EXPLORING THE IMPACT OF A HANDS-ON INTERVENTION WORKSHOP ON GRADE 7 GIRLS and THEIR FEELINGS ABOUT SELF, MATHEMATICS, SCIENCE, TECHNOLOGY AND RELATED CAREERS

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Abstract

Forty-five 12- and 13-year-old females attending Grade 7 in North York, Ontario were randomly selected from a group of 100 females who had volunteered to participate in a one-day hands-on workshop called It's Your Choice at Seneca College. The goals of this intervention were to broaden the career horizons of these students and to help them realize the need to continue mathematics and science through high school in order to keep occupational options unlimited. The young women were given a pre- and post-attitude survey to provide background information. In the month following participation in the workshop the students were interviewed in small groups (5 students per group) to discover their perceptions of the impact of the workshop. The interviews revealed that participants felt that after the workshop their feelings of self-confidence increased, specifically with respect to working with their hands. Participants felt more aware of the usefulness and importance of the study of mathematics, science and technology. They also felt that It's Your Choice increased their interest in careers in these domains and helped them to see that these careers are viable choices for females. The interviews also revealed that many of the participants felt that in this society their roles and their choices were influenced and probably limited by the fact that they are female.
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CHAPTER ONE: THE PROBLEM

Introduction to the Problem

This is a study of the immediate impact of It's Your Choice, a hands-on workshop, on twelve- and thirteen-year-old Grade Seven girls attending North York Board of Education schools in North York, Ontario, Canada. The study was conducted during the spring of 1992 at Seneca College. The emphasis of this descriptive study was on discovering how these young women felt about their current and future involvement in the study of mathematics, science, trades and technology and the pursuit of related careers.

The main purpose of this research was to explore how participation in the It's Your Choice Workshop impacted on these young women.

Background of the Problem

The Canadian labour market is beginning to experience a shortage of skilled labour. Demographics predict that within the next five years the number of new entrants to the labour pool, as well as the ever decreasing number of people interested in pursuing careers in the trades, will serve to magnify Canada's current skilled labour shortage. Although it is apparent that women are an excellent labour resource for the skilled trades, as well as for careers in mathematics, science and technology, and the numbers of women entering the labour pool has increased substantially
over the last two decades, women still seem to be clustered in the clerical and service occupations (Statistics Canada, Women in Canada, 1990). For many reasons, it is extremely difficult for women to pursue a career in the fields of mathematics, science, technology and trades.

The fact that occupational segregation by sex differs among countries suggests that no one sex has a "natural" monopoly on any occupation (Gunderson, 1976). The gender stereotyping of occupations is not only seriously affecting women and their ability to achieve equality as well as economic independence, but also affects Canada by virtually limiting its labour pool.

Our education system is but one area of society which fosters the ghettoization of women into traditionally female occupations. The school system tends to place science and technology in juxtaposition with the humanities and the arts. The resultant notion of "hard" and "soft" areas of study with their inevitable gender-related extensions of appropriateness develop, and are reinforced.

The decision by girls not to study mathematics, science, trades and technology can be seen as both a cause and effect in a somewhat circular pattern of reinforcing stereotypes and behaviours. The decision not to study mathematics and science at advanced levels limits girls' career options and increases the likelihood that they will be ghettoized in the secondary labour market, a market which
is characterized by low wages, no unions, low security and little opportunity for advancement. As well, this choice limits the numbers of females in these "hard" occupations, and therefore contributes to the stereotyping of these disciplines as male domains.

It is imperative that we as a society, and we as women begin to change our attitudes about the importance of women's potential contribution to the Canadian economy, and therefore take a pro-active stance on educational and career planning for women.

Although women in the 1990s are choosing careers in mathematics, science, trades and technology in ever increasing numbers, it is still clear that the rate of female entrance into these careers is significantly below male's rate of entrance (Statistics Canada, 1990).

Mathematics, science, trades and technology, domains defined by and for men, clearly are genderized disciplines. This genderization is a repercussion of the social climate, as well as the personal and social experiences of girls and boys within the educational system.

If sex differences in the study of mathematics, science, trades and technology courses and the pursuit of careers in these fields are at least partially caused by social-environmental and educational factors, strategies for change must seek to reduce or eliminate the sex typing of these disciplines and their related careers as masculine
domains. More support and encouragement must be provided to females in order to increase their representation in these fields.

However, there is an indication that change is occurring regarding female study of mathematics and science at the high school level. There are a variety of findings which indicate that the extent and pace of change seems to be affected by the use of intervention projects.

The problem is that there is a significant amount of conflicting research dealing with career interventions and their effectiveness. There are questions as to the optimum age of intervention, type and make up of the intervention strategy, optimal length of intervention strategy in order to be effective as well as other questions dealing with who specifically the intervention needs to be directed towards (females, males, parents or all of these groups). There also appears to be a void in the evaluation of the many intervention strategies that have been implemented.

Statement of the Problem

It is clear from the above-noted information that due to their socialization, women are often limited in the number and variety of occupational choices that they consider when choosing their careers. Our education system is but one area of society which fosters the ghettoization of women into traditionally female stereotyped occupations.
It therefore becomes apparent that much of the burden for encouraging women to enter into non-traditional occupations will fall on educators and counsellors.

This study was designed to explore the immediate impact of a one-day hands-on experience in a trades/technology environment on Grade Seven female students attending school in the North York Board of Education.

**Purpose of the Study**

The lack of female participation in mathematics and science courses in high school has proven to be related to the future pursuit of careers in these fields. The result is that these careers are considered to be non-traditional choices for women. After participation in It's Your Choice, a hands-on intervention strategy that seeks to broaden females' career choice, female students' responses to questions on a number of issues related to the study of mathematics, science and technology and their related careers have been analyzed. The findings of this study indicate the impact of participation in this one-day workshop.

**Questions to be Answered**

In order to understand the impact that intervention strategies have, the following four issues were addressed in both the interviews and the survey:
1. **MYSELF CATEGORY**
   How do these young women view themselves in terms of their perceptions of their own capabilities with respect to hands-on endeavours and one's ability in mathematics and science and technology?
   Are these feelings about themselves altered after participation in the workshop?

2. **SOCIETY**
   How do these young women feel about mathematics, science and technology's place in society?
   Did their feelings about the importance of these domains change after participation in the workshop?

3. **GENDER**
   How do these young women feel about being female?
   Do these young women believe that their gender affects their capabilities and opportunities with respect to career choice?
   Do they believe that others (peers and parents) feel that gender is restrictive with respect to capabilities and appropriate career choice?
   From the participants' perspective, did participation in the workshop precipitate a change in these gender-related attitudes?
4. **CAREER/EDUCATION PLANS**

Did these young women feel that participation in the workshop changed their feelings about potential career/educational choices or plans?

**Rationale**

This research may serve to justify the ongoing costs of delivering this type of hands-on intervention to young girls about to enter into the educational phase where they need to make subject choices which will have long-term career consequences. Given the significance, for women and for society, of the decision not to continue to study mathematics and science at the senior high school level, and combined with the fact that few existing intervention strategies have been extensively or sufficiently evaluated, it is the researcher's opinion that the findings from this research will begin to address this gap. The results will have the potential to make a contribution towards beginning to understand the impact of effective intervention strategies on increasing female participation in the math, science and technology domains. As well, the research will add to some of the existing work which attempts to outline components of an effective intervention strategy.

**Theoretical Framework**

The review of earlier research provided the basis for
the delivery of an intervention strategy that was directed
towards this particular age group. The work of Heather
Nicholson (1987) lists characteristics of "excellent"
intervention programs. Many of these were considered and
incorporated when developing this intervention strategy that
involved the use of hands-on activities as well as role
models. It was the researcher's goal to appeal to the
affective, cognitive and achievement level in this model of
intervention.

This research relied on qualitative methods (group
interviews) to gather the majority of the data. In order to
increase the trustworthiness of this qualitative research,
the data collected from the interviews were given over to
other educators familiar with the issues, who have had
experience working with 12-year-old females, in order to
solicit their opinions as to the reliability of the
responses received. As well, a written survey was
administered, prior to participation in the workshop, to
gain background information and a general understanding of
the attitudes that the participants were bringing to bear on
the workshop situation. The group was asked to respond to
the same survey two weeks to one month after the workshop
and the results were compared. The qualitative method was
chosen for this study as the primary method of data
collection because it is quite "amenable to the diversity of
the multiple realities" that characterizes this situation
The survey was used for background data collection and was compared to the qualitative data.

Importance of the Study

This research contributes to our knowledge of the potential impact this intervention strategy, and others like it, can have on how young women feel about themselves and their ability to involve themselves in the traditionally male disciplines of mathematics, science, trades and technology.

The importance of research in this area is evidenced by the fact that a great deal of energy and money is being directed towards the objective of increasing female participation in mathematics, science and technology education and careers.

The North York Board of Education supported this effort by agreeing to survey the participants before participation in the workshop. In addition they were responsible for distributing and collecting all information and permission forms pertaining to this research. In return they are expecting a final copy of the work.

Definition of Terms

Career Intervention Strategy: A strategy used whereby students are given an opportunity to participate in a
special program (role modelling, hands-on shop experience, exposure to career information, career discussions). Such programs have the objective of expanding the participant's range of occupational choice.

**Non-traditional occupation (for women):** An occupation traditionally dominated by males and that currently has less than 30% female participation.

**Attitude:** The manner of feeling, acting, or thinking that shows one's disposition and opinion.

**Scope and Delimitations of the Study**

The purpose of this study was to determine the immediate impact that participation in the It's Your Choice intervention strategy had on participants' feelings about themselves, and mathematics, science, trades and technology. Although the North York Board of Education serves a diverse socio-economic population, it must be acknowledged that this study looked at only a very small localized population. It therefore must be recognized that the results from this study do not necessarily represent any other region in Toronto, Ontario or Canada. Therefore, any generalizations of these results must be done with extreme caution. In addition, only the "immediate" or short-term effects after participation in It's Your Choice were examined. It is
therefore important to understand that no attempt was made to make any assumptions about the long-term effects of participation in the workshop.

Due to the difficulty of measuring attitudinal change, and the complex nature of the process of attitudinal change, this research attempts only to describe the feelings and attitudes articulated by participants in the interview situation. This work does not attempt to determine whether the feelings and attitudes expressed by the participants in the interviews represent attitudinal change. The comparison of the pre- and post-participation surveys was done for interest only. No conclusions were drawn from these results.

As well, because of the complexity of the issue of academic subject and career choice in relation to gender, and due to the fact that it was impossible to determine which aspects (if any) of this multi-component program were responsible for the observed changes, no attempt was made to establish any causal relationship between or among variables. Rather, the study explores, describes and attempts to explain the participants' reported changes in attitudes, feelings or behaviours.

Outline of the Remainder of the Thesis

Chapter Two acquaints the reader with existing statistics about females and their current position in the
workforce. The research reviewed indicates that this inequitable position appears to be a result of the ghettoization of women into traditionally female occupations. The chapter goes on to describe the research that tries to understand the reasons why women tend to overlook education and careers within the traditionally male domains of mathematics, science, trades and technology. It then outlines the theoretical basis for the development of intervention strategies and continues on with a description of a number of interventions that have been implemented in Canada and the United States.

Chapter Three describes the research methodology, including details about the research design, selection of subjects, the instruments used and the procedures followed. As well, the method of data collection, recording and analysis are described.

The information gathered in the survey is presented at the beginning of Chapter Four. The data collected in the group interviews are then presented in this chapter.

Chapter Five summarizes the results, describes the conclusions in relation to the questions posed and the literature review and makes recommendations for further research. Implications for theory and practice are considered.
CHAPTER TWO: LITERATURE REVIEW

Overview

This review of the literature acquaints the reader with previous research that has examined females' participation and achievement in mathematics and science education. In addition literature that looks at young women's lack of participation in the study of senior level (high school) mathematics and science, as well as math, science and technology related careers is discussed.

Common career development theories are reviewed in order to demonstrate that women's lack of participation in these non-traditional careers is not a result of poor or abnormal development, as one would tend to conclude from these female non-inclusive theories, but rather a result of attitudes arising out of the socialization process (education being an important conveyer of attitudes).

The chapter goes on to review many of the intervention strategies that have been and are currently being delivered to young women in the United States and in Canada today. Research which evaluated several of these interventions is also discussed.

Women in the Workforce

The typical working woman in Canada has a family with young children, may be a single mother, has only a high school education, and works because she has to work
(Statistics Canada, 1988). The concept that young females must prepare themselves better for a future that will encompass gainful employment and productive participation in the Canadian economy is supported by the following statistics: 75% of married women between the ages of 25 - 44 are labour force participants (Statistics Canada, 1989); 28% of marriages end in divorce (Statistics Canada, 1988); 80% of divorced women between the ages of 25 - 44 work for pay (Statistics Canada, 1989); 9.3% of women become single parents (Statistics Canada, 1985); and 58% of these women work to support their families (Statistics Canada, 1989). Considering these facts, it is apparent that women will enter the paid work force in ever increasing numbers each year.

However, women continue to hold an unequal status in the workforce: 59% of women in the paid labour force are ghettoized in clerical, sales and service positions (Statistics Canada, 1989); women in clerical, sales and service positions earned just over $13,000 in 1987 (Statistics Canada, 1988); 30% of women in Canada hold managerial or professional positions (Statistics Canada, 1989), but earn only 60% of the salaries men earn in these same occupational categories (Statistics Canada, 1988). Women classed as the head of their household earn an average income of $26,000 compared to $46,000 for men. Thirty-four percent of female-headed households survive on an income
under $15,000, whereas only 7% of male-headed households live in such poverty (Statistics Canada, 1988).

These inequalities persist partly because women do not seem to have a realistic view of their working future, nor do they prepare themselves for their role in the paid work force in the same way as men. They tend to compromise their career plans in order to accommodate domestic plans without enough knowledge of or belief in the reality of the consequences of these decisions. Girls continue to choose from a smaller range of careers than boys. Girls continue to limit themselves to traditionally feminine occupations and continue to limit their study of science, mathematics and technology. Even high school girls with exceptional academic preparation in math and science are choosing math/science careers in disproportionately low numbers (Mullis & Jenkins, 1988).

Women and Mathematics and Science Courses

In Canada, it is assumed that there is equal opportunity for males and females to learn mathematics. In both the United States and Canada neither boys nor girls are legally or even consciously prevented from electing to take mathematics, science or technology courses. However, data indicate that males elect to take advanced mathematics and science courses in secondary schools more often than do females (Armstrong, 1985). The difference between the
numbers of females and males studying mathematics after secondary school, as well as the difference in the numbers preparing for mathematics-related careers, is even more marked.

Recent statistics obtained from the Ontario Ministry of Education (Beauchamp & Feldberg, 1991) indicate that young women in Ontario continue to opt out of optional science, math and technology courses at a rate which exceeds that of their male classmates. In 1988 there were twice as many boys as girls in OAC level physics and four times as many boys in computer science and drafting.

The percentage of total OAC mathematics and science course enrolment which is female has been inching upwards since 1983, however the percentage of total females enrolled in a school who are taking algebra, physics and chemistry has actually declined between 1983 and 1988. This means that the apparent gains in enrolment for females are reflective of a decrease in total male enrolment, rather than an increase in female enrolment. (Beauchamp & Felberg, 1991)

Gender differences in the number of science courses students take are small. However, the pattern of course taking differs, with girls being more apt to take advanced biology and boys being more apt to take physics and chemistry at the advanced level (AAUW, 1992).
Women and Mathematics Achievement

There does not appear to be any strong evidence to support or refute a biological or genetic basis for sex differences in mathematical ability. Although Benbow and Stanley (1980) argue that the differences on the SAT-M are indicative of male superiority, others would argue that these differences reflect not only the impact of social conditioning, which directs girls away from an interest and desire to learn mathematics, but also the differences in test content and/or test-taking strategies. The Educational Testing Service in the United States has found that not only do SATs find larger gender differences than other achievement tests, but that they also tend to underpredict girl's performance and overpredict boys' (AAUW, 1992).

