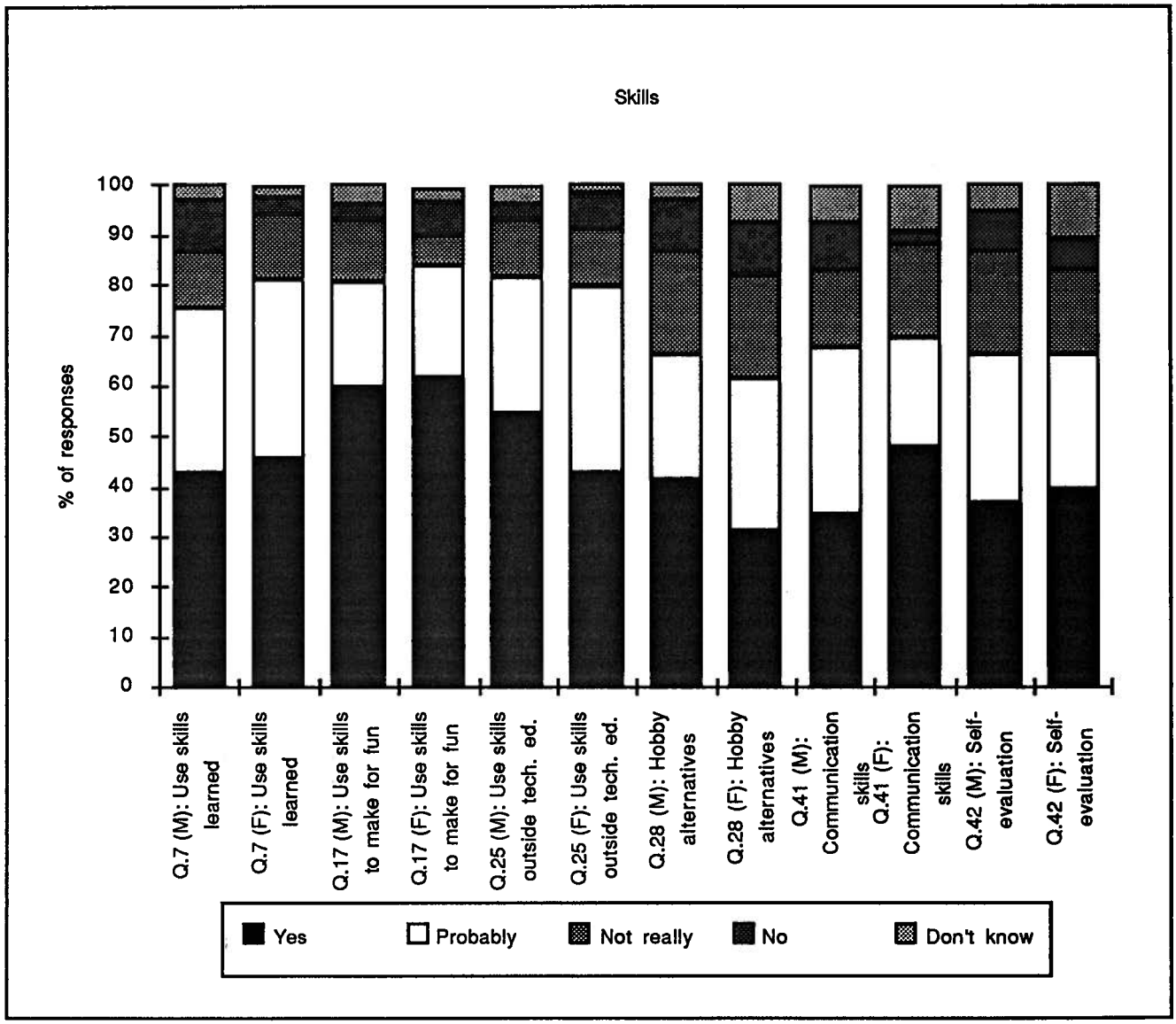


Figure 14. Responses to individual closed questions in the Skills category.

Chapter Five
Discussion

The purpose of this study has been to discern the thinking and orientations of female students in technology education programs in British Columbia, as well as to learn from those students which aspects of the course content are interesting and relevant to them. The specific research question has been: What aspects of technology education courses in British Columbia do female students perceive to be important, attractive and interesting?

This discussion will focus on the results that have just been described and, whenever applicable, link the findings to the literature which provides the backdrop for this study.

Areas of importance to female students

Machinery and equipment (including computers)

Given the assumptions that exist in our society about gender expectations, one would not have predicted that female students would have indicated use of machines and equipment to be the most important thing they learned in technology education. This finding could indicate various things. One would be that female students have learned to understand the significance of the use of machines in the classes and in our society and appreciate the opportunity to gain the ability to operate them. Two students seemed to understand the value of being able to make things for themselves when they said:

> "Yes, I plan to take tec [sic] ed next year because I need to complete my furniture set. Tec [sic] ed saves money and I need and want to learn how to use the rest of the equipment so that I will be able to do simple chores around the house or make more complicated things for the house."

> "I've learned how to use stuff, like machines, tools ect. . . [sic] I also learned how I can make things 3 times better & cheaper than what I buy in the stores."

One student said the most important thing she learned in class was:

> " How to work with a computer because it's imporant [sic] thing to know when I get a job".

A student from a different school stated:

> " I've learned how valuable it is to know computer skills."

A fifth student expressed a small sense of wonder at her accomplishment.

> "I have never used the machines before or knew [sic] how people have been able to design wood like they have. I never thought that I could make something out of wood and actually have it turn out."

Students in the original conversation interview stated that learning how to use machines gave them a sense of confidence and accomplishment. One student in this study reiterated this stance when she wrote:

> "The most important thing would be safty [sic] and confidence. When you know how to be safe on a machine and you know how to work a machine you get more confidence in yourself."

Another student in the same class wrote:

> "I have learned that using machinery is not very difficult. . . Before, I believed that woodworking was just a "man's" [sic] job - but now I realize that it takes more than braun [sic] to operate machinery - it takes a great deal of forethought and brain power."

This student seems to have entered this class with a mind-set of what she could do with machines and discovered that mind-set to be wrong.