Research indicates that achievement test items have been seen to be biased in favour of boys (AAUW, 1992). Until recently it was believed that boys' superior performance in spatial abilities was a given fact (Harris, 1978; Maccoby & Jacklin, 1974). As well, there was some thought that superior spatial ability was related to sex differences in mathematical achievement (McGee, 1979). However, several later studies have shed doubt as to the extent and nature of differences in gender-related spatial abilities (Sherman, 1979; Sherman & Fennema, 1978; Smith & Litman, 1979).

Meta-analysis in the United States comparing recent
research with studies done in 1974 seems to indicate that there is a significant decline in gender differences in mathematics achievement (Hyde, Fennema, & Lammon, 1990). Large U.S. research studies found no gender differences in math performance level at nine years of age, minimal differences at age thirteen, and a larger difference favouring males at age seventeen (Dossey et al., 1988). "As well, gender differences on the SAT Math have decreased between 1978 and 1988, however males still outsored females 498 to 455" (AAUW, 1992).

According to the National Assessment of Education Progress (NAEP), an assessment of education carried out in the United States, gender differences in science achievement have increased between 1978 and 1986 for nine- to thirteen-year-olds. However, the largest achievement differences exist for seventeen-year-olds. The Fourth NAEP Mathematics Assessment done in 1986 indicates that there appears to be a positive relationship at the Grade 3, Grade 7 and Grade 11 levels between students' perceptions of mathematics and their proficiency in the subject. Students who have somewhat higher levels of mathematical proficiency are also likely to have a positive attitude toward the subject. However, the Fourth NAEP Mathematics Assessment indicates that in spite of the fact that 17-year-old females' mathematics proficiency increased from 1982 to 1986, neither their reported enjoyment of the subject, nor their
perception of the nature of mathematics improved. Why then did their proficiency improve? The relationship between attitude and achievement appears to be quite complex.

Inequalities in the Education Experience

The AAUW Report "How Schools Shortchange Girls" reports that throughout the school years it has been found that girls and boys in the United States do in fact have different science experiences. This report illustrates this inequity with the following: It states that "Kahle and Lakes [1983] found that girls are more likely to take part in biology-related activities, and not as likely to take part in electrical and mechanical activities" (AAUW, 1992). It goes on to say that Mullis and Jenkins (1988) found that by Grade Three 51% of boys and 37% of girls had used microscopes, while by Grade Eleven 49% of males and 17% of girls has used an electricity meter. Zimmer and Bennet (1987) disagree with these findings. They found that equal numbers of girls and boys used microscopes by Grade Three. As well, they found that "through the ages 13 to 17 girls tend to develop an increasingly negative view of science, science classes and science related careers" (AAUW, 1992, p. 28).

It appears that our education system in North America, whose function seems to be to "produce a differentiated, stratified and conforming workforce, adjusted in personality
and character, equipped with the necessary skills and competencies to work in the socio-economic division of labour" (Bowles & Gintis, 1976), also fosters the gender stereotyping of areas of study and their related occupations.

From this research, it seems that females are not learning mathematics at the same level as are males. Studies have indicated that females do not have the internal belief systems equivalent to males that support them in the learning of mathematics. Girls are less likely to feel competent in these areas of study and because they tend to underestimate the importance of these subjects in their futures, they often do not persevere when the subjects become academically challenging. The result is that fewer females elect to study higher level mathematics.

According to the American Association of University Women's Report "How Schools Shortchange Girls" (1992), there is "compelling evidence that girls are not receiving the same quality, or even quantity, of education as boys. Girls are systematically discouraged from courses of study essential to their future employability and economic well being" (p. v). It is a recognized concept by both employers and educators that productive participation in the global economy of the future will require strength in science, mathematics and technology (Science Council of Canada, 1982)—subjects girls still perceive as unsuitable
for them. It is the responsibility of our country and education system to encourage and promote the study of mathematics, science and technology. The abdication of this responsibility will result in the lack of development and therefore the under-utilization of at least half of our human resources.

Self-Confidence and Mathematics

Much research indicates that success in mathematics is greatly affected by one's feelings of self-confidence and inversely, one's feelings of self-confidence are greatly affected by one's ability to succeed in mathematics. Females, more than males, tend to doubt their own ability in math (Fennema & Sherman, 1978). Studies by Sherman and Fennema (1977) and Sherman (1979) have found a strong relationship between responses to the confidence sub-scale of the Fennema-Sherman Mathematics Attitude Scales and performance in achievement tests for both boys and girls. For girls (but not for boys) self-confidence scores were related to perceptions of mathematics as a male domain. According to Hyde, Fennema and Lamon (1990) boys see math as very "male." A longitudinal study done by Armstrong (1985) indicated that the only variable consistently found to negatively affect females' math achievement was their view of math as "male." However, she found that girls who perceived mathematics as neutral were more likely to be
self-confident. Data from the National Assessment of Educational Progress (NAEP) in the United States indicate that girls who reject traditional gender roles have higher math achievement than girls who are entrenched in more stereotypical roles.

Although Sherman and Fennema (1977) found that boys, more than girls, rated mathematics as a male domain, this same study found that the girls' actions (actually deciding not to enrol in mathematics courses) seemed to contradict their expressed view of mathematics as gender neutral.

The overall impression that mathematics is a male domain is reinforced in several ways. Mathematical thought is often portrayed as objective, logical, abstract and rational. Much stress in the discipline is laid on completeness, certainty and absolutism. In addition, the mathematician tends to work alone. Most of the above-mentioned characteristics are characteristics often attributed in our current culture to males and are not rewarded in females.

The lack of female role models in the mathematics, science and technology classrooms, as well as their related careers serves to reinforce the belief that these areas are in fact male domains. As well, the genderization of mathematics, science and technology is further fortified by the fact that the presentation of these subjects, usually by males, is done in a formal, abstract and non-applicable
fashion and invariably and justifiably alienates a great many females.

**Usefulness of Mathematics**

Sherman (1979) believes that the perception of the usefulness of mathematics is an important prediction of course taking for girls and can also be correlated to mathematical achievement. In other words, if one believes that math is not useful, one will not try as hard, nor will he/she elect to study the advanced math courses. Wiggan (1982), whose work in is agreement with Sherman's has found that a student's perception of the usefulness of math and science is the strongest influence on course-taking plans. According to a poll commissioned in the United States by the American Association of University Women in 1990, males are more apt than females to envision themselves as using math as adults. This confirms the propensity females have towards discontinuing the study of higher level mathematics.

Some studies have discovered a shift of attitudes about mathematics, science, and technology, and their usefulness and relative appropriateness with respect to gender-appropriate career choice that occurs among girls in the high school years. This shift results in the development by girls of an attitude whereby they view mathematics as increasingly unimportant. Armstrong (1985) has also found that females in secondary school indicate that they feel
they will not use math in their future. If females do not see math-related careers as possibilities, they will not see math as useful and will therefore opt out of senior level math and science courses. As well, there seems to be a perception by these girls that boys tend to be superior in math (Boswell, 1980). From this it appears that boys rate math as more useful than do girls (likely because math and related careers are seen as a male domain) and as a result they seem to have a more positive view of themselves as math learners and of math itself (Fennema & Sherman, 1978).

Reasons for Opting in or out of Mathematics and Science Courses

In addition, Armstrong's (1985) work posits that girls and boys seem to pursue mathematics for different reasons. She found that girls who pursue math, do so in order to reach educational goals. Boys, however, indicate that they pursue math because of parental expectations. Both of these reasons for choosing to enrol in mathematics courses seem to be in agreement with Lantz (1985) who found that beliefs and attitudes leading to the decision to enrol or to avoid enrolling in a subject are acquired through rewards (i.e., good grades, approval, gaining entrance into university) and punishments (i.e., feeling stupid, not getting into university).

As well, gender differences in confidence were found to
be strongly correlated with continuation in math and science classes (Reyes & Stanic, 1988). Math confidence has been found to be more highly correlated with math performance than any other affective variable (Fennema & Sherman, 1977; Reyes, 1984). Females who have low self-confidence with respect to their ability to achieve in mathematics will tend to avoid the subject. Tobias (1978) concludes that females drop math because it is too hard, and it is thought not to be worth the effort. This is obviously an attitude well worth changing.

According to causal attribution theory, what one believes to be the causes of one's successes and failures is connected to one's locus of control, whether it be internal or external. If success is attributed to an external (unstable—the teacher) cause, then the student will not be as confident of success in the future and therefore will be less apt to strive or persist. If, however, success is attributed to an internal (stable—ability) cause, then the student will expect success in the future and will continue to strive in that area. Research has shown that it seems to be a female characteristic to attribute successes to external causes and failures to internal stable causes. Males, on the other hand, tend to attribute successes to internal causes and failures to external causes (Bar-Tal, 1978). Consequently, males are more apt to attribute their math and science success to ability; whereas girls, who tend
to exhibit an attributional style which is likely to inhibit persistence and other achievement-related behaviours very necessary for achievement in mathematics and science, attribute their math and science failure to lack of ability (Leder, 1990).

Often teachers will unconsciously buy into the misconception that mathematical ability is linked to gender. The lower expectation of teachers for female students results in unequal treatment in the mathematics classroom. If there truly was educational equity, there would be no detectable differential treatment of boys and girls, as groups, by teachers in the classroom. On the contrary, Fennema and Peterson (1987) found that girls were treated quite unequally in the classroom. In their monitoring of teacher behaviour in the classroom they found the following: Girls were addressed in the classroom less frequently than boys; boys were asked to solve problems more often than girls; boys were rewarded for correct answers in a different fashion than girls and were scolded more often than girls for incorrect answers. The lower expectations of teachers for girls results in less stimulation, challenge and reinforcement for females in the class. In addition, the differential treatment that Fennema and Peterson found in their study is often unconscious and subtle and, as a result, hard to detect and therefore change. It appears that classrooms are not providing the opportunities,
stimulation or expectations that girls, as well as boys, participate in activities that lead to being independent learners who are able to do high cognitive level mathematics and science. As well, the values of collaboration are often missing from the mathematics and science classrooms. Female learning styles are unlikely to be addressed.

In addition to being discouraged from the study of mathematics, science and technology, and from pursuing their related careers, women are often encouraged to focus on domestic life for personal fulfilment. Ten-year-old girls, although they prove to be the least dogmatic about the sex appropriateness of careers (compared to other ages), saw women's careers as secondary to family responsibilities (Guttentag, 1976). Unfortunately, this attitude reinforces the gender stereotyping of roles and occupations and continues to support a patriarchal society in which women's voices are rarely heard (Gilligan, 1982; Spender, 1980).

Jane Gaskell (1992) also found that adolescent girls assume that they will have primary responsibility for domestic work and that work outside the home will be secondary to work inside the home. With these priorities, young women choose paths that will tend to relegate them to gender-stereotypical places in the labour force. Once again, these choices contribute to the lack of educational and career development of women.
Theories of Career/Vocational Development

Much of the career development theory posited by authors such as Ginzberg, Ginzburg, Axelrad, and Herma (1951), Super (1957), Holland (1966), and Levinson (1986) also has ignored women simply by omitting women from their sampling. Theorists such as Anne Roe (1956) and J. D. Krumboltz (1979) have acknowledged that past experiences are of significance when an individual makes a career decision and therefore it would seem that their theories could possibly be generalized to women. However, women continually fail to fit many of the existing models of human development, career development and growth, due in large part to current theories' ommittance of female-related variables such as child bearing and child rearing (Romm Ben-Dor, 1979) as well as the women's commitment to being "in relationship" throughout life (Gilligan, 1982; Josselson, 1990; Miller, 1984).

Orenstein and Isabella (1990), using Levinson's (1986) model on adult development, found that there are major differences between men and women in career stages. Women may not adhere to the traditional model of career development, because they may have careers that are interrupted so that child bearing and rearing can be incorporated into their career agenda. It was discovered that women may be less heterogeneous than men with respect to career development and rather than aligning women with
where they are in their career, the theorists appear to align them more closely with their age (Orenstein & Isabella, 1990). The results are that women appear to be underdeveloped, abnormal.

Donald Super's (1957) vocational development theory has received a great deal of empirical confirmation. He does acknowledge that the nature of an individual's career pattern is influenced by parental socio-economic level as well as the individual's exposure to opportunities and available role models. In this avenue women are at a severe disadvantage. Availability of suitable role models for women in a full range of occupations is extremely limited and therefore this has resulted, so far, in women viewing a restricted range of traditionally female occupations as appropriate options. In addition, women's opportunities (educational and social) are quite different from men's, again restricting full choice.

Ginzberg's developmental theory of vocational choice (1951) posits that vocational choice is achieved through a series of compromises that individuals make between wishes and capacities. This requires self-awareness, as well as an accurate assessment of reality constraints. He makes the assumption that the crystallization of a career choice is irreversible as well as maturational. Therefore, there are distinct stages, common to certain ages, which are cumulative.
Unfortunately, Ginzberg has only studied the process from age 11 onwards, using only white, upper middle class Anglo Saxon males who were considered to be mentally stable as well as college bound. This has serious implications for women, since it is felt by many that options are restricted well before this age for girls (Astin, 1970; Bandura, 1977; Gottfredson, 1981; Guttentag, 1976; Herring, Lafontaine & Saindon, 1985).

Another problem with the generalization of Ginzberg's theory to women is that he does not separate "vocational choice" from "vocational preference." (Wirtemberg, 1978). According to Gottfredson (1981), an individual will not necessarily pursue his/her vocational "preference" if its accessibility is perceived as overly limited. Rather, he/she will pursue the "better bets" and this becomes known as his/her vocational "choice." The environment and society impose more severe and a greater number of limitations on the range of possible occupational choices for women. This, in fact, increases the impact that the discrepancy between the concepts of vocational choice and vocational preference has for women.

Anne Roe's personality theory of career development (1956) has as its basic premise the concept that early experiences, abilities, interests and other personality factors affect vocational selection. Roe translates early experiences with parents, such as degree of emotional
concentration on the child, into patterns of needs. These needs are seen by Roe as the major determinants of the individual's occupational choice and total life pattern. Her theory posits that if these early needs are not satisfied as they appear, they will develop into unconscious motivators. Depending upon early childhood, a person is either drawn towards people and people occupations, or away from such occupations.

Unfortunately there is a lack of empirical evidence to support this theory. Roe acknowledges the existence of large gender differences in interests. However, she never explains this as arising out of the differing childhood experiences, both social and educational, that males and females traditionally experience.

In spite of the fact that the theory is unsupported by data, this researcher feels that personality and childhood experiences are both important variables to consider in any theory of occupational development, especially if that theory is to acknowledge the existence of women's reality.

John Holland (1966) has developed a theory of career choice which posits that career choice is reflective of one's personality type. The theory says that work environments, as well as people, can be categorized into one of the following: Realistic, Investigative, Social, Enterprising and Conventional. Holland has observed that women as a group tend to receive more social, artistic and
conventional codes than men, and men receive more enterprising, investigative and realistic codes than women. However, this merely reflects the manner in which occupations have traditionally been segregated in relation to the sexes in North America.

"Holland's theory has been criticized for its lack of applicability to women and its perpetuation of the occupational status quo" (Wirtemberg, 1978). In spite of the fact that Holland stresses that environmental factors such as social pressures in early adolescence and childhood experiences with parents are important influences on vocational choice, the theory does not specifically take into account the environmental and socialization factors which limit women's choice.

Holland stated that, because the empirical data were obtained from men, his theory is probably less useful for understanding the behaviour of women.

Krumboltz's social learning theory of career selection (1979) posits that occupational decisions are viewed as an outcome of a lifelong series of learned responses. Once again, the impact for women is that learned responses are traditionally stereotypical. We are reinforced for gender-appropriate behaviour and this, once again, maintains the status quo with regards to occupational choice.

Linda S. Gottfredson (1981), however, has proposed a theory of career development which best acknowledges the
fact that it is extremely difficult to break loose from stereotyped notions that encourage the pursuit of traditionally gender-appropriate occupations. She has found that the gender self-concept is the most strongly protected aspect of self and has questioned whether it is in fact possible to reshape youngsters aspirations and views of themselves without massive intervention.

**Intervention Strategies**

**Effectiveness of Intervention Strategies**

Much of the research on intervention strategies appears to indicate that there are some problems in devising an intervention that will in fact accomplish the task of broadening females' career options to include non-traditional occupations. In a study done by Brooks et al. (1985) it was found that there were no significant effects of a non-traditional role-modelling intervention on the sex typing of occupational preferences. Brooks et al. conclude that perhaps interventions can be effective, but only at critical ages.