I have often heard the statement from colleagues - "The reason girls are not in the technology labs is because they are intimidated by large, noisy equipment." It is important here to repeat the finding that this was not so for 74% of the females in this study. I would venture to say that when females are taught proper and safe use of any equipment, they are given the emotional as well as physical tools to function successfully with them. Catton's (1982) position applies here. He says that the way subject matter is taught is more important than the content itself. If we recognize that female students are not likely to have had previous experience with machines

and equipment (even in play), our approach to teaching the use of machinery and equipment should take this into account. This does not mean girls are afraid or even reluctant around machinery, it just means they are unfamiliar and lack confidence when entering the classroom. They need time and space without the pressure of competition for the equipment to gain the confidence they speak of in their responses.

Making things

It seems reasonable that making things would be listed as important if using machinery and equipment is important. It has not been explicitly stated but it can be fairly assumed that students used the machinery to produce the things that are made. The importance of making things seems to be connected to a sense of accomplishment. One student said:

"That I can make things by myself with only the guidance of a teacher a little."

Another declared:

"That I can make things that are useful to me."

While a third female student gave the unusual (1 out of 117 students) response of :

> "Probably, because in grade 11 technology you get to make go-carts which I think would be really interesting learning how to create the engine and the body. I think it could help me understand my car better."

This sense of success and accomplishment in the tech lab is important to these girls. Choosing items to make that are meaningful to the female students can only serve to strengthen the significance of the activity (see Appendix A).

Safety

As was mentioned in the previous chapter, the relatively low number of responses that claimed safety to be the most important thing learned in class was a bit surprising. My experience in the trades taught me that female trades people were considerably more safety conscious that male trades people. One further

observation that might explain this finding is that female students view safety as so much a part of the use of machinery and equipment even without stating so directly, that they didn't think of it as a separate factor. Most (9 out of 14) of the responses linked safety with machines or tools - "How to work safley [sic] with the machines and materials"; "safety of the machines"; "how to use machines safely"; "use equipment safely" and "safety with power tools".

Use of machines and equipment, making things and safety are all reminiscent of traditional industrial education. Since the programs selected for this study were those with a different philosophy and approach from traditional programs, the question comes to mind - "Why did these topics emerge at the top of the list?". Perhaps the answer is that students are tied to their concept of what technology education is supposed to give them and don't recognize the importance of critical thinking, group work, problem solving by making and other factors that constitute the present day method of delivery. Perhaps the answer is that technology education classes are the only places where making things with machines occurs. Perhaps the answer is that making things with machines is what IS important to 13 to 17 year old female students in technology education classes and the approach taken by the teachers in these classes is the element that made them female inclusive. Surely gaining a sense of confidence and accomplishment is an important lesson for anyone to learn. Perhaps learning that lesson through making things with machines is especially important to females. If these topics are understood to be the concepts and contexts girls associate with technology, the next question becomes "What do female students *need* to know in order to fully function in our society?" This is the question de Klerk Wolters (1989) raised in his review of the PATT research. This is the question that must be answered in order to develop meaningful programs for our female students. In developing these programs, the findings of this study would indicate that making things with machines is meaningful to female students and should not be left out of the formula.

Attractiveness of technology to females

Yes, because its fun

Females in this study choose to take technology again because it is fun! This is a very complimentary statement, especially when the numbers of both male and female students are considered (see Figure 7). It is quite rewarding to have students say that they want to take a course because they had fun learning. However, student responses didn't indicate *what* makes a course enjoyable. Nor did they give us any information about the ultimate usefulness of the things students were learning. It is wonderful to provide students with opportunities to have fun learning. It is necessary to provide students with opportunities to have fun learning what they need to know to survive in our technological world. Since the relationship between technology and society is part of the directive from the provincial Technology Education Curriculum/Assessment Framework, this is an area that merits further research.

Yes, because of general interest

Although students appear to be attracted to technology education because they are generally interested in the area, many of them like those in the Raat (1985) study seem to have less ability to recognize technology in their daily lives. (Note the answers to Q 31 on Figure 8.) It may be that teachers need to make more connections between classroom experiences and the "real world" of the students. It may be that more time needs to be spent helping students realize the historical and contemporary effects of technological development on their lives. Two students actually suggested such activity as changes they would make to the course.

"talk more about the actual study of technology and how it effects [sic] people"

"bring in more technology relative to our real life."

Rothschild (1989) and Franklin (1984) seem to think females have a special contribution to make to a discussion of the effects of technology on our lives. Brant

and Roelofs (1989), Catton (1986) and Grant (1986) suggest that females are attracted to technology as it relates to society. This, too, seems to be a worthwhile question for further research.

Yes, career

The apparent lack of awareness of the significance of technology to a career and the attractiveness of technology as a career is almost alarming considering the increasing number of jobs that require technical knowledge and skill (Thompson, et. al., 1993). Female students do not seem to make a connection between what they are learning in the tech ed classroom and the world of work (see answers to Q 21, Figure 9). Many seem to understand that they need to be able to use a computer as a tool (See Figure 2 and Figure 4 for items involving computers) but the impact of technology on the world of work seems to escape them (see answers to Q 36, Figure 8). Many authors (Cowen, 1979; Farmer, H. S., et al., 1985; Gaskell, J., 1984; Gaskell, P. J., et al., 1990; Thompson, et al., 1993) express concern over the discrepancies between males and females in the job market. Part of the motivation behind the GIST (Whyte, J., 1986a) project in the United Kingdom was to help female students make the connection between subject choice and future employment. Perhaps female students do not see themselves in the technological portion of the work force as was indicated in the J. Gaskell (1984) study. Perhaps female students don't realize how many jobs require a foundation in math, science and technology. Perhaps the socialization process is at work here. In any case, this finding is cause for concern over the career related content of our courses.

Maybe/Don't know

Ten percent of the female responses were "maybe" with a positive tone to the remainder of the answer. Several girls also answered "probably not, I'd like to, but I don't have enough electives for all my choices" or a similar answer. The latter students were counted as part of the "No, course selection" group. However, if the "no, but I'd like to" students are put with the "maybe" students, the two groups

together represent about 13% of the students surveyed. Since I believe that in North American society all female students need a background in technology as strong as the one they get in English or Social Studies, I advocate encouraging all of these students to take technology. A little more time spent on the significance of technology and technological development in and to our lives might serve to attract these girls to technology education and convey its value to them. Including course content that connects to life beyond the classroom in areas with which females identify (Grant, M., & Harding, J., 1987) might also encourage these female students to stay in the program.

No, because of course selection or lack of interest, etc.