Over the past 15 years, schools all over the world, in response to the knowledge that females must be encouraged to persist in mathematics, science and technology if they are to even have the opportunity to enter into occupations which are currently non-traditional for women, have developed a
wide variety of intervention programs to provide the support and encouragement that females need. This stems from the belief that intervention programs can make a difference. Due to funding constraints, the majority of these strategies are never formally evaluated. As a result there is little concrete evidence that indicates which interventions do in fact reach their goals and therefore what must be included in an intervention if it is to be successful.

Characteristic and Components of Effective Intervention Strategies

According to Tsuji and Ziegler (1990), intervention strategies that have the goal of increasing math and science course enrolment can appeal to young women at one or more of three levels. The first, the cognitive level, looks to change beliefs about the usefulness of these disciplines. The second, the affective level, looks to increase confidence in the subject and at the same time decrease anxiety. The third, achievement level, looks to improve achievement in the subject (Tsuji & Ziegler, 1990).

According to Lantz (1985) interventions that focus on the affective and achievement level appear to have more impact than those that simply appeal to the cognitive level.

An intervention program delivered in the United States called Multiplying Options and Subtracting Bias, which is aimed at increasing females' beliefs about the usefulness of
mathematics (Fennema & Carpenter, 1981) seems to differ with Lantz's conclusion. The workshop's goal is cognitive in nature. The intervention was composed of four workshops, each of which was directed at a different target group—students, teachers, parents and counsellors. The workshop included a video tape and activities that served to increase awareness about the gender stereotyping of mathematics, females' feelings about mathematics, the differential treatment that females often receive in the classroom, as well as the usefulness of mathematics for all people. This program has been extensively evaluated by Fennema and this evaluation found that this particular intervention had the capacity to substantially influence students' attitudes about mathematics, the stereotyping of mathematics and their desire to enrol in mathematics course in spite of the workshop's singular focus on the cognitive.

A second intervention strategy, planned and delivered by the Math/Science Network in the San Francisco Bay Area, had the goal of increasing young women's participation in mathematical studies and to motivate them to enter careers in science and technology. This intervention involved bringing junior and senior high school girls together for a one-day conference where they would be involved in hearing a panel or speaker, participate in two hands-on math or science workshops and one or more career workshops, and where they had the opportunity to interact with women
working in math/science-related fields. Pre- and post-conference questionnaires were administered to the participants and according the research it was found the "the conference 1) increased participants' exposure to women in a variety of technical and scientific fields, 2) increased the participants' awareness of the importance of taking math and science, and 3) increased participants' plans to take senior level mathematics." The evaluation of both of these interventions gives us evidence that it is possible to change females' attitudes about mathematics and their course choice patterns in a relatively short period of time.

Holland, Magoon and Spokane (1981) observed that the minimal effects frequently found for career interventions may be due in part to their short-term nature. With this in mind, Brooks et al. (1985) examined the effects of a longer (five week) non-traditional role-modelling career intervention. As well, their study explored the possible differences in effects this intervention had on early versus middle adolescents. It was their belief that the early adolescents should be more susceptible to interventions; however, their study showed that there were no significant effects of this intervention on the sex typing of occupational preferences or career salience of middle and high school girls. They conclude that perhaps interventions can be effective, but only at critical ages. They felt that
research should be conducted to discover this "critical" age.

Anton and Humphreys (1982), on the other hand, report that six months after attending a one-day career conference, girls' math and science career interests and course-taking plans were higher than they were prior to the conference. As well, three years of follow-up of a four-week math/science and sports summer program for minority junior high girls found that the girls increased their math and science course-taking plans an average of 40 percent (Campbell, 1990). A two-week residential science institute in the United States for minority and white female high school juniors tended to decrease the participants' stereotypes about people who were good in science, and strengthened their commitment to careers in math and science (Campbell, 1990; AAUW, 1992).

In a paper written by Heather Johnston Nicholson and others, which was presented at a Vision to Reality conference sponsored by the American Association for the Advancement of Science in July 1987, the following list of characteristics of excellent intervention programs was generated.

- hands-on activities
- practical examples and applications
- co-operative learning styles
- team approach to teaching and learning
- starting where people are, not where they are expected to be
- role models of people plausibly "like me"
- sensitivity to group being served
- connecting activities to careers in math and science
- parental support and involvement
- clear goals and objectives
- evaluation of program's effectiveness

Nicholson reports in her paper that other researchers such as Malcolm (1944), Lockhead et al. (1985), Kreinberg (1982) and Smith (1987) conclude that the best intervention programs both espouse and incorporate many or most of the above characteristics.

In a study done by Veres and Carmichael (1982), it was found that classroom activities which provide students with information about career decision making and non-traditional career choices, as well as the chance to discuss the choice process, can affect students' attitudes and opinions about occupational choice, particularly in the direction of developing a more positive attitude towards non-traditional careers and therefore broadening their career choice to include math-, science-, and technology-related careers.

Lunnenborg (1982) found that the non-traditional orientation of professional women was fostered generally by a strong supportive milieu, in which siblings, teachers, peers and both parents provided emotional support and encouragement. This work attempted to rate the order of importance of each of these influences and found that school personnel have the least amount of impact on females' decisions to pursue male-dominated occupations. This opinion is shared by Veres and Carmichael. Perhaps this lack of impact that school personnel are seen to have is
related to the traditional guidance counselling method used in the school system. There is a great deal of research which indicates that women's career aspirations and employment patterns are related to the women's mothers, or to other significant role models (Astin, 1970; Burlin, 1976). Bandura (1977) also talks about the impact had by role models of the same sex, who are viewed to have high prestige, or who possess engaging qualities. Laws (1978) concluded that young girls need both occupational and lifestyle role models.

Herring et al. (1985) feel that role models are very important in helping girls become aware of the diversity of available career options, as well as the viability of these options for themselves. It is also important for girls to know that they are capable of doing every possible type of job and these authors feel that participation in a hands-on experience will likely facilitate such feelings of efficacy. Laws (1978) as well as Bandura (1977) agree that it is more likely a girl will attempt to enter a non-traditional career if she feels both able to perform the tasks and confident of a reward (social and financial).

Lemkau (1981) found that background factors that foster broader sex roles were more frequent in non-traditional men and women. This suggests that any interventions which foster broad rather than narrow sex roles should contribute to the desegregating of the workforce. It was found that
nontraditional women, as well as men, described themselves as less sex-typed, both in "on the job" and in social situations. The non-traditional persons surveyed also had less stereotyped marital and family roles. In addition, it was found that non-traditional women, who were viewed as tough-minded, had support from male parents and teachers. This suggests that support from important males in a woman's life will increase the likelihood of her pursuing a non-traditional career. If such male support exists, perhaps this prevents women from feeling that occupational choice must preclude intimate relationships with men.

Interventions in Ontario

In Ontario it seems that one of the more common types of interventions are programs which attempt to expose girls to role models (women who are studying or working in non-traditional careers in math, science, technology and trades). The Ontario Women's Directorate has developed and sponsored programs which provide older students studying in the math, science, technology discipline and career women in non-traditional fields for in-school career days, job shadowing mentoring and other such programs. Two of these programs are known as "Pathmakers" and "Open Doors."

Another commonly used intervention in Ontario is the career conference approach. These conferences, sometimes for boys and girls but often for girls only, are attempting
to develop interest in math- and science-related fields by exposing students to female role models in non-traditional careers. Toronto Board of Education's Horizons Program is an example of such a career day. In addition school boards on their own or in partnership with industry or community colleges or universities have arranged similar types of conferences that will often include a hands-on session. Georgian College provides such a combined program called Here Today, Where Tomorrow for the school boards in its surrounding region. In addition, the Toronto Board of Education in 1989-90 brought Grades 7 and 8 girls into the workshops of technical high schools for a day of hands-on activities and interaction with female high school students enrolled in non-traditional programs. This was a one-time event and it was not evaluated.

The Primary Career Awareness program, developed by the Women's Incentive Centre, Windsor introduces primary children to the concept of non-traditional careers, as well as the concept that most women will more than likely work and that they can do all types of work and still be a mother. Children will also learn about the importance of math and science during this program.

The London Girls' Conference developed by the London Women's Teachers Association presents a one-day, Saturday conference to Grades 6, 7, and 8 girls whereby mostly female speakers talk to girls about their jobs and often do a
hands-on demonstration. The main purpose is to expose these girls to occupations to which they would not normally be exposed.

The Young Women on the Move Conference in Lambton County is sponsored by the local community college, the local public and separate school boards, as well as the Lambton Women Teachers Association and the Federation of Women Teachers Association. This conference is similar to the London Girl's Conference.

Ms. Math, St. Catharines is a program developed to help girls develop positive attitudes towards math to encourage them to continue taking math throughout high school. For two hours on eight consecutive Saturday mornings the girls are taught problem-solving strategies and spatial lessons. Role models are often brought in to speak and classes are held at Brock University.

Girls Exploring Technology, a one-week summer program delivered at Fanshawe College, introduces girls to a variety of career choices by learning about the trades and technology through hands-on activities. These experiences are linked to the study of math and science.

The IDEA Book (Robertson, 1988) lists 21 different organizations in 14 Ontario communities which sponsor career days. In addition, many Ontario Universities, including York University, Brock University and Ryerson offer special outreach programs for girls in math and science. York
University has offered *A World of Opportunity* and *The Mathematics Colloquia (Real Women Don't Do Math)*. Brock University has offered *Scientifically Yours*. These programs have been three-day residential conferences. Upon completion of the programs described above, overall, participants themselves have evaluated their experiences very positively. External evaluation has not been done.

Another somewhat controversial curriculum intervention is the sex-segregated math class. According to Sangster (1988), an experimental program at A.Y. Jackson Secondary School in North York, Ontario in which "female only" Grades 11 and 12 math classes were provided, yielded no significant results on math achievement or attitudes. This was based on the following evaluation procedure and its results: In order to assess attitudes towards mathematics, the Fennema-Sherman Mathematics attitude scale was used. Results of this showed that females, both the control group and the test group, were significantly more likely to see math as being suitable for men and women than were male students. Anxiety level about math was significantly greater for both sexes at the comparison school than at A.Y. Jackson. Females at A.Y. Jackson were significantly more confident than females at the comparison school at Grade 11. Perceptions of the usefulness of mathematics declined over time for both the control group and the test group. In light of these results many view Sangster's conclusion as
inconclusive.

In contrast, in an isolated rural Mid South community in the United States, participation in an all-girls accelerated math class for the mathematically gifted did have an impact on the course-taking behaviours, plans and aspirations of the girls who did participate in this program. This program also included a career awareness component and exposure to female role models. The participants were found to have higher levels of educational aspirations than boys or girls who had not received the treatment (Fox, 1979).

Additional studies have raised questions about the advisability of segregating students by gender. Fox, Brody, and Tobin (1985) posited that rather than sex segregation, perhaps having a sizable number of females in math classes (science and technology) would provide an educational environment that would be conducive to female success.

**The Age of Intervention**

The literature also seems to indicate that there is a significant amount of conflicting research dealing with the issue of the optimum age of interventions of this nature. According to Maccoby and Jacklin (1987, cited in AAUW, 1992), by the time children are six or seven they have clear ideas about gender, based on what they see in the world
around them, and both girls and boys behave in a way that promotes these gender role stereotypes. Guttentag (1976) found that 5-year-old children believe strongly that males and females do different things. Bandura (1977) suggests that the younger, more literal-minded child will reject occupations as appropriate choices if a same-sex adult with whom they are familiar is not employed in these occupations. Gottfredson (1981) posits that between the ages of 6 and 8 years, children tend to eliminate as career options jobs viewed as unsuitable for their sex. Gilligan, Brown and Rogers (1988) report that young girls show "striking capacities for self-confidence, courage, and resistance to harmful norms of feminine behaviour as well as a detailed and complex knowledge of the human social world...Up until the age of eleven or twelve...girls are quite clear and candid about what they think and feel and know." They go on to say that as girls enter into mid-adolescence, they become increasingly conflicted about themselves and their responsibilities and the opportunities that exist for them in the world.

Likewise, Herring et al. (1985) found that as age increases (12+), girls are continuously less open to considering non-traditional jobs as appropriate for them. The study also showed that the percentage of females favouring non-traditional jobs tended to remain stable from elementary school age to puberty. They believe that this is
an indicator that interventions should be provided in elementary school. It seems to this researcher that in order to broaden females' occupational considerations, interventions should begin in early elementary school, and continue on until at least puberty.

Summary

Data from Statistics Canada clearly indicate that women are increasing their participation in the paid workforce at a rate that indicates they now make up close to 50% of the labour pool. In spite of this, women continue to be segregated into traditionally female occupations, occupations which pay significantly less than male occupations, and as a result, limit women as to the level of economic independence they are able to achieve.

This segregation of women into traditionally gender-appropriate occupations is due in part to the socialization process, which tends to reinforce the attitude that views women's careers as secondary to domestic/familial obligations and views mathematics, science and technology as male domains.

The research indicates that women do not enrol in science, mathematics and technology courses at the senior high school level in the same numbers as do men. This is seen as being, in part, responsible for the small numbers of women who then choose to pursue careers in these fields.
The literature is wide and varied when it comes to isolating the factors that determine whether a female opts in or out of senior level high school mathematics. Research has indicated that society's attitudes about math, science and technology and the genderization of these domains has a great impact on women's decision to opt out of these subjects. The research indicates that there is no evidence that indicates that the difference (however minimal that difference is) in mathematics and science achievement between men and women is biological in nature. It is posited that the existing differences in enrolment and achievement is due, in part, to women's attitudes about themselves and their perceptions about their capabilities in these fields. As well, it is well documented by many researchers that one's perceptions about the potential usefulness of these subjects in one's future has a great deal to do with one's decision to enrol in these subjects.

The readings indicate that females receive different treatment in the classroom, which serves to foster low self-esteem. As well, the curricula and delivery of these subjects insidiously discourage women from excelling. In view of the literature it appears that there is a common, far-reaching belief that intervention programs are worthwhile efforts in encouraging and expanding female participation in math, science, technology and trades education and their related careers. However, because of
apparent lack of funding, the many programs that are being offered to our young girls are seldom sufficiently evaluated. Many questions remain as to which interventions are most likely to accomplish their goals. Some of the questions which arise are:

a) What type of intervention is most likely to accomplish their goals?

b) When should interventions be made? and

c) Who should be targeted for these interventions?

As it stands, it is impossible to know what impact, if any, these interventions have had on their participants.

This study begins to address this gap.
CHAPTER THREE: METHODOLOGY AND PROCEDURES

Overview

This chapter addresses how the study was conducted. It begins with a description of the research approach and the intervention strategy. The research design includes data collection, data processing, recording and analysis, a description of the survey instrument and its previous use, of the interview, and subject selection. The chapter concludes with a discussion of the methodological assumptions and limitations and a restatement of the problem.

Description of Research Approach

After a review of the literature was conducted to determine and justify an appropriate research approach, it was decided that this exploratory study would benefit most if background information about participants' attitudes was gathered through a survey and then qualitative methods of data gathering were used to understand what impact the intervention had on the participants. A post-participation survey was carried out.

The Intervention Strategy

(It's Your Choice Workshop)

The It's Your Choice workshop was developed by the researcher in collaboration with the North York Board of
Education in response to a need identified by the researcher and the Board of Education. The first series of workshops was held in 1989 at Seneca College. Twelve-year-old girls were invited to spend the day in the Women in Trades Shop at Seneca college where they would have the opportunity to make a continuity/battery tester from start to finish. This task would serve to introduce the young women to the use of an assortment of hand and power tools and a variety of skills including soldering and wiring. In designing this workshop, the construction of a continuity battery tester was chosen as the hands-on project because it had a high success quotient. It was the researcher's belief that it was important that all the girls participating in the workshop be successful at completing the project. As well, the tester was a piece of equipment that would be likely to be used at home, by participants and their families. It was also felt that the regular maintenance the tester was likely to need would serve as a reinforcer to the girls and their families, that they in fact made the tester.