With only thirty-nine percent of the female responses on the "No" side of the ledger in terms of course choice, it appears that females in this study are definitely ahead of the female participants in the studies reviewed in Chapter 2. It also appears that the technology education programs selected for this research are doing a good job of appealing to and meeting the needs of the female students they serve. Review of the program questionnaires supplied by the teachers for each participating school indicates that for the most part, these programs do attract female students. In six of the schools, one-third of the class is female; in five of the schools, around fifty percent are females and in two of the schools, less than one percent of the class is female. (One of the 'less than one percent' schools had a class first semester that had fifty-percent females but the enrollment dropped second term when the survey was able to be administered because, as the teacher put it, "of the boys that were signed up for the course"! The other 'less than one percent' school has a strong, high profile program but it does not appear to be geared to the girls.) A couple of the other teachers also indicated that their female enrollment was down this year for some reason. Obviously, such things fluctuate.

Changes to the course which indicate specific interests

Changes to course content

There are numerous suggestions offered on how the content of the course could be changed, but most of them are simple changes except for those that suggest that students be allowed to make more projects (12 out of 27 responses). The idea that female students are interested in hands-on activity and making things is quite clear throughout this study, both in open ended and closed questions. Five students reflected the position taken by Grant and Harding (1987) that girls respond to technology that is connected to usefulness and the society at large, yet more that 80% verify a female interest in knowing about technology that effects them. (Questions 1 "I like knowing about the various kinds of technology that I use every day"; and question 9 " Technology is all around us so we should learn about it and understand how it affects us", both found on Figure 8.)

In an effort to confirm the areas of interest indicated on the closed questions, I looked at all of the answers that were seventy percent or more positive ("yes" and "probably" together). This revealed female interest in knowing about technology that affects them and in using equipment and skills to design and make things with different kinds of materials.

Wouldn't change

One last piece of evidence of student interest can be found in the strong vote for the status quo which seems to be an indication that female students are getting what they want out of the courses they are taking. The numbers of students who are choosing to take technology education again also tends to support this position.

My overall conclusion is that the programs that were chosen for this study have attracted the female students, made them feel successful and encouraged them to continue taking technology education. The students themselves have indicated that learning to use machinery to make things out of different kinds of materials is

important, attractive, enjoyable and interesting to them. Knowing about technology as it relates to their lives is likewise important, but they tend to see this in tangible, hands-on 'making things' terms.

Implications for the teacher

As I have suggested in the literature review and on a couple of occasions throughout this paper, the teacher is the key to the success of making technology education attractive and interesting to female students. The core components of technology education such as design, problem solving, social awareness and student centered activities were present in all of the programs studied. However the teacher's selection of activities and ability to have students "enjoy [them] very much , . . [learn] a lot and . . have fun at the same time" is what makes a program work. I have offered some suggestions in the literature review that may assist teachers in discerning how to help female students enjoy the courses. This study has indicated that the content of technology education should include using machines to make things if you wish to interest female students and attract them to the class.

Need for further research

This study has made an attempt to discern interests that B. C. female students have in technology. It has also been designed to discern the attitudes and concepts which these students hold as they enter the classes. Since this seems to be the only study in North America that I could find that deals with females in technology since 1989 (Bame and Dugger), and since our relationship to technology is ever changing, it is strongly suggested that further research be carried out. This study included only 13 selected schools out of approximately 1100 tech ed/industrial ed programs in the province. Given the need for female students to have education in technology as expressed at the beginning of the literature review, one major area of study would be to discover what is happening for the female students in other programs.

I have not dealt with the factors in the environment nor the actions and attitudes of teachers that have made the participating programs successful. This would be a most valuable study. Some questions that may be appropriate to ask would include those regarding teacher contribution:

What components of your teaching do you believe encourage the girls to feel they "belong" in your class?

What do you expect the girls to contribute to your classroom?

How do you encourage success for the female students?

What do you believe to be the factors of socialization that girls bring to class?

regarding environment:

Does the physical environment encourage female students to feel it is a pleasant place to be?

What kind of posters and displays cover the walls?

What about cleanliness?, smell?, light?

Is the social environment inclusive?

How inclusive is the language - of students and of the teacher?

Is access to machines, equipment and materials truly equal?

What is the level of male "pushiness" in the activities?

How is assertiveness rather than aggression encouraged?

regarding content:

How much of the content can females relate to their own experience? or envision using in their lives outside of school?

Further research is also needed to gain insight into female student preference with regard to the type of project made or whether the context for which the project is made makes a difference. Neither of these issues has been addressed in this study.

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Appendix A

1 Women and Industrial Arts

A list of suggestions to encourage young women to enroll in technology education taken from:

Oregon State Department of Education. (1984). High school industrial arts. A guide for teachers. Salem, Oregon: Author. (page 14).

2 A list of technological interests of boys and girls

taken from:

Brand, M. & Roelofs, L. (1989). Guidelines to make technology attractive to girls: Experiences of the MENT project. In de Klerk Wolters, F., Mottier, I., Raat, J., deVries, M. (Eds.), Teacher education for school technology: Report PATT - 4 conference. (pp. 343-353). Eindhoven, the Netherlands: Pedagogical Technological College. (page 350).

1

A number of strategies can be used to encourage young women to enroll in industrial arts [technology education] classes.

- Do not use sexist language, inferences, expressions or jokes.

- Review course titles, course descriptions and recruitment materials to ensure they clearly state that classes are open to both sexes and will benefit both. Use language that is not specific to either sex.

- Review guidance materials used by counselors to be sure that neither girls nor boys are stereotyped.

- Eliminate policies, requirements and situations that would discourage or hinder females from enrolling in classes.

- Display photographs, posters, wall hangings, and projects in show cases that show both sexes involved in class work.

- Point out to students the sexism implicit in most of the existing teaching materials and books for industrial arts [technology education]. Discuss how sex biases are encouraged by textbooks that only show boys operating machines or participating in industrial arts [technology education] classes.

- Prepare a brochure or a one-page flyer describing why your subject might be attractive and beneficial to young women. Distribute them through the counselor's office, library and homerooms.

- Invite present female students in industrial arts/technology classes as role models in recruitment activities.

- Send an informational letter to parents of potential female students pointing out the short and long-range benefits of industrial arts [technology] education.

- Present information about benefits of industrial arts [technology education] classes at open-house programs and PTA meetings.

Adapted from AIAA Affirmative Action publication, *Providing Technology Education for all Students.* 1983

2

Boys and girls are both interested in technical aspects of daily life: telephone, camera, record player and in spectacular and natural phenomena such as earth quakes, volcanoes, fossils and crystals. Also the consequences of a nuclear disaster, pollution and automation are interesting to both.

What girls do not like is electricity (the way it is taught at school now), energy, electronics, engines, space travel and nuclear weapons. They are interested in road safety, x-rays, questions on health care and everything related to food. These are mainly subjects that are related to society, the human body, safety and medical technical applications.

Boys are particularly interested in engines, and vehicles, space travel, nuclear energy, weapons and electricity. On the other hand they are not so much interested in subjects that are related to caring for people, health and food.

For the subject technology education, it is important that subjects are chosen form [sic] the aforementioned three groups that are not discouraging for anyone in particular and that give all pupils the same opportunity to develop a positive attitude towards technology. (Page 350-351)

Appendix B

Submission to
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Update on (Defining and) Teaching Technology Education
including a request

Judy Doll

This technology education business is certainly an on-going process! Every year I gain a bit more confidence, get a little better understanding and try to put all the pieces together so they make good sense and a good program for my students. I am happy to say that the definition of technology that I settled on two years ago still holds up. I said then that "It is historical, starting at the point when human beings began to think of how to extend one's natural abilities to provide food, shelter or clothing. It is a process of building on knowledge of the past to increase human ability to meet needs and desires. But most of all it is a practical application of human intelligence." The challenge comes when putting this definition into practice in the classroom and adding a "social consequences" component.

This past year I have had the privilege of working at Moscrop Secondary School in Burnaby where my colleague and administration were all very supportive. It really does help to work in a supportive environment. I think I moved a small step forward in spite of having to prove myself as a "new kid on the block". I tried several of the ideas I picked up from Tony Wheeler in my class at UBC last summer. Some of these have been circulating for a while, I just got around to using them after this class. These experiences included; developing activities within a theme, student evaluation of many of the steps in the process of designing and making a project, and putting activities in a variety of contexts (school, home, business, finance, industry, etc.). I also tried to get the idea across that technology is best if it truly meets a human need. Many of my students had trouble with this idea as they were used to doing assigned projects and not having to decide where or how or by whom that project might be used.

As a result of this classroom experience and this summer's courses at UBC, I have decided I need to know how the students themselves are reacting and relating to the approaches we are taking in technology education. I have thought of

different ways I could find out what I want to know and decided that the best way is to take a survey of students enrolled in technology education classes. I want to find out what aspects of the course are interesting, meaningful, and useful to the students. I also want to be able to answer the often asked question of "How do I get girls into my classroom?" I will use the information to meet my UBC course requirements but mostly I hope to get information that can give direction to the programs we are developing and labeling "technology education".

One of the first requirements in taking on this project is to find teachers who are willing to participate. I have a few volunteers who have been in classes with me at UBC but I would like to survey 10-12 schools that reflect a broad representation from throughout the province. One of the basic reasons for this article is to let tech educators know what I am doing and invite anyone who is interested in participating to contact me. I would like to survey, by questionnaire, students who are in any program that emphasizes the teacher as a facilitator, focuses on the students, uses problem solving as the key approach to delivering content in a "making and doing" context and deals with the social consequences of technological development (whether you label yourself technology education or not). Having about a third of the class female would also be significant. I hope to conduct the survey the first week of January which means I need to ask permission from your school districts no later than the middle of November and I need an indication of teacher interest as soon as possible but no later than the first week in November.

I can be contacted by letter at Moscrop Secondary School, 4433 Moscrop, Burnaby, B.C. V5G 2G3, by local phone at 664-8575 or by fax (available from me personally) at the school.

Appendix C

1 Teacher participation letter (sent through principal of school) and Teacher/Program Questionnaire

2 Questionnaire administration instructions

3 Student questionnaire

1

November 12, 1993

Dear Principal,

I am working on a graduate degree at the University of British Columbia in the field of technology education. My name is Judy Doll and I am working under Dr. Ann Anderson in the Department of Mathematics and Science Education. The title of my proposed study is "What aspects of technology education do students perceive as relevant, interesting and attractive." Since this field is in a period of major transition, it is critical that we as educators become aware of the interests and values important to students. In an effort to gain this awareness, I am conducting a questionnaire survey of students in present technology education classrooms. I want to question all the students but I will be writing my major paper/thesis on female students' perceptions of the course. I have limited my data analysis to females because of my personal time limitations, my personal involvement in gender issues and my belief that the information I gather from focusing on females will enhance technology education courses.

I expect the survey to take one class period of time from the students during the second week of January, 1994. Identities of all participants will remain anonymous since no indication of identity will appear on the questionnaire. It is important to note that any student has the right to refuse to participate at any time and such refusal must not jeopardize their standing in the class. In the case of non-participants, I would need for an alternative activity to be provided that would not in any way minimize the importance or interfere with the completion of the questionnaire.

In order to gather information that will answer my concerns, I have secured approval from your district office to do research within your district. Now I seek your cooperation and am requesting that (name of teacher), as the teacher of technology education in your school, be approached to administer a survey questionnaire of the students in at least one of your technology education classes. I am also requesting that (he or she) fill out the accompanying questionnaire that describes the nature of the technology education program being taught. If you have any questions or need clarification on any part of this request I can be contacted by letter at Moscrop Secondary School, 4433 Moscrop, Burnaby, B. C. V5G 2G3, by phone at 664-8575 or by fax at (664-8581). Or Ann Anderson can be contacted at 822-5298.

Any information obtained in connection with this study that can be identified with your school will remain confidential.

I am truly grateful your consideration of my request and would like you to return of the attached consent form as soon as possible but no later than November 30, 1993.

Sincerely,

Judy Doll

COPY OF CONSENT FORM Please retain for your records

I,_____, agree/ do not agree (circle one) to participate in a questionnaire survey to discern the interests and attractiveness of the program for students enrolled in at least one technology education class.

_____

Signature Date

"What aspects of technology education do students perceive as relevant, interesting and attractive."

Teacher/Program Questionnaire

Name

School

Home phone (optional)

Name of your course(s)_____No. of students____No. of girls_____.

Nature of your technology education program:
(If additional space is needed, feel free to write on the backs of these pages or add pages of your own.)

How do you use a design component in the course?

_____

_____

_____

_____

_____

In what ways is your program student centered?

_____

_____

_____

How do you see yourself as a teacher facilitator?

In what ways are you able to include a social awareness component?