The project is broken down into individual tasks which are completed at separate work stations. The girls rotate through these work stations, which are staffed by female role models (women currently preparing for non-traditional occupations, or currently working in math-, science-, technology- or trades-related non-traditional occupations). Working alongside these women affords the girls the
opportunity to develop a more personal relationship with women that they otherwise may never have the chance of knowing. As well, in order to reinforce co-operative learning, the girls are instructed to teach the task that they have just completed at each station to newcomers to the station, prior to moving on to the next task.

During the lunch hour, the role models give informal career presentations to the girls. The role models are instructed to include information about their early schooling and how they felt as young girls. As well, they are encouraged to share information about how and where they got their emotional and moral support while they were pursuing their non-traditional path.

The day's message to these young women is that occupations need not be gender stereotyped and that being female does not determine whether one has the capability of working within a mathematics, science, technical or trades environment. The importance of retaining math and science throughout high school in order to keep all career options open is continually stressed, especially when the career presentations are being made.

For the purposes of this study, 100 female North York students volunteered to participate in the 1992 It's Your Choice Workshop. Seventy-two agreed to be surveyed and of those 72 only 67 were available for both of the surveys. Of the 72 participants who agreed to be surveyed, only 59
agreed to also participate in the interviews. Some students were intimidated by the idea of having their opinions and feelings captured on audio tape. In actual fact, due to absences and other commitments, only 45 young women participated in the group interviews.

Data Collection

Data for this exploratory study were collected using two methods of data collection. The main method used to collect data involved the interviewing a sample of 45 key informants by the researcher in a small group after participation in the It's Your Choice intervention strategy. The interview method was chosen in order to record descriptions of the participants' reactions to the hands-on workshop and the impact that they felt it had on them in detail.

Prior to participation in the It's Your Choice Workshop, a survey was administered by the North York Board of Education to develop a broad overview of the attitudes these 12-year-old girls held towards mathematics, science and technology, in relation to gender, self, and society, as well as education and careers. For the purposes of this research it was felt that the data gathered from the administration of this survey would be useful as background information. Two weeks to one month after participation in It's Your Choice, the participants were re-surveyed.
The Survey Instrument

The survey used to gather the background information in this study (see Appendix A) is one designed by Greg Chan, a researcher at the North York Board of Education. This survey consists of 43 items. Items 1 - 12 are statements that relate to how these young women feel about their self-confidence and competence in mathematics, science, and technology; items 13 - 19 deal with issues of gender; items 20 - 29 are statements about the usefulness and necessity of these subjects in a societal context; and items 30 - 39 look at the career and education plans of the respondents. The last four items on the survey are questions about the participants' backgrounds. All statistical analysis of the data was carried out by Greg Chan.

Items for the North York Board of Education survey were selected and adapted from the Second International Mathematics Study (SIMS). The items were modified in order to accommodate science, technology and the hands-on component in addition to mathematics. The items for the SIMS survey were selected from the first International Educational Assessment (IEA) mathematics study, from the National Assessment of Education Progress (NAEP) mathematics assessment in the United States and from other existing mathematics attitude scales. Previous analyses of the SIMS survey indicated satisfactory results for reliability (Robitaille, 1981). In the SIMS study items were reported
individually; however, in the North York survey items were
grouped for reporting purposes in the same way that they
were grouped in a report on the Second International
Mathematics Study in Ontario (McLean, Raphael, & Wahlstrom,
1984).

The survey had been previously administered to a total
of 201 young girls in the North York Board of Education
prior to their participation in the It's Your Choice
workshop each year in 1989, 1990, and 1991, the three years
prior to this study. In looking at the data from these
earlier surveys, the mean was found to be 2.296. The
variance was 0.438. The standard deviation was found to be
0.662. The minimum was 1.050, the maximum was 3.538 and the
median was 2.150. The alpha was 0.943 indicating excellent
reliability.

The Interview

The interview questions and format were designed and
carried out by the researcher. In order to accommodate the
individuals and their schools, group interviews were
arranged. The researcher contacted the schools. The
schools then arranged for the girls who had signed
permission forms to meet with the interviewer at a
designated time and place. When the group was gathered
together the volunteers were further informed about the
process. At that time they were given the option to
participate or to return to their classes. Forty-five girls were willing to participate in the taped interviews.

Based upon the literature review for this study, interview questions were designed to document how the girls felt (with respect to their self-confidence and perceptions of their own capability) at various stages of the workshop as well as after the workshop. The interviewer wanted to understand how these girls saw themselves, and how they perceive others saw them in relation to their capability in mathematics, science, and technology related to education and occupations. Questions were also chosen so that the young women's attitudes about gender in relation to self as well as mathematics-, science- and technology-related education and occupations would be described. The interviews were guided by these scripted questions (see Appendix B) and although some latitude for adjustment was necessary during the actual interviews to encourage rapport, and to guide the direction of the discussion, the questions and sequence were largely adhered to in order to ensure that each group had the opportunity to answer the same questions and therefore cover the same issues.

Thus the interviewer entered each group situation with a series of scripted questions which were reworded as required during the interview. Unscripted verbal prompts and summations were often used to facilitate the flow of information. The interviews were taped on a cassette. Last
names of the girls were not included in the interviews. Only groups according to home school were identifiable, and individual confidentiality was thereby protected. The tapes were transcribed.

Selection of Subjects

The subjects studied were 12- and 13-year-old females who were enrolled in 1991-1992 in Grade 7 in the North York Board of Education and who were participants in the It's Your Choice program. The participants for the It's Your Choice program were chosen in the following manner:

Guidance personnel from each school were informed about the It's Your Choice program and were told that they could bring 10 female Grade 7 students to the program. In a briefing in preparation for the program, counsellors were told that their choice of students should permit the broadest range of students to attend this workshop. Therefore neither "good" nor "problem" students should be excluded. The only stated condition for the choice of students was that the students should be interested in attending this workshop. (A copy of the written material distributed to the school guidance personnel prior to the project is included in Appendix C.)

Each school approached the decision of who should be chosen to attend in its own fashion. Some schools simply asked for volunteers. Others chose participants. Ultimately only those students who provided their school
with parental permission to attend the workshop were permitted to attend.

The students electing to participate in the workshop, 100 in total, were then informed about the research project through a written letter (see Appendix D). This letter was distributed with the North York Board of Education special event permission form. They were asked to take the letter home to their parents and to consider whether they would be willing to volunteer to participate in the research, as well as the workshop. They were also informed about the interview process and were invited to volunteer to be participants in the taped interview. It was made clear that their decision whether or not to participate in the research would in no way impact on their invitation to participate in the workshop or in their academic standing at their school.

The girls therefore had the following options:
1. To participate in the workshop, but not to participate in the research
2. To participate in the workshop, as well as agree, with parental permission, to participate in the survey portion of the research only
3. To participate in the workshop, to agree, with parental permission, to participate in both the survey portion and interview portion of the research.

Agreement and permission to participate in the interview,
however, did not guarantee that the volunteer would, in fact, be chosen to be interviewed.

There were a total of 100 participants in the It's Your Choice Workshop in 1992. Although 72 of those participants agreed to be surveyed only 67 of those who agreed to be surveyed and had signed permission forms were actually surveyed due to absence from school on the day of the survey. Of the 72 participants who agreed to be surveyed, 13 of those did not agree to participate in the interview portion of the research. There were a total of 45 girls interviewed. Group interview sessions were set up at nine of the ten participating schools. One school that had participated in the workshop had forgotten to distribute the research information and permission forms and was therefore disqualified from participating in the research. There were approximately 5 girls in each of the group interviews. (Names of the schools that participated in the interview portion are included in the Appendix F.)

Data Processing, Recording and Analysis

Survey

Individual student responses to each of the statements on the survey in April (prior to participation in the intervention strategy) were recorded. Scores are reported for each student in each section of the survey and for the overall total. Scoring for each item is based on a 5-point
scale, with 5 assigned to the most positive choice and 1 for the least positive. The scores on all the items in each of the sections are grouped to determine section scores. The scores for the post survey were gathered and reported in the same fashion. The results were compared (see Appendix E).

**Interview**

The audio tapes were listened to and then transcribed in detail. The content was then read several times and reduced for manageability, reportability and comparability.

**Methodological Assumptions**

The study was predicated on the assumption that participants would be able to describe how they felt prior to, during and after participation in the It's Your Choice Workshop. It was assumed that the participants would be able to identify and articulate why they felt as they did and that they would be willing to share this information with the interviewer. This was based on the assumption that through a variety of interview and facilitation strategies, the appropriate level of rapport and trust could be created between the interviewer and the participants so that they would in fact willingly disclose their views about the workshop.
Limitations of the Study

This study looks at only a very small localized population. Although the North York Board of Education serves a diverse socio-economic population, it must be recognized that the results from this study do not necessarily represent any other region in Ontario or in Canada. Therefore, any generalizations of these results must be done with extreme caution. In addition, only the immediate or short-term effects on attitudes were looked at. Conclusions about the long-term effects of this intervention strategy cannot be drawn from this study.

Due to the fact that a control group was not used in this study it is impossible to say whether the changes that are described by the young women themselves in the interview were the direct result of participation in this workshop.

Researcher bias also potentially limits this study. Any changes or lack of changes in the pre- and post-survey scores must be viewed cautiously. The short time between the two surveys limits the conclusions that can be drawn from the two administrations of this instrument.

Survey Limitations

The potential for growth between April and June is limited due to the relatively short time span between administrations. In some cases where an April score was close to an upper limit, change in a positive direction
cannot be shown. Also, the intervention of a one-day workshop can be expected to have only a limited affect on attitudes, given that attitude change is a long-term process.

Interview Limitations

Because the in-depth interviews were carried out in a group format it must be assumed that this would possibly have an impact on the responses received in the following ways: The interviewees would possibly have felt the pressure of conformity, and as a result may not have felt free to speak their mind. On the other hand, it is possible that the group format provided safety and resulted in participation that would not have been achieved had the interviews been carried out on a one-to-one basis. The information shared in the interviews must be interpreted with caution. The use of scripted questions may have limited the content, quantity and quality of the data collected. The same researcher asked the same set of questions in the same order to each group of participants, but she could not control other factors that may have affected the data collection process during the interview sessions. Also, because the researcher was connected to the workshop, the girls may not have been as candid as they might have been with someone unconnected to the workshop.

Consideration must also be given to the fact that the
data were collected and interpreted by only the researcher. This could affect the validity of the study and give way to researcher bias.

Due to the fact that there was no follow up done with the interview groups the study is limited. It was impossible to reassemble the interview groups due to the fact that the school year was coming to a close and the individuals were dispersing for summer vacation. In a study such as this one, the findings could have been further substantiated with verification from the individuals interviewed. Had this been done, the result would likely be a richer study.

Limitations Related to the Researcher's Preconceptions and Epistemological Stance

Before entering into this research, I must clarify my preconceived notions about an intervention such as It's Your Choice. I believe that through the participation in such a workshop, participants are likely to discover something new about their own capabilities, likes and dislikes. In the interview portion of the research I have looked for these possible changes in self-perception. I also entered into this research with a strong belief that gender bias was firmly and insidiously entrenched in our social and educational system and that this bias impacts on everyone's preconceived ideas about the female's capabilities and place
in society.

Restatement of the Problem

Due to the socialization process as well as the genderization of the disciplines of mathematics, science, technology and trades, girls tend to underestimate their capabilities in these areas and the potential importance of these subjects in their futures. The result is that girls tend to opt out of senior level math, science and technology education, thereby reinforcing the gender stereotyping of these fields as male. If this is to change, the education system must contribute by developing strategies that will serve to encourage female students to pursue education and careers in math, science, technology and trades, thereby facilitating the ultimate desegregation of careers. The question as to whether a hands-on workshop impacts on participants was looked at in this study.
CHAPTER FOUR: FINDINGS

Overview

This chapter contains a presentation of the findings of the group interviews conducted with some of the participants in the It's Your Choice program. The information gathered in the survey done in April prior to participation in It's Your Choice provides the reader with background information about the participants and their attitudes towards mathematics, science, technology, future occupation plans and educational plans prior to their involvement with the program. This is presented at the beginning of the chapter. (Data from the survey done after participation in the workshop are contained in Appendix E.) The group interviews conducted with some of the participants in the program within one month following the program reveal the thoughts, attitudes, and feelings of those interviewed and will be discussed. When appropriate, this information will be compared to the attitudes revealed in the survey.

For reporting and analysis purposes, the survey and the interview findings have been organized into the following four categories: The MYSELF category, which measures personal self-confidence and one's perception of one's competence in mathematics, science and technology; the GENDER category, which reflects one's feelings about gender and its relationship to mathematics, science and technology; the SOCIETY category, which reflects the respondent's
attitudes about the importance and usefulness of mathematics, science and technology in today's society; and the CAREER/EDUCATION PLANS category, which measures the participant's attitudes and ideas about mathematics, science and technology with respect to her future career and educational plans. In instances where participants' interview responses will be quoted, the participant's individual identity will be anonymous; however, the participant's school will be noted in brackets following the quote.

When reporting on the survey results the scores for the terms "Strongly Agree" and "Agree" will be combined. As well, "Strongly Disagree" and "Disagree" will also be combined to facilitate the reporting of the results.

Myself

Background Information: The Survey

Items 1 - 12 in the questionnaire are statements that relate to how these adolescent women felt about themselves in relation to mathematics, science and technology. Issues such as self-confidence, competence, enjoyment and amount of effort they were willing to commit to these disciplines were queried.

One hundred percent of the respondents said that they really wanted to do well in mathematics and science. As
well, 100% said that their parents really wanted them to do well in math and science. Ninety-three percent indicated that they felt good when they solved a mathematical or scientific problem. Fifty-eight percent thought that math and science were fun. It is interesting to note that 42% of the girls did not like people to think that they were too smart in mathematics or science. Prior to participation in the workshop 17% felt they could never be good mathematicians or scientists. Twenty-one percent felt that math and science were harder for them than most people.

Eighty-six percent said that they liked to help others with mathematics and science problems. Seventeen percent said they refused to spend a lot of their own time doing mathematics and science, but 76% felt they would work a long time in order to understand a new idea in mathematics or science class.

The attitudes revealed in the survey around mathematics and science seemed to be somewhat positive; however, they seemed to be somewhat out of sync with the interview comments.

Items 13 - 19 on the survey deal with the issue of gender. The responses to these questions indicate that 91% of those who responded agreed or strongly agreed that studying math and science was just as important for girls as for boys. One hundred percent disagreed or strongly disagreed with the statement that men make better scientists
and engineers than women. As well, 96% of respondents disagreed or strongly disagreed with the statement that "boys have more natural ability with mechanical things than girls."

The survey continues with statements such as "Boys need to know more mathematics and science than girls" (91% disagree); "A woman needs a career just as much as a man does" (94% agree); "Girls have as much natural ability with their hands as boys" (96% agree); "I would trust a woman as much as a man to repair a car or build a house" (88% agree). All of these statements were responded to in a way that indicates a belief in gender equity in terms of abilities and roles.

Items 20 - 29 on the questionnaire are statements which are intended to find out about the participant's attitudes about the usefulness and necessity of mathematics, science and technology in a societal context. The following is an indication some of the attitudes the participants had prior to participation in the workshop. In the statement "An understanding of technology is not needed in everyday life," only 46% of the respondents strongly disagreed or disagreed with this statement and 33% had no opinion. This statement is followed by "It is important to know mathematics and science in order to get a good job." Eighty-six percent of the respondents indicated agreement with this statement. However, the survey goes on to indicate that 60% of the
respondents strongly disagree or disagree with the statement "Most people do not use mathematics and science in their jobs."

The survey continues with statements such as "Skilled trades like carpentry or electronics do not require much knowledge of mathematics and science" (2% agreement); "Math and science are useful in solving everyday problems" (85% agreement); "I can get along well in everyday life without using mathematics and science" (9% agreement); "Most of the mathematics and science I learn has practical use on the job" (63% agreement); "Mathematics and science are not needed in everyday life" (10% agreement); "Understanding technology will be an important part of life in the future" (77% agreement); "I expect to have little use for mathematics and science when I get out of school" (32% agreement).