Teacher involvement in this project includes:

a) Agreement to participate - includes the amount of time it takes to fill out the questions regarding your program that are listed above and return of the signed form that accompanies this questionnaire.

b) Thirty minutes to one hour of time the first week of January to receive, review and organize administration of the questionnaire. (Parental permission MUST be signed for each student who participates.)

c) (? minutes) Time to prepare an alternative seat assignment for those students who do not participate. (Parents may not grant permission or students may forget to return the permission form.)

d) Thirty-five to fifty minutes (depending on nature of class) of class time one day during the first week of January to administer the questionnaires to participating students.

e) Return of the questionnaires by the end of the second week of January.

In appreciation of your participation in this study I expect to provide you with a copy of the finished project, trusting that it will be helpful in your on-going program development. I will also be reporting results of the research in The View in hopes that the information I find will be of help to all teachers in the field.

Please return this information, and the signed participation form to Judy Doll C/o Moscrop Secondary School, 4433 Moscrop, Burnaby, B.C. V5G 2G3 no later than November 30, 1993. I want to print the required number of questionnaires and parent "letters of permission to participate" before the Christmas break so I can have a chance to enjoy the holidays too. Thanks.

School
Teacher
address
in full

This is to acknowledge that I have received a copy of the consent form and all attachments for my own records.

Signature:_____Date:

I, _____(Teacher), agree/do not agree (circle one) to participate in a questionnaire survey to discern the interests and attractiveness of the program for students enrolled in a technology education class.

Signature

Date

2

Questionnaire administration instructions

1. Please look over the entire questionnaire to estimate the amount of time your specific class will need for everyone to answer all of the questions. A maximum of one class period should be used, 25 - 30 minutes seems to be adequate.

2. Please prepare an activity for those who are not participating (and those who finish early) that will maximize the honesty and usefulness of all answers given. Even though this is not a "test", the atmosphere and respect given to testing is requested for this endeavor.

3. Please give the parental permission letters to students two to three school days before you expect to administer the questionnaire and encourage your students to return them to you by the day before the questionnaire is administered. You should use your own discretion on the amount of time needed for students to return the letters. The ethics committee policy at UBC states that any student who has not returned a permission letter should not complete the questionnaire.
Please have your students fill in the name of your school on the parental forms along with the date the forms must be returned to you on both the letter and the return form.

4. Please help the students understand the value of their honest opinions in developing technology education programs that are of genuine use to them. As much as possible, please allow the students to interpret and answer the questions themselves.

5. It is important that the students read the entire page of instruction including the example for answering and that they be guided to give demographic data (age, grade and gender) ONLY (no names or other means of identity please) on the answer sheet. (Please see the sample answer sheet.) I also need for you to identify the open ended questions (second page of questionnaire) by gender so the answers will be of use to me. You can collect them separately, turn the corner of the page or mark them in some other way as long as you tell me how you have "coded" the female responses.

6. Please administer the questionnaires and then return (1) the second page only of the questionnaires, the scan form answer sheets and the signed portion only of the parental letters of permission to Judy Doll, c/o Moscrop Secondary School, 4433 Moscrop, Burnaby, B.C. V5G 2G3 by the end of the first week in May unless alternative arrangements have been made with Judy Doll or Dr. Anderson.

Enclosed you will find letters of permission for the parents, and enough questionnaires and bubble sheets for the number of students some of you indicated would be participating in the study. I am sending 30 copies to cover administration to at least one class to those schools that have 50 to 90 students in technology education. You may use the questionnaire in more than one class if you so choose. I am using a standard NCS answer form and the form needs to be the same for me to scan it for the information. It will also be necessary to make copies of both the letter and the questionnaire. Please feel free to make copies or call me to work out a way to get more copies of everything from me. I genuinely appreciate your participation and the investment of time and energy you are giving. Thank you.

3
Student Questionnaire

Participating students,

The title of this study is "What aspects of technology education do students perceive as relevant, interesting and attractive." It is being conducted by Judy Doll who is a graduate student at the University of British Columbia under the direction of Dr. Ann Anderson. If you have any questions or need clarification on any part of this exercise you can contact Judy Doll at Moscrop Secondary School in Burnaby, 664-8575 or Ann Anderson at UBC, 822-5298. The purpose of the study is to find out the aspects of the technology education program that YOU as students find interesting, valuable, meaningful and relevant to your lives. It is hoped that with this information, teachers who are developing curriculum for the classes will be able to truly meet the needs of students. You are simply expected to answer all of the following questions to the best of your ability. There are no "right" answers, but I do ask you to please be as honest as possible.
You have a right to refuse to participate or withdraw at any time without hurting your standing in the class. This activity should take 35 - 50 minutes to complete. You are expected to respect the participation of other class members by not disturbing them while they complete the questionnaire. If you complete this questionnaire, it will be assumed that your personal consent to participate has been given. Your participation is completely anonymous since there is no indication of identity on the questionnaire and there should not be any name on the answer sheet.

Student Questionnaire

Please respond to the following statements on the bubble sheet provided. Use only pencil so your answers can be read by the computer. Please respond according to the scale listed below based on your agreement with the statement. Your first response is probably the best, but we do want honest answers. Your teacher will tell you how much time you will have to complete the questionnaire. If you finish early, you will be given an assignment to be worked on until the end of the allowed time.

Scale: A - Yes B - Probably C - Not really D - No E - Don't know

EXAMPLE:

Q. Michael Jordan should get back in the game.

If you strongly agree you should fill in circle (A) on the mark sheet.

If you think its a good idea but aren't that enthusiastic, fill in circle (B) on the mark sheet.

If you think he has a right to quit playing basketball if he wants to, fill in circle (C) on the mark sheet.

If you are glad he has quit and hope he stays at home, fill in circle (D) on the mark sheet.

If you don't know who Michael Jordan is or don't care what he does, fill in circle (E) on the mark sheet.

Scale: A - Yes B - Probably C - Not really D - No E - Don't know

1. I like knowing about the various kinds of technology that I use every day.
2. I like putting simple machines together to see how they work.
3. I like learning how to use the equipment.
4. I like being able to design the project I am supposed to make.
5. It is important to discuss the affects of technological development on our society.
6. I like to draw out my ideas on paper before I make a project.
7. I think all students can use the skills we learn in this class.
8. I really enjoy working by myself.
9. Technology is all around us so we should learn about it and understand how it affects us.
10. Knowing how to use tools and equipment safely helps me feel confident in the tech ed shop.
11. Tech Ed has shown me how science and math concepts can be applied.
12. Knowing how to make things myself can save me money.
13. I prefer learning how to work with only one material such as plastic or wood rather than having lots of options.
14. I enjoy solving problems by making things with my hands.
15. I am frightened by large, noisy machines and/or equipment.
16. Learning about the use of energy can help me save money and maybe save the environment.
17. I can use skills I have learned in this class to make things just for fun.
18. I learn a lot from my classmates when we work in teams or groups.
19. Knowing how to properly set up and use equipment makes me feel good about myself.
20. Knowing how things are made helps me make better decisions about things I buy.
21. The concepts and skills I have learned in Tech Ed will help me decide what kind of work I would like to do when I finish school.
22. Making prototypes is fun and useful.
23. I like presenting my design ideas to the class.
24. It is important to know how to work safely in the tech ed lab.
25. I am gaining technical skills in this class that I can use in other parts of my life.

Scale: A - Yes B - Probably C - Not really D - No E - Don't know

26. Computer drafting is fun.
27. It is important to understand how technology changes the world.
28. The concepts and skills I have learned in tech ed provide me with alternatives for hobbies I enjoy.
29. The things I learn on the computer in this class help me in other areas of my life.
30. I am able to use concepts learned in tech ed to help me in my math and science classes.
31. Technology Education has helped me to understand the world around me.
32. Solving problems by making things is exciting.
33. Studying the history of technology helps me understand the ways technology influences my life.
34. I will be able to use what I have learned about machines for the rest of my life.
35. Working in groups teaches me how to get along with others.
36. It is important to talk about how technology affects people's jobs.
37. The things we are learning in Tech Ed will probably help me get a job.
38. The group skills taught in Tech Ed are important for me to know.
39. Learning to use the computer in the tech ed lab is important.
40. It is useful for me to know how to design and make things.
41. The communication skills I have learned are useful to me.
42. I have learned how to evaluate my work honestly in this class.
43. It makes me feel good to know how to identify and use tools.
44. I am able to fix things at home because of things I have learned about tools in this class.
45. I like learning how to work with lots of different materials.

Please answer the following three questions carefully. Give some thought to the best answer you can give so your information and opinions will help teachers who are choosing activities for technology education classes.

1. What is the most important thing you have learned in this class?

Why do you choose this answer?

2. Do you plan to take technology education next year? If so, why? If not, why not?

3. If I could change the tech ed course, I would

Appendix D

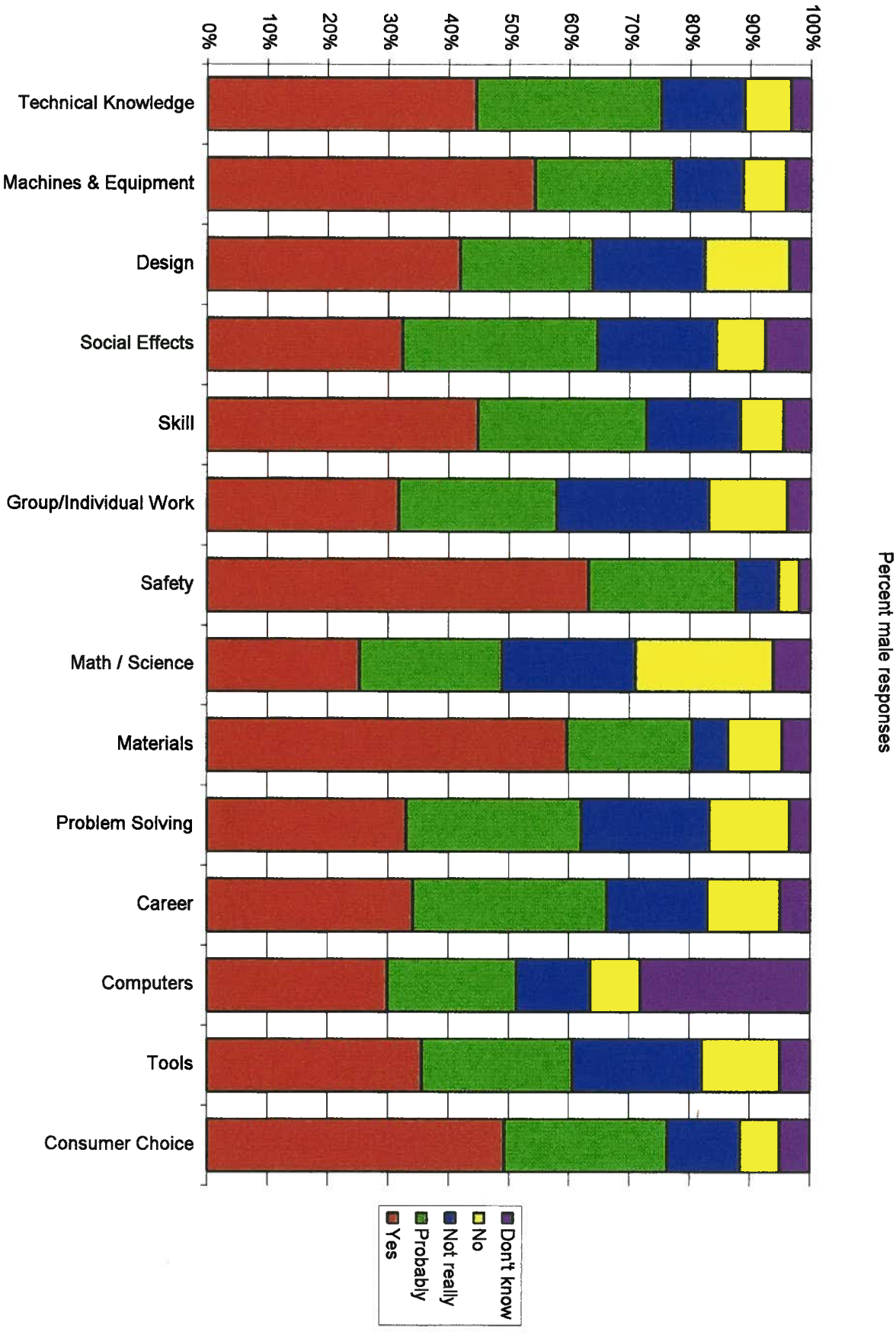
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Technical Knowledge
Machines & Equipment
Design
Social Effects
Skill
Group/Individual Work
Safety
Math / Science
Materials
Problem Solving
Career
Computers
Tools
Consumer Choice
Yes
Probably
Not really
No
Don't know
Percent male responses

Figure D1.