Items 30 - 39 on the questionnaire look at the career and education plans of the respondents. The following emerged on the survey:

Fifty-six percent agreed with the statement "My teachers have encouraged me to continue to take mathematics and science courses." Eighty-five percent disagreed with "If I had my choice I would not learn any more mathematics and science." Only 5% agreed with the statement "My parents would think I wasn't serious if I told them I was interested in a career in science, mathematics or technology."
Seventy-six percent felt that they were interested in continuing to study mathematics and science because of the career opportunities it will open for them. Only 7% indicated that they would not like an occupation where they used their hands. Sixty percent indicated that they would like to work at a job that lets them use math or science. Seventy-seven percent indicated that they felt the knowledge of mathematics and science would become increasingly important in the high technology careers of the future. Thirteen percent felt that their teachers would not think they were serious if they expressed interest in a science, math or technology career. Ninety-four percent of the girls said they are planning to go to college or university. Eighty-five percent felt that they would continue taking mathematics and science courses in secondary school.

The 1992 It's Your Choice participants were surveyed again two weeks to one month after the workshop. There was no change between the April and June scores in the Myself category, or in the items related to Gender. Through the use of a paired sample t test, it was ascertained that there were statistically significant increases in the Society and the Career categories and in the overall total (see Appendix E).

The Interview

During the interview I asked four questions which
related directly or indirectly to the girls' self-confidence and/or perceived competence in relation to technology. Two questions deal with how the young women felt before they had been through the project:

1. How did you feel when you saw the continuity tester and realized that you were going to be making this?
2. Did your feelings about your ability to successfully complete the Seneca project change throughout the day? If so, when?

The third and fourth questions, which deal with feelings of self-confidence and self-efficacy after completion of the project, are as follows:

3. What did your family think about what you had done? How did this make you feel?
4. How did it feel to have people think that you could not possibly have made the tester?

In response to the first of these questions "How did you feel when you saw the continuity tester and realized that you were going to be making this?" the overwhelming response from all the groups interviewed, irrespective of the school that they attended, was that the individual participants felt that they were not likely to be successful at completing this project. The following responses were typical:

I didn't think that I would be able to make it because
it looked really complicated. (Brookview, Cummer, Elia, Beverley)

I thought the wiring would be too hard.
I was scared and I didn't think that we would be making it all by ourselves. I thought for sure that someone else would be doing the hard stuff for us. (R.J. Laing, Dublin, Humber)

A number of girls throughout the groups interviewed recalled being anxious about using the machines. They were worried about the possibility of "messing up" and of "hurting themselves." These answers seem to reflect the low level of confidence that these girls had with respect to their ability to be involved in a hands-on technical project prior to working on the project.

It was interesting that these feelings of self-doubt were so widespread, for it was revealed in the interview process that they all had been previously involved in shop (industrial arts) activities at their respective schools.

When questioned further about their industrial arts experiences at school I found that one of the main reasons they felt their in-school shop experience was less than positive was due to the fact that they do not make "useful" things in their own shop. They were excited and impressed about the fact that the project made at Seneca was one that
they and other members of their family could use. This was expressed in several ways and at several different times during the interviews, for example:

Seneca's shop was better than our shop, because in our shop we make stupid little aliens. (Don Mills)

We like that we could USE the Seneca project. When you make useful stuff you really feel proud. (Dublin)

We got to do stuff at Seneca that was really actually something that we could use. (Cummer)

It's not your usual plastic or wood object. It is something different. It does something, you use it. (R. J. Laing)

I then asked the second question dealing with their feelings about their ability to successfully complete the Seneca project, whether they changed throughout the day, and if so, when and why? It was common to hear that yes, they got more confident throughout the day. They said the following:

When we were actually doing it we realized that it was not really that hard. (Humber)
When we were actually doing it, it seemed easy and fun. (Beverley)

When we got to the wiring we realized that it would be o.k. (Donview, Ledbury, Cummer, Elia, Dublin)

Once we got going, and could ask the women questions, it got easier. (R. J. Laing)

Still others were unable to feel confident about their ability to be successful until the very end, when they saw that the bulb actually did light up.

I wasn't sure I could do it, but I wasn't worried, because if it didn't work, then I knew that my dad would fix it. (Elia)

There were several individuals in a couple of the groups interviewed who felt quite a bit more positive about the prospect of making the battery tester right from the start of the project. However, I must add that these positive attitudes and expressed feelings of self-confidence seemed to be tempered with a mild, but honest dose of scepticism. One such student reported that at the outset she felt:
I do things with my dad, so, like I thought it wouldn't be THAT hard. (Dublin)

Another said,

I thought it would be possible because why just think that they [boys] could do it, because if they could, they why can't we [girls]? (Don Mills)

And still another response was:

I knew I could build it, if only I know HOW to do it. (Brookview)

Some of the students also expressed that the role models had a positive impact on their feelings of efficacy by saying:

When the women [role models] showed us what to do it got easier. (Dublin)

Once we got going and could ask the women [role models] questions, we felt a lot more confident. (Elia)

I then asked the third question that deals with self-confidence. I inquired, "What did your family think about
what you had done? How did this make you feel you feel?"
As reported by the interviewees, the common response by
family members to the fact that these girls made the
continuity/battery tester ranged from disbelief and
amazement to mild surprise.

You mean you made that? Are you sure? (Dublin)

You couldn't possibly have put all those wires
together. (Beverley)

From every school, girls reported feelings of extreme
pride that their families were impressed with their
accomplishment and that important family members in fact
were using the testers. The following comments seem to
illustrate that these girls, in response to the feedback
that they received from their families, experienced a great
deal of pleasure and positive feelings about themselves.
One girl said:

My brother, who makes stuff at home didn't think that I
made it because he thought I was too dumb or something,
so I showed him the insides and he said, wow, I didn't
know that you could make something like that. (Dublin)

Another girl from the same school said,
My parents thought it was great, they believed me and everything, but my brother didn't think I made it, he thought I stole it or something. (Dublin)

My dad took it and now he has it and is using it. That really makes me feel happy and proud. (Humber)

I felt great, powerful, that I could do something. (Beverley)

My family was amazed and glad.
I ended up feeling proud, pleased and capable.
I had to fix it when my brother blew the bulb. It felt GREAT to fix it. (Elia)

My mom and dad said it was good that I could make something like that, and it came in useful because my uncle fixed a lamp with it. I was really proud and stuff. (Don Mills)

I took it apart to see what I did, then I changed the bulb and it worked again. That felt amazing. (Brookview)

I gave it to my grandfather for his birthday and he couldn't believe that I made something that costs $30
in the store. (Ledbury)

My dad keeps it in his garage with his stuff and uses it. He likes it and that makes me feel good that I actually did something that is worthwhile. (Cummer)

These positive feelings of self-efficacy were voiced at another point in the interview when I asked the interviewees the fourth question in this series: "How did it feel to have people think that you could not possibly have made the tester?" There were three types of answers to this question. Many girls said that they found the disbelief annoying. They were slightly indignant about having to prove to their peers or families that they had made these testers themselves.

It's annoying. If they don't believe it, it is hard to prove. (Dublin)

Upset because they think that girls cannot do things like that.
They'd believe it if guys made it. (Humber)

I felt bad because not only men can do this you know, women can too. They make you feel like you are lying. (Donview)
I told them to stuff it.
Angry. (Don Mills)

I was upset, cuz they didn't believe me and think that I would be able to make it. (Brookview)

It bothered us, some people said it probably doesn't work. (Cummer)

Others felt that the disbelief only increased the positive feelings that they had about their accomplishment.

I liked it. It made me feel like I did something that other people can't do. (Donview)

I felt great because they thought that they couldn't make it. (Brookview)

I felt good that we accomplished something. (R.J. Laing)

I felt proud. I use it and each time I feel "I made it" - it's my creation, so I don't care what they think. (Ledbury)

It was also common to have the girls say that they
understood others' disbelief.

They felt the same as we felt - that thing looks too
good, too hard for us to make, but then you get to know
it and it is easy. (Beverley)

I surprised myself by making this, so I guess I
understand their being surprised that we could make it.
(Brookview)

It's a normal reaction really. When you look at it, it
looks professional, so I understand. Parents would
probably be surprised if boys made it too, but the kids
at school would be more likely to believe that boys
made it. (R.J. Laing)

Attitudes About Mathematics: The Interview

In spite of the background data revealed in the survey,
the interviews seemed to indicate much less positive
attitudes about mathematics. They revealed a range of
answers to the question "When I mention the subject math,
what is your immediate gut reaction? Why do you think that
you feel this way?" Answers ranged from "I like math, it
can be fun" to "ICH!! I hate math, it's boring."

The discussion that ensued revealed that there was a
common theme suggesting that math was boring and the result
was that only a very few students felt positive about the subject. Many placed the responsibility for their negativity about math, as revealed in the interview, on the teaching style. For example:

The teachers talk too much. (Elia)

It's boring watching the teacher just teach. (Donview)

Our teacher doesn't really teach us. You have to go in a lot [for extra help] if you want to learn something, otherwise you don't really learn that much. Some math teachers don't explain enough. I can't stand math, it's too hard and I'm embarrassed by the teacher. (Don Mills)

There is a lot of pressure in math; the teacher treats you like you don't have an opinion. Everything has to be perfect. If you get an answer wrong, she screams. It's "yes" or "no" for her, not "maybe." She embarrasses us, and never gives us a second chance. (Don Mills)

I find math much easier than most in my class, but I still don't like it because it's so boring. We don't learn anything when the teacher just talks. (Ledbury)
The repetitiveness of math was often mentioned as a reason for finding math boring.

Multiply, divide, just goes on and on. (Elia)

I don't like doing the same thing all over again. We do drills every single day. (Don Mills)

So many numbers and so many things to remember. (Ledbury)

It was also very common to hear:

It's hard, it's too hard, it's lots of work, memorizing and multiplying is too hard for me. A lot of kids in the class think it's kind of hard and it doesn't make sense. (All schools)

The above comments were heard from at least some students at all the schools. Finally, it was quite common to hear:

I'm not really good at math.
I don't find it fun or anything.
I wish they could make math more funner [sic].
I like to be more active. (All schools)
The interview revealed that there were a very few unique students who felt quite positive about mathematics. They said:

It's ok; fine; interesting; love it; it's fun.
(Beverley)

I like math when I'm good at it. (Don Mills)

It's easy for me of course, cuz I came from Hong Kong and we have to work really hard at it.
I think it's easy and I love it. (Ledbury)

It's not my favourite subject, but it has always interested me. (Dublin)

Attitudes about Science: The Interview

In the interview they were then asked, "How do you feel about science?" The overall opinion about science was that they enjoyed it more than math. It was a common response that science was:

Kind of interesting, better than math because you are looking at nature, not just at a textbook. (Humber Summit)
I love it, you learn about the world around you.  
(Beverley)

I love science. (Don Mills)

It seems that the girls interviewed enjoyed that they were active in science (as opposed to doing book work) and this was a contributing factor to their overall satisfaction with the subject. Most said that:

I like the experiments and projects. It's generally more fun because you are doing things. (Donview)

I love it when we get to do our free stuff, to explore the world. (Don Mills)

We sometimes get to go outside, look at nature - now that's fun because it is something that I can relate to. (Cummer)

Most said that they really did not use math in science.

In response to both questions about math, and about science, it seemed that there was a direct relationship between the girls' positive attitude about each of the subjects and their own perception of their ability to do "OK" in the subjects. Those who liked the subjects felt that they did "OK" in the subjects. This was a typical
Science is ok. I'd say I'm pretty good at it, there is stuff that I sometimes don't understand, but I try. I do pretty good in science and I like it a lot. (Dublin)

As with math, these girls felt that in science the teacher had a significant contribution to their attitude towards the subject:

The teacher makes it fun, it's boring when the teacher just talks and talks and talks. (Humber Summit)

The majority do not like science — they think that the teacher leaves a lot to be desired. (Dublin)

Science is cool, but in this school it is boring because the science teacher here assigns us a page and leaves and then comes back at the end of the period. (Don Mills)

However, a few students felt that the measurement and the conversions required in the experiments were in fact using math.
We use math in science, and that math is easier than regular math, and it's fun too because you understand what you are doing. (Brookview)

Several of the students, who liked math and science, were wanting to do more complex math in science class.

A Dublin student was extremely enthusiastic about science. She said:

I do pretty good in science and I like it a lot; I was chosen with four other guys to do some individual projects, really advanced stuff, and that was kind of fun, because I really like science. (Dublin)

Gender

The Interview

Although the survey indicates that these young women feel that there is gender equity in their lives, a much different picture was revealed in the group interview. When asked, "What was the response like when you got back to school with the completed tester? What did the other students say?" the overall common response to this question was that their fellow students reacted with disbelief. They had a difficult time believing that these girls in fact made these testers, by themselves, from "scratch." "They did
not believe that we made it" (everyone). The participants reported that they were accused of "buying it, stealing it, borrowing it, anything but making it." Similar responses were given when I asked the groups, "What did your family think about what you had done? How did you feel?"

I continued on with the question, "Why do you think that people have the reaction of disbelief?" The majority of girls, regardless of school, answered that they felt that their peers and family do in fact think that girls are less capable in this area than boys. They answered:

Because we are girls! (Elia, Ledbury)

They think girls can't do things like this. (Humber)

Because we are women, and we are not capable of it. (Donview)

They probably think that girls can't do that, only boys can. (Cummer)

Because it looked too good and they don't think that girls can do it.

They think that they can't make it, so there is NO WAY that we [girls] could do that. (Don Mills)
I then probed further by asking "How did it feel to have people think that you could not possibly have made the tester?" There were three types of answers to this question. Many girls said that they found the disbelief annoying.

Upset because they think that girls cannot do things like that.
They'd believe it if guys made it. (Humber)

I felt bad because not only men can do this you know, women can too. (Brookview)

It was also common to have the girls say that they understood other people's disbelief. After all, they themselves were sceptical at the start about their own ability to make the project.

They felt the same as we felt - that thing looks too good, too hard for us to make, but then you get to know it and it is easy. (Beverley)

I surprised myself by making this, so I guess I understand their being surprised that we could make it. (Elia)
It's a normal reaction really. When you look at it, it looks professional, so I understand. Parents would probably be surprised if boys made it too, but the kids at school would be more likely to believe that boys made it. (R.J. Laing)

Responses such as these seem to be somewhat at odds with the survey, which indicates that these girls do believe, at least in principle, that there is equity in math, science and technology and females are as capable as males.

The interviews further demonstrate that the respondents believe that those around them are deeply entrenched in attitudes which are gender stereotyped. I asked, "What is the main message that you get about being a girl?" The answers to this question varied. It was fairly common to hear that these girls got the message that they were unequal and not as capable as boys.

They don't think that we can be an engineer or anything like that. (Humber)

Guys are the best, girls are second best, girls are wimps.
Girls can't do anything, they're sloppy, all we can do is makeup and hair. (Donview)
Boys are more equal than women.

My dad makes rude comments, I give him heck. (Don Mills)

Some people say that girls can't do it like boys.
(Brookview)
Boys are better than us and girls can not do as well as them. (Cummer)

In spite of how the survey was answered, it was quite common for these girls to make comments in the interview that indicated that they themselves and those around them have gender-stereotypical attitudes about females. In many instances these comments seem to have seriously negative undertones. The following comments illustrate this:

All girls can do is makeup and hair. (Donview)

Girls need to stay away from trouble, or they'll get pregnant. (Don Mills)

Girls are supposed to stay in the kitchen and cook and clean. The wife stays home and takes care of the kids and the guy goes out and has to bring home the paycheque. (Brookview)
Girls have more responsibilities. (Ledbury)

Boys think that girls are kind of stupid. It's not right that women should just bear their [men's] children, give them pleasure. We sure can't think of men like that. (Cummer)

It was far less common to hear positive remarks about girls from the respondents; however, there were a few:

I haven't encountered many stereotypes. I can do pretty much anything that the guys in my class can do in terms of school work, shop, etc. Maybe I am not as good in sports. (Dublin)

Only old-fashioned people think that we can't be things like engineers. (Humber Summit)

Girls are brainers. (Donview)

We are encouraged more than when our parents were around. Basically we're equal and girls can do anything that boys can do. (Don Mills)

As a group, the girls from Ledbury seemed to have, overall, the most positive attitudes about being female. They said:
Boys and girls are equal.
You can do just as well as they can.
Girls are better.
Girls have more responsibilities. (Ledbury)

I then inquired, "If you could come back to this world as a boy or girl, which would you choose and why?" It was common for those who said that they would prefer to come back as girls to explain this with some very stereotypical reasons such as:

Girls can dress up.
There's more things for girls, dressing up, shopping, friends, makeup and going to parties. (Donview)

Girls dress better, have better hair and look better. (Don Mills)

You get to bring life into the world. (Humber)

I really think tradition is cool - guys doing heavier work, I like the tradition that girls are paid for when you are out. (Cummer)

Some additional reasons mentioned for wanting to come back as a girl were:
A girl can do anything a guy can do, even if they might get a hard time from the guys. (Dublin)

It's based on your attitude and how you look at it: if you go for it, you'll get it. (Humber)

Girl, because boys are so immature at this age and they don't see how serious some issues are. (Cummer)

Girl, because girls are going to have good opportunities because of the work that is being done by and for women now. (Cummer)

I would want to come back as a girl mainly because I don't like the way guys act, I am used to being a girl, so I'll stick with it. (Cummer)

Girl because now the world is geared to women. Women can now catch up really fast and now it seems to be an equal world. Guys are still living the same as they always have, but girls are coming up in the world and overtaking a little bit. (Cummer)

An almost equal number of the girls interviewed felt that they would rather return to this world as a boy. They felt that boys had more opportunity, more freedom, were
physically safer and they had less responsibility than girls.