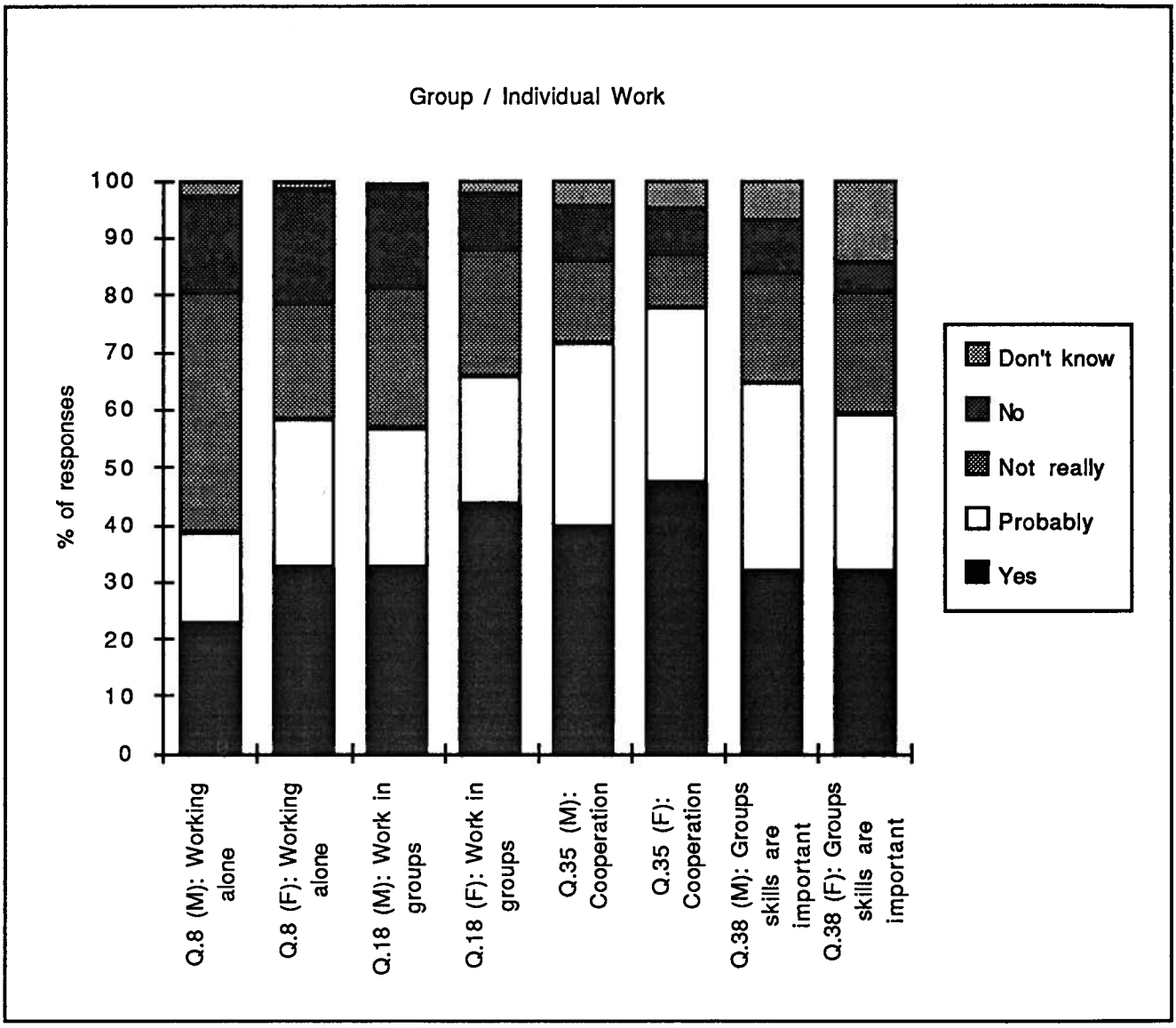

Figure D1. Responses to individual closed questions in the Group / Individual Work category.

Figure D2.