Boys have more opportunity, especially in sports. Boys have more freedom, it's assumed that they can take care of themselves better. Boy, because they can do anything they want; girls are getting raped. (Beverley)

I'd rather be a boy because I wouldn't have to go through as much pain. (Elia)

Guy - they don't do chores, don't get pregnant, they get off with everything, they don't get stuck with the baby. (Donview)

A very few girls felt that they really couldn't make this choice because they had no idea what it was like to be a boy. Their answers sounded like this:

I'm not sure because I don't know what it would be like to be a guy, our brains would be the same, but maybe I wouldn't get pushed around as much for playing soccer. (Dublin)

It's hard to choose because I don't know what guys are
thinking deep inside their head. I like the way that I think, and I like the way I am, so I'd probably want to be a girl. (Cummer)

It's hard to say because I have never been a guy, so I don't know what goes on between guys and guys. I've talked to my brother and he says that he'd rather have the relationship that girls have with girls because it's a lot closer. There is a lot more bonding. I like having someone to express my feelings to. (Cummer)

The answers to the final interview question about what they basically got from the workshop seem to indicate that some of their final thoughts were ones that challenged some of their stereotypical attitudes about females and their roles and capabilities. They said:

Now I know that I can do that. I know that girls can do whatever guys can do and vice versa. (Dublin)

This proves that girls can do this kind of thing. This workshop can change people's negative attitudes about girls working in the trades. (Humber Summit)

Not only guys can work with their hands. Girls can too! (Elia)
Not only men can do it – maybe I can do it better.  
(Donview)

I can do some things that a guy can do, like make stuff with wires and bulbs.  
It shows the guys that we can do anything that they can do and better.  (Don Mills)

I found this different because women were teaching us this. I wouldn't really think that women would teach this at a college, I thought it would be men. I learned that I could do what my dad does. (Cummer)

Society

Usefulness of Mathematics, Science and Technology: The Interview

Although the survey seems to indicate that these girls had a strong belief in the importance of mathematics, science and technology in life, the interviews seem to both support this and, at the same time, indicate that the young girls often have difficulty truly putting this into the context of life as they know it. For instance, one Dublin student explained her feelings about mathematics in the following way:
I think I'm OK in math, but some of the stuff we do, it's hard to understand where we'd ever need it in life. (Dublin)

In the group interviews I asked "Do you really believe that you will need math in your life?" Almost all responded that yes, they believed that it was important for the rest of their life; however, the only tangible reason that the majority of respondents could come up with was that "you use math for figuring out money, taxes, buying things and billing clients."

Several girls understood that math was important if one worked in a field that required measurements, such as architecture, carpentry, engineering. Several others felt that you just had to have it because "it looks good on your resume," "you need it to get into university," and "even if you don't use it every day, you need it just in case." I got the feeling from their responses to this question that because they had been told about the importance of mathematics by their teachers and their parents, they believed that you need mathematics (mostly because everyone says so) but they still did not have a solid, tangible understanding of how it would in fact be useful to them.

The interview responses indicated that the girls were more able to understand science and its connection to the real world. From the responses, it seems that these girls
have an easier time relating to science and the course content than to math. Perhaps that in turn results in their having a better understanding about its potential usefulness in life. One girl said:

A good teacher makes science fun. Everything is related to science, even cooking can be part of science, so it is really important. (Cummer)

However, the other extreme was also expressed:

I hate it. Why waste your time taking things you don't need?
Sometimes it's useless, sometimes it's worse than math - you're not going to use it. (Beverley)

When I asked the girls what they thought they got from the It's Your Choice workshop, several of the students articulated that the workshop left them with a clearer understanding of the importance and usefulness of mathematics and science.

It helped me see that math and science are useful. (Dublin)

It made me realize that I really do need math and so I
better do my work. (Beverley)

It was interesting, I never knew that science was so important. (Elia)

**Importance of Doing Well in School**

I also asked "What messages do your parents give you about doing well in school? Do your parents feel that some subjects are more important than others? Which ones?" All the girls reported that their parents stressed that it was important to do well in school. They all said that their parents felt that math and science were extremely important. Comments that demonstrated this message were as follows:

They said I have to do good in most of the subjects, but math is the subject that they really want me to do good in. (Dublin)

They'd get really mad if I failed both subjects [math and science], or even just one; they'd rather I get a better mark in science and math than in subjects like geography and history. (Dublin)

Keep math because you need it. (Humber)

Work hard and reach your goal and study in math really
They tell me that math and science at the advanced level are the things that lead you to better careers. Math, English and science are the most important. (Beverley)

My parents want me to go to university [said with an attitude of "Can you believe that?"] and they tell me to do good in math and science. (Elia)

Math and science are the most important things in school. (Donview)

They tell me to do well in math and not art, but I love art. (Brookview)

They say that as long as you try your best and understand that math and science are always going to be in your life, so you gotta know the basics. (Ledbury)

My parents are pretty hard on me. I get grounded if I don't do well enough. I have to get 80s and their biggest emphasis is on math. (Cummer)
The survey results support these remarks. One hundred percent of the respondents in the survey agreed or strongly agreed with the statement "My parents want me to do well in mathematics and science."

Career And Education Plans

The Interview

In the group interviews I asked whether they had a "dream occupation," and the most common response was that they wanted to be a doctor (paediatrician or psychiatrist) or a lawyer. The other less common occupations mentioned were fashion designer, dentist, and actress. The following occupations each were mentioned only once throughout all of the interviews: pianist and mechanical engineer (mentioned by the same person), construction stuff, veterinarian, design technician, police officer, and working with computers.

I then asked if they had any ideas what their parents hoped that they would become. It was quite common for these girls to feel that their parents wanted them to "do whatever I want to do," but when they were asked "Yes, but what do you think your parents secretly would like you to become?" the occupations doctor and lawyer were the most common responses.

Many of the girls seem to think that the interactions
with the role models and their career presentations in the It's Your Choice Workshop added a bit of reality to their occupational thoughts. I asked how they felt about the role models. All the girls responded that they really liked working with them. They especially liked that these women talked about how they got into their present jobs, and not just about the job itself. Some comments were:

I like the way the women told us how they got higher up and how they got to do what they like to do. That gave me an idea that I could change jobs if I didn't like what I was doing and I could be whatever I wanted to be. (Dublin)

It was really good having them there because they tell the REAL story, they tell the downfalls - how they had to change occupations, because their first choice of secretary didn't really turn out. (Humber)

The Final Interview Question

The responses to the final question of the interview session, when compared to the responses to the initial two questions about how confident these girls felt when they first came into the Seneca shop, seem to indicate that perhaps a change in the girls' attitudes about themselves in relation to their ability to be successfully involved with
technical projects did take place upon completion of project. I asked, "What would you tell someone about the It's Your Choice Workshop with respect to what you got from attending it?" They answered:

That if I want to do something, I can do it!
I can do whatever I want to do. (Dublin)

You can do what you want to do if you put your mind to it.
You can apply yourself and the results will be rewarding.
This has given me confidence. (Humber Summit)

I felt more confident, I want to be what I want to be.
It is a good experience for women because it helps them believe in themselves and then say I can do this.
It gives you self-confidence. (Beverley)

Before in shop I felt that I probably would get an F because there's nothing I do that is perfect. After I came from the Seneca workshop, I started getting all these good marks because I felt positive - like Wonder Woman. (Beverley)

I felt capable and that there were more possibilities
in life.
Before I didn't think we could do something like work
in electronics, now we think that we could.
I feel proud, happy, confident. (Elia)

It was fun. You'll feel proud, with a sense of
accomplishment.
You can say "I made that," and nobody can say that I
didn't.
If I can do it now, then I can do it in the future.
(Donview)

I came out feeling strong.
I feel that I can do anything if I put my mind to it.
(Brookview)

I rate it a ten. It gave us the self-confidence that
we have now. (Ledbury)

I found out that I'm a little bit talented in this
stuff.
I liked it because I found out that I can actually do
something without breaking it.
It shows you things that you'd think you couldn't do
before and you have learned how to do them. (Don
Mills)
I found out about some abilities that I didn't know I had.
I never realized that this kind of stuff was so easy.
I always thought that it was really, really complicated and I found that I could actually do it. I was pretty amazed actually. (Cummer)

However, it must be noted that there were a few girls, in some of the groups interviewed, who said that they felt relatively confident in the shop area from the start. They answered the above question in the following way.

I always knew that I could do something like this, but I'm glad that I actually proved it now. (Beverley)

I knew already that I could do these things because I do them at home with my dad. (Brookview)

The final interview question also reveals that the participant felt that participation in the It's Your Choice Workshop broadened the career/educational options that they would now be considering. They said:

It showed me that there is a variety of things to do. (Dublin)
The hands-on experience gave me an idea of how much fun it is to do this kind of thing and that may affect your choice of job. (Humber Summit)

You learn about non-traditional jobs and that women can do it too. (Elia)

I didn't think that we could do something like work in electronics, now I think that we could. (Elia)

I learned more about non-traditional jobs and that women can and not just men can do these jobs. (Ledbury)

After this I am really thinking of a job within science and math. (Cummer)

With women teaching I could really relate to them and them to us and I could see what I wanted to be when I grow up. It really shows me that it is wide open for me. (Cummer)

**Summary of Findings**

In this chapter, the findings from the survey and the interviews have been reported in relation to the categories of Myself, Society, Gender and Education/Career.
The Survey

The two administrations of the survey indicated that there was no change between the April and June scores in the Myself category (personal self-confidence and competence in mathematics, science and technology) or in the items related to Gender. There were statistically significant increases in the Society and the Career categories and in the overall total. The difference in survey scores between April and June may indicate positive growth in overall attitudes towards mathematics, science and technology and more specific growth in the categories related to the societal importance of these areas of study and their impact on career plans; however, any such conclusions would need further substantiation.

The Interviews

Throughout the interviews the young women often referred to the gender stereotyping of roles and occupations. It was clear that they believed that their peers and families felt that they were less capable than males in the areas of math, science, trades and technology. The difficulty everyone (the participants, their peers and their families) had in believing that the participants were capable of constructing the continuity/battery tester was seen by those interviewed as having much to do with the fact that they themselves are girls. The participants' many
comments related to the gender stereotyping of roles and occupations indicated that many of these young women felt that being female resulted in limited opportunities, limited safety and limited freedom. However, some of the participants did not experience these feelings, and felt that our society today, due to all the special initiatives aimed at women, would provide excellent opportunities for females.

The interviews revealed that, prior to and early on in the workshop, participants were very concerned about their ability to successfully complete the continuity/battery tester. Their comments also revealed that the majority of participants had an overall lack of self-confidence in relation to mathematics, science and technology education. According to the participants, confidence levels increased throughout the day, with respect to their hands-on abilities. Upon completion of the project many expressed that they felt "proud, competent, confident," indicating an increased level of self-efficacy.

Participants claimed that participation in the program helped them gain a clearer understanding of the usefulness of mathematics and science, and an appreciation of the important place technology has in everyday life. They also expressed the desire to do well in math and science and they plan to continue to study these subjects at the senior high school level and perhaps in university. The responses in
the interviews indicated that, after participation in the It's Your Choice Workshop, these young women had a broader perspective with respect to career options. Many of the participants said that they now felt that careers in these domains were viable options because they now realized that they "could do it" and that "it's wide open for me" with respect to careers in math-, science-, technology- and trades-related fields. Still others went as far as saying that participation in the workshop has really led them to consider a job within science, technology or mathematics.
CHAPTER FIVE: SUMMARY, CONCLUSIONS AND IMPLICATIONS

Overview

In this chapter, the main focus of the study and the findings will be reviewed and summarized. Conclusions will be drawn and a synthesis proposed from the findings as related to the problem stated and the research questions asked in Chapter One. Implications for practice and theory, and recommendations for further research will be discussed.

Summary

This study has explored the immediate, short-term impact of the one-day It's Your Choice Workshop on the participants. The research has revealed participants' expressed attitudes about the study of mathematics, science and technology and their feelings about careers in these disciplines. More specifically, this work has looked at:

- participants' expressed feelings of self-efficacy with relation to the hands-on project,
- their perceptions of themselves and their capabilities, particularly with respect to mathematics, science and technology-related education
- their thoughts and feelings about the importance and usefulness of math, science and technology in their future and in society
- their thoughts and feelings about being female and
the effect gender has upon their capabilities and upon career choice and opportunities

- their thoughts about their future academic and career options approximately one month after participation in the It's Your Choice Workshop.

This research provides evidence of the effectiveness of this program and suggests the need for its continuation.

The research was exploratory in nature, and was mainly qualitative in nature although some qualitative elements were used for background and comparative information. The research consisted of the following four segments:

- survey of participants
- participation in one-day hands-on intervention strategy called It's Your Choice
- re-survey of participants, and
- group interview of selected participants.

The It's Your Choice Workshop is an ongoing intervention strategy, developed by the researcher in collaboration with the North York Board of Education. The program was first delivered in April, 1989.

Previous research indicates that in order to be effective, intervention strategies that have the goal of promoting the study of mathematics to females should appeal to young women at the affective level, the cognitive level and the achievement level. A combination of the affective
level and achievement level is seen to be most beneficial in terms of potential effectiveness (Lantz, 1985). Other research indicates that workshops which appeal to the cognitive level by promoting the concept of usefulness are highly affective (Fennema & Carpenter, 1981). Still other writings stress the importance of role models on girls' attitudes about math, science and technology and their related careers (Herring, Lafontaine & Saindon, 1985).

According to the research, the age at which interventions have the potential to have the most impact is a contentious issue; however, there is consensus among most researchers that pre-puberty is an opportune time for interventions which deal with occupational choice in relation to sex role stereotyping (Herring et al., 1985). This researcher agrees that pre-adolescence is an important time for such an intervention due to the fact that at this age students begin to think about the choices they will be making with regards to the subjects they choose to study in the high school years, and this is the age when girls tend to develop negative attitudes towards non-traditional work (Herring et al., 1985).

It was with these theories in mind that the It's Your Choice Workshop was designed to be delivered to twelve- and thirteen-year-old Grade Seven girls. The hands-on component was included to foster feelings of self-efficacy and enjoyment and to promote math-, science- and technology-
related vocations as viable career alternatives. The involvement of role models as participants in the hands-on portion of the workshop was based on the premise that working together would provide participants with the opportunity for a more personal encounter and that this one-to-one contact would have more impact on the young girls. At lunch hour, the role models gave career presentations to the group. The decision to include this type of activity was based on Lantz's (1985) work which stressed that "career workshops" convey information that has the potential to lead to additional career exploration, definitely an objective of this intervention. Role models were instructed to give the young girls information on their lifestyles and the various roles (e.g., wife, mother, friend, employee) in which they are involved. The role models also talked about their lives as non-traditional teenage girls, and where and from whom they got the support and encouragement they needed in order to continue with mathematics and science and their non-traditional career path. It was believed that this type of presentation would better enable the workshop participants to relate to the role models than traditional, straightforward career presentations. In turn, the participants would gain a better understanding with regards to the usefulness of math, science, technology and trades, and the importance of pursuing these subjects successfully in high school.
During the two weeks prior to participation in the workshop the young girls were asked to respond to the survey. In the month following participation in the workshop they once again answered the same survey. In that time period the researcher also went to each participating school and interviewed a group of the participants.

Conclusions

The four main questions/categories which guided this research provided the basis for drawing conclusions. Although the survey indicated some changes in scores in the Society and Education/Career sections, the interviews clearly depicted how the girls felt in relation to the four categories after participation in the workshop. From the participants' perspectives, as described in the interviews, it was clear that participation in the workshop had an important impact on them in all of the categories used in the research.

Myself

Self-confidence.

Although the survey showed no change in the overall mean score in the Myself category between April and June, individual scores did show some change, and the interview sessions reflected a definite change in the girls' comments
about feelings of self-confidence in relation to their ability to work in a shop. In spite of their previous experience in their school industrial arts classes, the majority of these girls reported that at the beginning of the workshop they experienced strong feelings of self-doubt with respect to their ability to successfully complete the continuity/battery tester. It was clear in their accounts to the interviewer that these feelings of self-doubt were gradually alleviated throughout the day and that at the time of the interview a great many of the girls felt "capable," "proud," and said that now they knew that "I can do whatever I want to do, I just have to put my mind to it."

Myself and mathematics and science.

The survey revealed that all the respondents wanted to do well in mathematics and science and that they also felt that their parents wanted them to do well in these subjects. Although a large majority (93% in April and 95% in June) reported that they felt good solving mathematical problems, the June survey still indicated that a significant portion of the girls surveyed (28% of the respondents) felt that they were not very capable in science and mathematics (down from 34% in April). These feelings are very much in line with the findings of Boswell (1980) and Fennema and Sherman (1978). The fact that there was a decrease between April and June in the survey results of the percentage of
participants who felt that they were not very capable in science and math as well as a percentage decrease of those who felt that science and math were more difficult for them than for others (21% in April and 19% in June) may indicate that involvement in the workshop impacted on these girls in a positive way. It is important to acknowledge that these score changes may only be attributable to individual shifts. A number of other factors such as the halo effect and influences occurring at school may also have contributed to the change.

In spite of the above-noted attitude changes, the interviews unearthed some fairly negative attitudes about the participants' own abilities to excel in mathematics, as well as their attitudes about mathematics as a school subject. This would seem to imply that the workshop was not able to completely erase some girls' lack of confidence in math. Rather, the overall boost in self-confidence expressed by the participants may have been generalized to include mathematics. It is possible that the participants will bring this attitude to future academic endeavors involving mathematics, science and technology or any other related discipline traditionally perceived as difficult.

It is interesting to note that the participants in this study placed the responsibility for their negativity about math, and their inability to do well in the subject, on the teacher and the teaching style. This is contrary to Bar-
Tal's (1978) theory which posits that females tend to attribute their failures to internal, stable causes. Due to the fact that attributional style was not identified prior to participation in the workshop, it is impossible to determine whether the hands-on shop experience impacted on the participants in such a way as to affect their attributional style.

As with math, these girls tended to hold their teacher responsible for their attitudes about science and their success or lack of success in the subject. The researcher's overall impression, from the groups interviewed, was that these Grade 7 girls tended to enjoy science more than math, and this enjoyment seemed to be related to the following two factors: they reported that science demanded active involvement through participation in scientific experiments (as opposed to book work) and it was easier to relate to science and see how it fit into real life and was useful.

Society

Usefulness of math, science and technology.

According to a great deal of research (AAUW, 1992; Sherman, 1979; Wiggan, 1982), one's understanding and belief in the usefulness of a particular academic subject (mathematics, science, technology) will greatly affect one's achievement in that academic discipline, and therefore it is
seen by these researchers as an important factor in one's decision to continue to study that subject when the option arises. It has been documented that girls in the high school years tend to underestimate the importance and therefore usefulness of mathematics, because they do not view math- and science-related careers as viable career options.

Results of this study indicate that between the time of the first and second survey, the participants came to a clearer understanding of the importance of technology in everyday life. As well, the interviews reflected a similar shift. Several of the participants who were interviewed reported that the workshop left them with a clearer understanding of the importance and usefulness of mathematics and science. Perhaps the shift between the April and June attitudes as measured in the "Usefulness of Mathematics, Science and Technology in a Societal Context" section of the survey and expressed in the interview can be attributed to some degree to participation in the workshop. This type of result is in line with Anton and Humphreys (1982).

On the other hand, the interviews revealed that although these girls stated that they understood the importance of math, science and technology in everyday life, they had difficulty articulating this in the context of life as they know it. Notwithstanding that the workshop provided
the participants with an opportunity to see how math is needed, and how it is used in the context of the various careers that the role models were involved in, it seems that they still had a difficult time coming up with tangible uses for mathematics. However, the girls did say that these subjects "look good on a resume," and "you need them to get into university." According to Armstrong (1979) and Lantz (1985), the above statements were also given in their research and seem to be sufficient motivators for girls to continue the study of math in secondary school. Armstrong (1979) found that girls tend to pursue math in order to reach educational goals. Lantz (1985) feels that the reward of gaining entrance into university was often motivation enough to continue to study math.

Gender

Gender equity.

Results from both the April and June survey indicate that there was no statistically significant change in scores in this section of the questionnaire. The high scores on the gender section of the questionnaire, both in April and in June, indicated that the participants in the It's Your Choice Workshop had, prior to participation in the workshop, a belief in gender equity. Specifically, with respect to mathematics and science, these girls indicated that studying
these subjects is as important for them as it is for boys. They felt that a career was as important for them as it was for boys. They expressed that they felt boys did not have more mechanical ability than girls, nor do they have more natural ability working with their hands. They also said that men did not make better scientists or engineers than women and that they would trust a women to build a house or repair a car.

In light of the information gathered in the interviews, the researcher would have to assume that the girls tended to give normative responses on the survey. These girls seemed to be giving us the answers on the survey that they thought they were supposed to give to us.

The interviews revealed, however, that the participants had a very different view of their world than is indicated by their responses to the survey. They said that prior to participation in the workshop they did not feel confident in their ability to complete the project. They told the interviewer that they felt that their peers and families probably would have found it easier to believe that boys made the tester. Some even confirmed that they too might find it easier to believe that a boy made the tester. This is in direct conflict to the survey statements "Boys have more natural ability with mechanical things than girls" (a statement that was largely disagreed with in the survey), and "Girls have as much natural ability with their hands as
boys" (a statement that was largely agreed with).

Many of the girls said that the messages they got in their life about being female conveyed that they were unequal and not as capable as boys. They shared many negative feelings about their femaleness and their apparently unequal role in their world. Almost half of the girls interviewed told how they believed that boys have more opportunity in this world, are physically safer and have less responsibility than girls. It seemed, by the responses, that these girls were quite affected and disturbed about the lack of physical safety that exists in our society for females. They felt that their freedom to go out and play or socialize, like the boys were allowed to do, was greatly affected by the possibility of being raped. They felt that most of the responsibility for sexual relationships (such as the consequences of pregnancy) fell on their shoulders, as did the domestic chores in their homes. As a result, their freedom and opportunities were seen by them to be greatly limited. This focus was more apparent from the girls who attended school in the Jane/Finch corridor.

In response to the fantasy of being able to choose to return to this world as either a boy or a girl, there were three types of responses. A portion wanted to return as boys. A group of girls in the interview who knew that they valued the close relationships that girls tend to have, were
unsure as to whether boys had as rewarding relationships and therefore did not know if they would prefer to be a boy or a girl. A number of the girls interviewed (several from Cummer Valley) really felt that, if given the choice, they would choose to be a girl because they valued their femaleness and really felt that the world was full of opportunities, especially for women today. These remarks are in direct contrast with the concerns about physical safety, lack of opportunity and freedom and excessive responsibility that were given by a great number of the interviewees. It would be very interesting to know if anything different is happening at Cummer Valley to promote this type of attitude. It would also be important to see if living and attending school in this area and others like it fosters different feelings (and realities) than living and going to school in the Jane/Finch corridor.

Through the perceptions of the participants it appears that the workshop served to challenge some of the stereotypical attitudes that they held about being female. Many expressed that the workshop helped them to see that girls can do this sort of thing just as well as boys, and maybe even better. Many of their stereotypical and contradictory ideas about appropriate careers for females in general and themselves in particular were exposed.
Careers and Education Plans

Comparisons of the girls' responses to the June survey and the April survey indicated a small change in attitude towards math-, science- and technology-related careers. The responses that were given in the interviews clearly demonstrated that these girls felt that participation in the workshop had broadened their career/educational options. It is likely that the intervention of the workshop affected the attitudes of these girls about the gender appropriateness of certain careers because evidence from interviews suggested that exposure to role models in the workshop increased their self-confidence during the day in the Seneca shop.

Most of the girls felt that they would continue to study mathematics and science in secondary school, mostly because they realized that the knowledge of math and science would become increasingly important in high technology careers of the future. This was indicated in both the survey and the interviews. With respect to careers, it was repeatedly mentioned in the interviews that these girls felt that participation in the It's Your Choice Workshop helped them see that they too could do non-traditional occupations. Laws' (1978) conclusions that young girls need both occupational and lifestyle role models is confirmed by the participants' expressed feelings that the role models were very helpful, that they really liked working with them and
that they especially liked finding out the "real story" from these women.

Although only minor changes in survey results from April to June were found, consideration should be given to the following: the pre-selection of participants likely resulted in a group that already had positive attitudes towards maths, science and technology; the potential for growth between April and June was limited because some April scores were close to the upper limit and provided little room for improvement (e.g., Gender category); and it may be unreasonable to expect that a one-day intervention has the potential to effect attitudinal change.

However, the interviews served to illustrate, from the participants' perspective, a clear change in feelings about one's capabilities as well as a change in feelings about mathematics, science, trades and technology. The interviews painted a picture of these girls as feeling more positive about their capabilities, particularly in relation to working in a shop, as having a clearer understanding of the importance and usefulness of mathematics and science, and as feeling that careers in these disciplines were viable options for them. The girls reported enjoying the experience of the workshop and many expressed the desire to participate in a similar experience again next year.
Implications

In view of the information revealed by the participants in the interviews, it seems that their immediate reaction to participation in the workshop was extremely positive. In the participants' own opinions the hands-on portion of the workshop served to increase their self-confidence, specifically with respect to their ability to work with their hands in a shop environment. As well it seems that this increased self-confidence was generalized by many of the participants to encompass an "I can do anything if I put my mind to it" attitude. Both the active participation of the role models in the workshop and their career presentations seemed to impact on the participants' feelings about the viability of math-, science- and technology-related careers. As a result many of the young girls felt that this served to help them gain a clearer understanding of the importance of math, science and technology and therefore plan to continue to study these subjects throughout high school and perhaps in university.

Considering this type of feedback, it seems appropriate to surmise that this type of intervention strategy has the potential to impact, in a positive way, on young girls' feelings of self-efficacy in this type of environment. As well there are indications that the workshop played some part in the broadening of the participants' career horizons and therefore has the potential to influence future
educational and course-taking plans.

This study indicates that a hands-on workshop has the power to increase feelings of self-confidence, promote understanding about the importance and usefulness of mathematics, science and technology and broaden career choice. This suggests that a hands-on shop experience, where students work at a project that is seen as useful and relevant in their lives, become integrated into the permanent curricula. There are indications from previous research, from interventions currently being delivered in Ontario and other parts of Canada and North America, and from this study that girls benefit in terms of developing attitudes about themselves, society and career/education plans that will support them in the study of mathematics, science and technology throughout the high school years. As an integral part of the curricula this type of programming could be offered for a more extended time period, and regularly throughout the primary and early high school years. The girls' reactions to the role models suggests also that regular exposure to various females studying and working in non-traditional careers has the potential to break the cycle of the gender stereotyping of occupations and careers.

**Implications for Practice**

Through the interview process it became quite clear to
me that the effectiveness of the It's Your Choice Workshop was in part directly related to the choice of the project (continuity/battery tester) used in the intervention. Much of the research reviewed in this work has revealed that the understanding of the usefulness of a subject is a critical element when making a decision to continue to study a particular subject. I believe that this concept applies in the shop situation, as well as in the math and science classroom.

These girls found their school shop situations far less than satisfactory. The most common complaint about their school shop experience was that they never made anything "worthwhile, that they could use" in shop class. The girls revealed that the fact that the battery tester was useful, not only to themselves, but to all of their family members and friends, and increased the value of this experience considerably, both in their own and in others' eyes. It only makes sense that our education system have projects in our shop curriculum that result in an end product that is viewed as useful and therefore valuable.

I feel that the concept of immediate usefulness must also be applied to the teaching of mathematics and science, because immediate usefulness translates into relevancy for students. This in turn helps students "relate" to the material being taught. Certainly this was articulated by the participants interviewed when they voiced their
preference for science over math. They felt that they could relate the subject to the rest of their lives and see how "science is everywhere."

**Recommendations for Further Research**

It would seem prudent to consider doing further research on the participants of this workshop in order to gather some longitudinal data and therefore get closer to an understanding of the potential long-term impact, if any, participation in such a strategy had on these girls.

As well, this researcher feels that there is a strong case for carrying out some research that has the potential to detect attitude change. In so doing it could be determined whether an intervention strategy has the power to change attitudes.

It may also be interesting to see if participation in such an intervention strategy has any effect on achievement (grades) in mathematics, science and technology. As well, the researcher would suggest that the optional high school course-taking behaviour of participants be monitored to determine whether participants are likely to continue the study of these subjects at the senior level. An attitudinal survey towards the end of high school could be administered to determine whether the attitudes revealed in this research remain stable, or change, and in which direction changes occur. Career plans of participants could also be followed
to determine whether these young women are more likely to pursue careers in these domains.

Previous research and theory speak to the difficulty in altering stereotypical ideas, as well as attitudes, about gender-appropriate career options. According to Gottfredson (1981), gender identity and the accompanying "gender appropriate" ideas are the last to be compromised when making career decisions. If you add the pressure to conform to societal norms to this equation, and acknowledge that these gender-stereotyped ideas about careers and the study of math, science and technology are insidiously perpetuated in the school system, it is not difficult to see that females need help if they are to be expected to pursue education and careers in these traditionally male domains. Clearly the It's Your Choice Workshop and similar intervention strategies, which have the potential to promote gender equity in education, as well as in career choice, should become a regular part of the curriculum. In order to be effective over the long run, the researcher believes that students should be exposed to these interventions beginning at a very early age and continuing on like "booster shots" throughout the elementary and secondary school years.

The education system is seen by researchers to play a large part in reinforcing these stereotypical attitudes and therefore fostering the cycle that gender stereotypes math, science and technology and their related careers. Not only
does the system treat females differently from males in the classroom, but it also fails to demonstrate its philosophical commitment to this issue through the setting aside of funds. These funds would be used to develop and evaluate career intervention strategies and then entrench them into the curriculum mainstream. In so doing, the education system will be doing its part to promote these disciplines to women and therefore contribute to gender equity.
References


Armstrong, J. M. (1979). A national assessment of achievement and participation of women in mathematics. Final report to the National Institute of Education, Denver, CO. (Grant No. NIE-T-7-0061)


Bibliography


APPENDIX A

STUDENTS' OPINIONS ABOUT MATHEMATICS, SCIENCE AND TECHNOLOGY

Please read each of the following statements carefully and indicate the extent to which you agree or disagree with each statement. Use the answer sheet to record your response, fill in the bubble matching your choice.