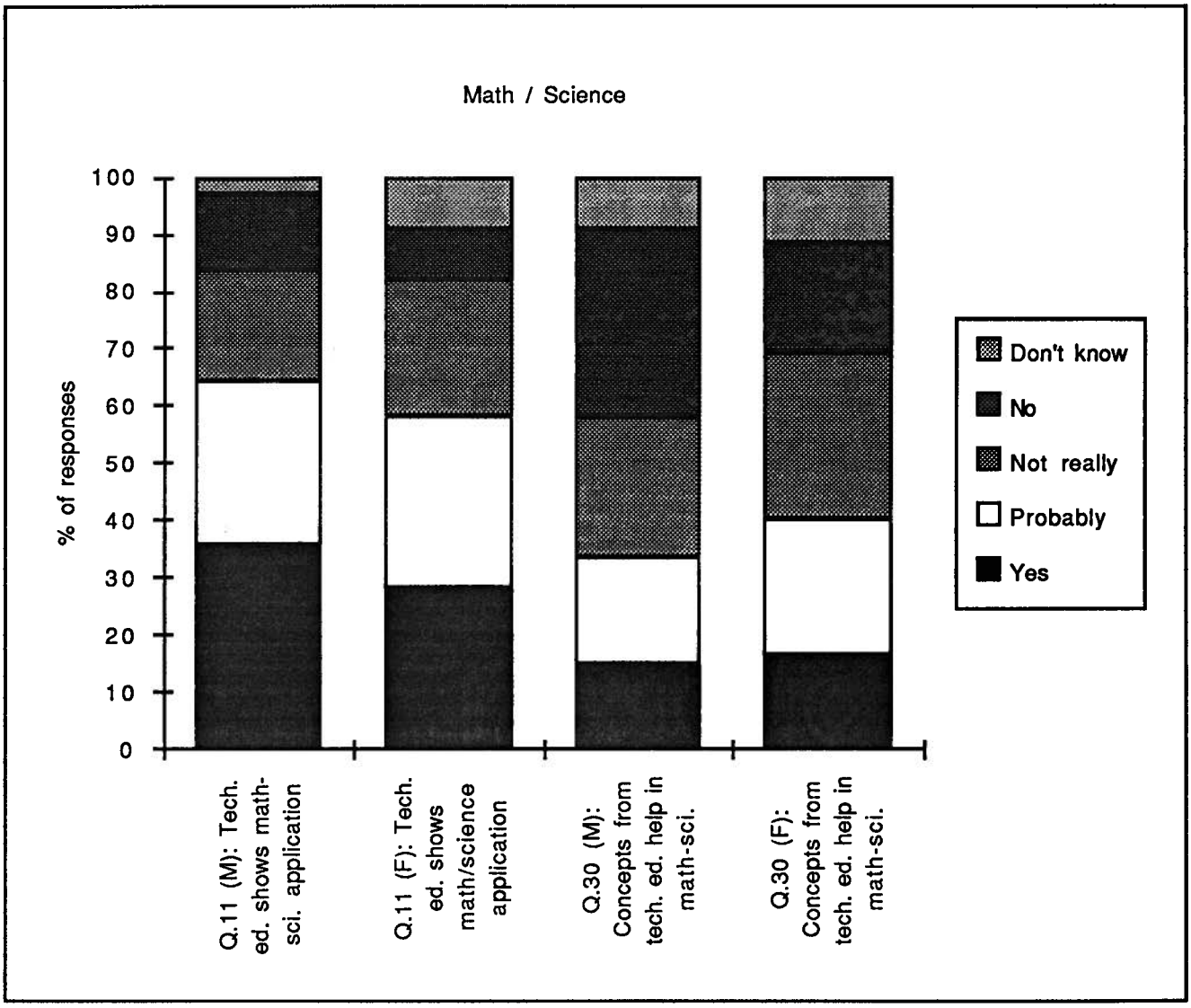

Figure D2. Responses to individual closed questions in the Math / Science category.

Figure D3.

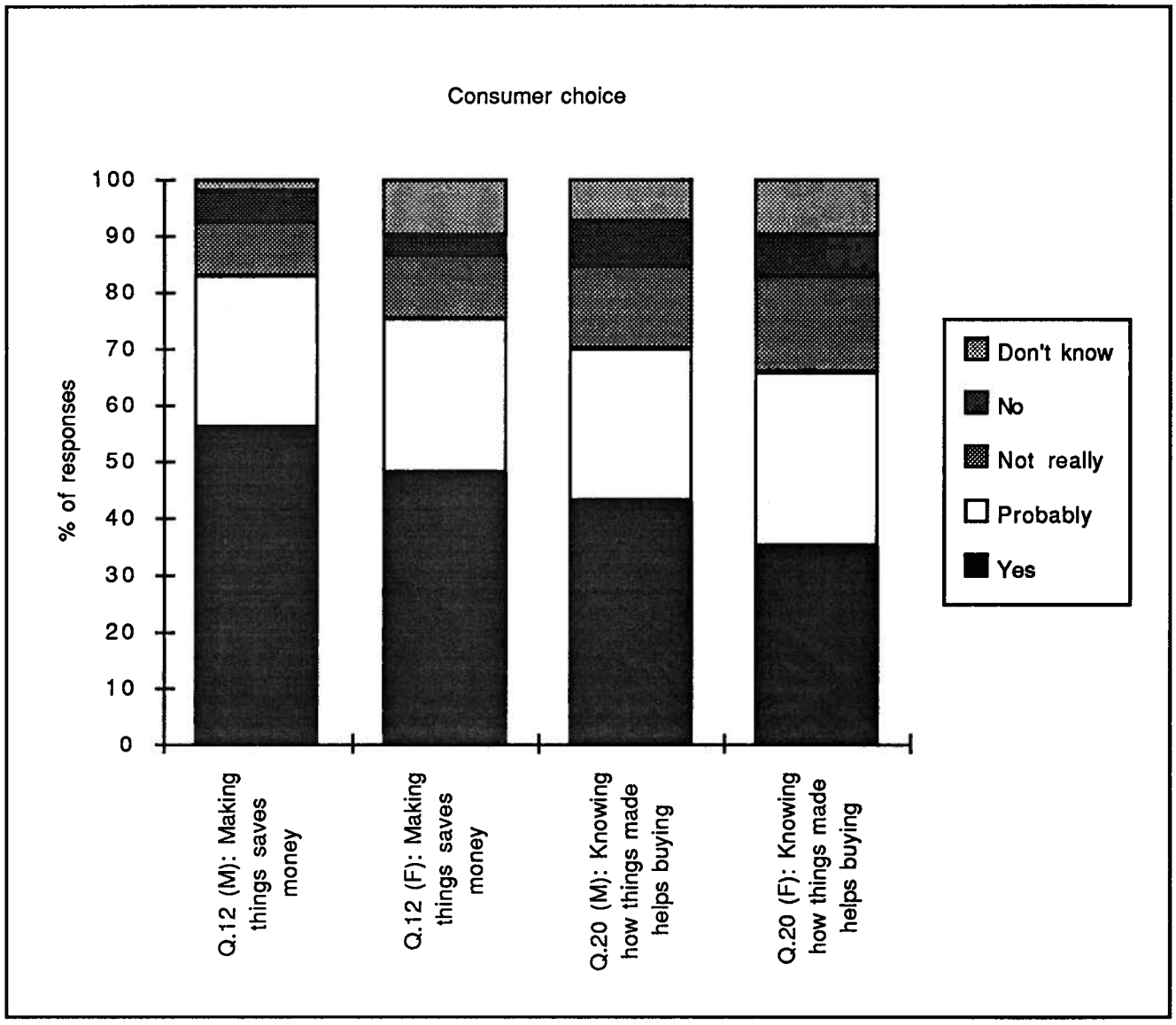

Figure D3. Responses to individual closed questions in the Consumer Choice category.

Appendix E

British Columbia Technology Education

1992 Draft Curriculum Intentions

1. The learner will have opportunities to develop the ability to solve technological problems.

2. The learner will have opportunities to develop the ability to make things and explore technology.

3. The learner will have opportunities to develop the ability to deal ethically with technology.

4. The learner will have opportunity to develop lifelong learning patterns to help him or her function effectively in a changing technological environment.

5. The learner will have opportunities to acquire skills and attitudes to enable him or her to work with technology both independently and as a cooperative member of a group.

6. The learner will have opportunities to develop appropriate attitudes and practices with respect to safe work and personal health.

7. The learner will have opportunities to gain competence in working with tools, materials, and processes to produce high-quality work.

8. The learner will have opportunity to develop language and visual communications skills to investigate, explain, and illustrate aspects of technology.

9. The learner will have opportunities to apply and integrate skills, knowledge, and resources across disciplines and technological activities.

10. The learner will have opportunities to explore and pursue technological careers and associated lifestyles.

11. The learner will have opportunities to become a discerning user of materials, products, and technical services.

Fraser, D., Anderson, S., Bastone, C., Doll, J., Hall, L., Kenyon, T., Keiwitz, K., Kovich, A., Trant, P., & Wilson, G. (1992). Technology Education: Primary-Graduation: Curriculum/Assessment Learning Guide. Victoria, B.C.: The Queen's Printer.