1. I really want to do well in mathematics and science at school.
2. My parents really want me to do well in mathematics and science.
4. I feel good when I solve a mathematical or scientific problem myself.
5. I am not so good at mathematics and science.
6. I like to help others with mathematics and science problems.
7. I refuse to spend a lot of my own time doing mathematics and science.
8. Mathematics and science are harder for me than most people.
9. I could never be a good mathematician or scientist.
10. I will work a long time in order to understand a new idea in mathematics or science class.
11. Working with my hands makes me happy.
12. I think mathematics and science are fun.
13. I don’t like people to think I’m too smart in mathematics or science.
14. Studying mathematics and science is just as important for girls as for boys.
15. Men make better scientists and engineers than women.
16. Boys have more natural ability in with mechanical things than girls.
17. Boys need to know more mathematics and science than girls.
18. A woman needs a career just as much as a man does.
19. Girls have as much natural ability with their hands as boys.
20. I would trust a woman as much as a man to repair a car or build a house.
21. An understanding of technology is not needed in everyday life.
22. It is important to know mathematics and science in order to get a good job.
23. Most people do not use mathematics and science in their jobs.
24. Skilled trades like carpentry or electronics do not require much knowledge of mathematics and science.
25. Mathematics and science is useful in solving everyday problems.
26. I can get along well in everyday life without using mathematics and science.
27. Most of mathematics and science I learn has practical use on the job.
28. Mathematics and science is not needed in everyday life.
29. Understanding technology will be an important part of life in the future.
30. I expect to have little use for mathematics and science when I get out of school.
31. My teachers have encouraged me to continue to take mathematics and science courses.
32. If I had my choice I would not learn any more mathematics and science.
33. My parents would think I wasn't serious if I told them I was interested in a career in science, mathematics or technology.
34. I am interested in continuing to study mathematics and science because of the career opportunities it will open for me.
35. I would not like a occupation where I use my hands.
36. I would like to work at a job that lets me use mathematics and/or science.
37. Knowledge of mathematics and science will be come increasingly important in the high-technology careers of the future.
38. My teachers would think I wasn't serious if I told them I was interested in a career in science, mathematics or technology.
39. After finishing secondary school I plan on going to college or university.
40. I plan to continue taking mathematics and science courses in secondary school.
41. Were you born in Canada?
   a) Yes  (go to Number 43)
   b) No   (go to Number 42)

42. If "No", did you arrive in Canada:
   a) in the last year
   b) in the last 2 years
   c) in the last 3 years
   d) in the last 4 years
   e) in the last 5 years or more

43. What language do you most often speak at home?
   a) English
   b) French
   c) Other

44. About how much time do you spend on mathematics and science homework each week?
   a) I don't do any mathematics and science homework
   b) Less than 1 hour
   c) Between 1 and 2 hours
   d) Between 2 and 3 hours
   e) More than 3 hours

45. On average, how much time out of school do you spend watching TV programs each day?
   a) None at all
   b) Up to 1 hour
   c) Between 1 and 2 hours
   d) Between 2 and 3 hours
   e) More than 3 hours
APPENDIX B

INTERVIEW QUESTIONS

1. What did you think about the prospect of coming to Seneca College for this project?

2. How did you feel when you saw the continuity tester and realized that you were going to be making this?

3. How did you feel when you saw the continuity/battery tester and knew that we expected you to make this yourself in the day at Seneca?

4. Did your feelings about your ability to successfully complete the Seneca project change at all throughout the day? When? Why?

5. Have you ever done any kind of work like this before?

6. Is the shop that you work in at school any different than Seneca’s? How?

7. How did you like the presentations made by our guest role models? Who did you enjoy meeting the most? Why?

8. What was the response like when you got back to school with the completed tester? What did the other students say?

9. What did your family think about what you had done? How did you feel?

10. How did it feel to have people think that you could not possibly have made the tester?

11. Why do you think that people have the reaction of disbelief?

12. When I mention the subject math, what is your immediate gut reaction? Why do you think that you feel this way?"

13. Do you really believe that you will need math in your life?
14. How do you feel about Science?
15. What messages do your parents give you about doing well in school? Do your parents feel that some subjects are more important than others? Which ones?
16. Do you have a dream occupation?
17. Do you think that your parents have a dream occupation for you?
18. What is the main message that you get about being a girl?
19. If you could come back to this world as a boy or girl, which would you choose and why?
20. What would you tell someone about the "It's Your Choice" Workshop with respect to what you got from attending it?
APPENDIX C

'TIT'S YOUR CHOICE!'

A HANDS-ON EXPERIENCE IN TRADES AND TECHNOLOGY FOR GIRLS

GOALS AND OBJECTIVES:

1. To heighten awareness of skills and their significance to future career choices.
2. To broaden career horizons by providing a technological focus and hands-on experience.
3. To help girls realize the need to continue mathematics and science through high school in order to keep occupational options unlimited.
4. To provide a bridging mechanism between what is studied in school and the reality of the application of that in the world of work.
5. To provide an opportunity to interact with women role models.
6. To develop the confidence and decision-making skills in order to help make informed career choices.

SELECTION GUIDELINES FOR STUDENTS AND ADULT PARTICIPATION:

1. Ten (10) female, current grade 7 students from each school
2. Female students who:
   • enjoy working with their hands, eg. puzzles, crafts, etc.
   • indicate an openness to explore vocational fields involving trades and technology
   • enjoy project-based activities and might benefit from a hands-on experience
3. Academic, ethnic and socio-economic cross-section of students
4. Two teachers - one counsellor and one from mathematics, science or technical studies (would prefer at least one female if not two).
Dear Parents:

Your Grade 7 daughter is currently being offered the opportunity by her school to participate in a special hands on workshop in May, which takes place at Seneca College. I have been involved with this workshop over the past four years. This year, as part of the requirements for my Master of Education degree, I would like to do some research on the impact this workshop has on your daughter’s feelings and attitudes about the study of mathematics, science and technology, as well as on her feelings about careers in these and related fields.

Your daughter’s participation in my research requires parental consent, and before permission is given I would like to explain what will be required.

Your daughter will be asked to fill in a questionnaire before and after she participates in the hands on workshop. There are 45 statements on this questionnaire to which your daughter will be asked to indicate the extent to which she agrees or disagrees with the statement. We will ask that no names be placed on the questionnaire or answer sheet and in this way your daughter’s responses will be totally anonymous. Statements such as "Mathematics and science are harder for me than most people." or "It is important to understand science and mathematics in order to get a good job." are examples of the types of statements that will be found on this questionnaire. I imagine that the questionnaire
can be answered in approximately ten to fifteen minutes.

In addition I will be interviewing a few students from those who participate in the workshop to find out, in more detail, how participation in this program has affected your daughter. I will be taping these interviews unless requested not to do so by an individual. The interview will be conducted at your daughter’s school, and will take about 10 - 30 minutes. All information collected in this interview will be strictly confidential. At no time will your daughter’s privacy be compromised.

Should you decide to permit your daughter to participate in all or only parts of my research I will be very appreciative. If at any time your daughter wishes to not participate, or to discontinue her participation in the research, this wish will be immediately respected.

I would like to thank you very much for taking the time to read this information. Should you require any additional information please feel free to contact me at 491-5050, ext. 2490. Should you be interested, copies of the research will be available upon completion.

Yours truly

Carol Henry
Co-ordinator, Women’s Trades Programs, Seneca College
I hereby give my permission for ____________________________
to participate in 1) the completion of the research questionnaire
   outlined in the accompanying letter:
       __YES __NO
2) the taped interview:
       __YES __NO

Signature of Parent/Guardian: ________________________________

Date: ________________________________
APPENDIX E

STUDENT'S OPINIONS ABOUT MATHEMATICS, SCIENCE AND TECHNOLOGY

"IT'S YOUR CHOICE" PROGRAM
1992

The following are the frequency of responses for all 44 items in the survey.

Myself and Mathematics, Science and Technology

1. I really want to do well in mathematics and science at school.

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<td>June</td>
<td>75%</td>
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2. My parents really want me to do well in mathematics and science.

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<td>June</td>
<td>78%</td>
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3. I feel good when I solve a mathematical or scientific problem myself.

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<td>45%</td>
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4. I am not so good at mathematics and science.

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5. I like to help others with mathematics and science problems.

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April 19% 67% 9% 5% 0%
June 21% 55% 16% 8% 0%

6. I refuse to spend a lot of my own time doing mathematics and science.

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7. Mathematics and science are harder for me than most people.

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8. I could never be a good mathematician or scientist.

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9. I will work a long time in order to understand a new idea in math or science class.

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10. Working with my hands makes me happy.

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11. I think mathematics and science are fun.

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12. I don't like people to think I'm too smart in mathematics or science.

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Gender and Mathematics, Science and Technology

13. Studying mathematics and science is just as important for girls as for boys.

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14. Men make better scientists and engineers than women.

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15. Boys have more natural ability with mechanical things than girls.

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<td>73%</td>
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16. Boys need to know more mathematics and science than girls.

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17. A woman needs a career just as much as a man does.

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18. Girls have as much natural ability with their hands as boys.

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19. I would trust a woman as much as a man to repair a car or build a house.

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Society and Mathematics, Science and Technology

20. An understanding of technology is not needed in everyday life.

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21. It is important to know math and science in order to get a good job.

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22. Most people do not use mathematics and science in their jobs.

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<td>10%</td>
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23. Skilled trades like carpentry or electronics do not require much knowledge of mathematics and science.

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<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>0%</td>
<td>2%</td>
<td>32%</td>
<td>27%</td>
</tr>
<tr>
<td>June</td>
<td>1%</td>
<td>5%</td>
<td>20%</td>
<td>31%</td>
</tr>
</tbody>
</table>

24. Mathematics and science is useful in solving everyday problems.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>41%</td>
<td>44%</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td>June</td>
<td>41%</td>
<td>44%</td>
<td>9%</td>
<td>5%</td>
</tr>
</tbody>
</table>

25. I can get along well in everyday life without using mathematics and science.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>June</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>No Opinion</td>
<td>Disagree</td>
</tr>
<tr>
<td>------</td>
<td>----------------</td>
<td>-------</td>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td>0%</td>
<td>9%</td>
<td>16%</td>
<td>42%</td>
<td>33%</td>
</tr>
<tr>
<td>June</td>
<td>1%</td>
<td>10%</td>
<td>15%</td>
<td>44%</td>
</tr>
</tbody>
</table>

26. Most of the mathematics and science I learn has practical on the job use.

<table>
<thead>
<tr>
<th>April</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>43%</td>
<td>32%</td>
<td>6%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>26%</td>
<td>45%</td>
<td>25%</td>
<td>4%</td>
<td>0%</td>
</tr>
</tbody>
</table>

27. Mathematics and science are not needed in everyday life.

<table>
<thead>
<tr>
<th>April</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>8%</td>
<td>25%</td>
<td>25%</td>
<td>36%</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>3%</td>
<td>6%</td>
<td>14%</td>
<td>37%</td>
<td>41%</td>
</tr>
</tbody>
</table>

28. Understanding technology will be an important part of life in the future.

<table>
<thead>
<tr>
<th>April</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>31%</td>
<td>46%</td>
<td>21%</td>
<td>1%</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>44%</td>
<td>42%</td>
<td>14%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

29. I expect to have little use for mathematics and science when I get out of school.

<table>
<thead>
<tr>
<th>April</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>12%</td>
<td>20%</td>
<td>7%</td>
<td>23%</td>
<td>39%</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>13%</td>
<td>19%</td>
<td>11%</td>
<td>26%</td>
<td>31%</td>
</tr>
</tbody>
</table>

Career/Education Plans and Mathematics, Science and Technology

30. My teachers have encouraged me to continue to take mathematics and science courses.

<table>
<thead>
<tr>
<th>April</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>24%</td>
<td>32%</td>
<td>28%</td>
<td>13%</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>31%</td>
<td>40%</td>
<td>18%</td>
<td>8%</td>
<td>4%</td>
</tr>
</tbody>
</table>

31. If I had my choice I would not learn any more mathematics and science.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
32. My parents would think I wasn't serious if I told them I was interested in a career in science, mathematics or technology.

<table>
<thead>
<tr>
<th></th>
<th>Agree</th>
<th>Agree</th>
<th>Opinion</th>
<th>Disagree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>5%</td>
<td>1%</td>
<td>9%</td>
<td>33%</td>
<td>52%</td>
</tr>
<tr>
<td>June</td>
<td>1%</td>
<td>9%</td>
<td>9%</td>
<td>36%</td>
<td>46%</td>
</tr>
</tbody>
</table>

33. I am interested in continuing to study mathematics and science because of the career opportunities that it will open for me.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>39%</td>
<td>37%</td>
<td>21%</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>June</td>
<td>43%</td>
<td>35%</td>
<td>22%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

34. I would like an occupation where I use my hands.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>0%</td>
<td>7%</td>
<td>44%</td>
<td>32%</td>
<td>17%</td>
</tr>
<tr>
<td>June</td>
<td>4%</td>
<td>66%</td>
<td>38%</td>
<td>30%</td>
<td>23%</td>
</tr>
</tbody>
</table>

35. I would like to work at a job that lets me use mathematics and/or science.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>13%</td>
<td>47%</td>
<td>33%</td>
<td>7%</td>
<td>1%</td>
</tr>
<tr>
<td>June</td>
<td>20%</td>
<td>46%</td>
<td>28%</td>
<td>6%</td>
<td>0%</td>
</tr>
</tbody>
</table>

36. Knowledge of mathematics and science will become increasingly important in the high-technology careers of the future.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>48%</td>
<td>29%</td>
<td>20%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>June</td>
<td>51%</td>
<td>34%</td>
<td>14%</td>
<td>1%</td>
<td>0%</td>
</tr>
</tbody>
</table>

37. My teachers would think I wasn't serious if I told them I was interested in a career in science, mathematics or technology.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>No</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>
38. After finishing secondary school I plan on going to college or university.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>74%</td>
<td>20%</td>
<td>4%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>June</td>
<td>80%</td>
<td>16%</td>
<td>4%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

39. I plan to continue taking mathematics and science courses in secondary school.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>No Opinion</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>43%</td>
<td>42%</td>
<td>11%</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>June</td>
<td>48%</td>
<td>40%</td>
<td>11%</td>
<td>1%</td>
<td>0%</td>
</tr>
</tbody>
</table>

The table below shows mean scores for each section of the survey.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Myself</td>
<td>46</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>Gender</td>
<td>31</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Society</td>
<td>39</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td>Career</td>
<td>41</td>
<td>39</td>
<td>41</td>
</tr>
<tr>
<td>Total</td>
<td>157</td>
<td>155</td>
<td>158</td>
</tr>
</tbody>
</table>
Background

40. Were you born in Canada?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>57%</td>
</tr>
<tr>
<td>No</td>
<td>27%</td>
</tr>
<tr>
<td>Missing</td>
<td>16%</td>
</tr>
</tbody>
</table>

41. If "no", did you arrive in Canada:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>in the last year</td>
<td>10%</td>
</tr>
<tr>
<td>in the last 2 years</td>
<td>23%</td>
</tr>
<tr>
<td>in the last 3 years</td>
<td>10%</td>
</tr>
<tr>
<td>in the last 4 years</td>
<td>13%</td>
</tr>
<tr>
<td>in the last 5 years or more</td>
<td>43%</td>
</tr>
</tbody>
</table>

42. What language do you most often speak at home?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>72%</td>
</tr>
<tr>
<td>French</td>
<td>0%</td>
</tr>
<tr>
<td>Other</td>
<td>22%</td>
</tr>
<tr>
<td>Missing</td>
<td>7%</td>
</tr>
</tbody>
</table>

43. About how much time do you spend on math and science homework each week?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I don't do any math and science homework</td>
<td>6%</td>
</tr>
<tr>
<td>Less than 1 hour</td>
<td>24%</td>
</tr>
<tr>
<td>Between 1 and 2 hours</td>
<td>41%</td>
</tr>
<tr>
<td>Between 2 and 3 hours</td>
<td>17%</td>
</tr>
<tr>
<td>More than 3 hours</td>
<td>11%</td>
</tr>
<tr>
<td>Missing</td>
<td>1%</td>
</tr>
</tbody>
</table>

44. On average, how much time out of school do you spend watching TV programs each day?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>None at all</td>
<td>3%</td>
</tr>
<tr>
<td>Up to 1 hour</td>
<td>10%</td>
</tr>
<tr>
<td>Between 1 and 2 hours</td>
<td>30%</td>
</tr>
<tr>
<td>Between 2 and 3 hours</td>
<td>26%</td>
</tr>
<tr>
<td>More than 3 hours</td>
<td>30%</td>
</tr>
<tr>
<td>Missing</td>
<td>3%</td>
</tr>
</tbody>
</table>
APPENDIX F

Beverley Heights Middle School
Brookview Middle School
Cummer Valley Middle School
Don Mills Middle School
Donview Middle School
Dublin Heights Middle School
Elia Middle School
Ledbury Park Middle School
R. J. Laing Middle School