GENDER DIFFERENCES IN GRADES 7 AND 10 STUDENTS TOWARDS SCIENCE, MATH, COMPUTERS AND FUTURE CAREER CHOICES

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Abstract *— A research project is underway at the University of Calgary to investigate the personal and educational factors that contribute to junior and senior high school participation and high achievement in the sciences for both males and females. The study will also identify the factors that most directly contribute to decisions on the part of males and particularly females to pursue programs and careers in science and related disciplines. In the first phase of the study, approximately 1,400 grade 7 and 10 students were administered a 45 minute questionnaire. Initial analysis of the grade 7 cohort showed that there are significant gender differences in future career interests, especially relating to science and technical careers. This paper will extend these initial findings to include grade 10 students. Questions about the students' futures and their career choices, as well as questions regarding computer interest and usage will be analyzed. Comparisons between the males and females in each grade level, as well as males and females across grade levels will be shown.*

Index Terms — gender and computers, gender and future plans, career choices

INTRODUCTION

The need to increase the representation of women in science and engineering careers has led to significant research being done to better understand the perceptions of younger boys and girls towards math and science, what their future career goals are, and what are the factors that influence their decision making processes. In particular, research has suggested that during the ages of 12 through 16 girls start to lose significant interest in math and science as it starts to play a conflicting role with adolescent pressures and expectations [1]. Moreover, long term studies of gifted females and other subgroups of "hidden gifted" indicate that the potential of many students, male and female may be significantly under-developed, e.g. [2] [3].

In order to better understand these issues, and to provide the necessary information to develop targeted intervention strategies, a large-scale research program is now underway at the University of Calgary. The purpose of the study is to investigate the relation between school culture, socialization, ability, gender and values and the relative degree of influence on adolescent student choice in courses, programs, activities in general, and in science and technology specifically. This is a three year project of which the first phase is the administration of a survey to over 1,400 male and female students in grades 7 and 10 in and around the city of Calgary. This questionnaire, modified for the study, was developed by Eccles over a twenty-year period, and is based on the Eccles model on achievement-related choices in education and career decision-making [4] [5].

The focus of this paper is to present some important findings from the first phase of the study which was administered in February to April, 2000. The focus areas are computer usage and preference, important characteristics of a future career, future plans, and future career choices. This is an extension of a prior analysis on a sub-sample of the grade 7 students [6].

DATA COLLECTION AND METHODOLOGY

Grade 7 and 10 schools in Calgary, and the surrounding area, were identified for participation in the research project. These schools were selected to give representation across different socio-economic strata and also to provide representation between rural and urban schools. The high schools were selected first, and then junior high schools that fed into these schools were approached to seek their participation. In total, four school boards are participating in the project, two rural and two urban, and there are a total of 27 junior high schools and 14 senior high schools. From these schools, parents of over 6,000 students were sent information and release forms. The positive response rate is approximately 25% with a balance between males and females.

Students with permission to participate in the project were given a 45-minute survey that was conducted during class time. A total of 1430 surveys have been administered to a proportionately representative group. Of this group, 872

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(61%) were grade 7 students, while 558 (39%) were grade 10 students. Of the grade 7 cohort, 465 (53%) were female and 407 (47%) were male. Similarly, 306 (55%) of the grade 10 group were female and 252 (45%) were male. In addition, 1013 (71%) are from Calgary (urban) with the remaining 417 (29%) from rural areas surrounding Calgary.

The survey consists of 209 questions (based on the Eccles Michigan Study of Life Transitions Questionnaire - MSALTQ) and contains the following sections (i) background information (e.g. family status, parental education, language spoken at home), (ii) general (e.g. about schoolwork, leadership interests, self-esteem), (iii) relationship with mother and/or father, (iv) interest and value of math, science and English, (v) computer usage and interest, (vi) future plans and career choices, (v) adult roles in society, (vi) friends, and (vii) adult attachment. Most of the questions had responses that used a five point scale (typically ranging from strongly disagree to strongly agree), which were then coded to scores of 1 (strongly disagree) to 5 (strongly agree).

For this paper, comparisons are carried out between males and females as well as grades 7 and 10. Urban and rural students will be considered together. Gender and grade comparisons are done for the variables of interest using Chi-square tests as well as analysis of variance (ANOVA). Significant findings using these tests are indicated and a discussion of the reasons and implications for these findings is given. Because of the large size of the data set, a level of significance was set for $p < 0.01$.

RESULTS AND ANALYSIS

Computers

The survey contained 11 questions relating to computer usage and affinity. The motivation for posing these questions was to assess the level of interest students had in computers and to eventually relate this to science and math interests as well as future career selection. Other research being conducted on the attitude towards, and usage of, computers has shown significant differences between boys and girl, with girls being less interested in computers [7].

Interestingly, about 96% of the students responded that they, or their family, owned a computer, compared to 45% of Canadian households reporting having a computer in 1998 (www.statcan.ca/Daily/English/991213/d991213a.htm). This difference may be due to the dramatic decreases in computer costs and also a tendency for Calgary families with children to purchase a computer for educational purposes. There was no significant difference between the males and females in terms of computer ownership.

Tables I and II show the responses for questions regarding computer usage. Specifically, Table I gives a breakdown of the age of which the students started using computers. Over 60% of all students reported using a computer for the first time when they were between the ages of 6 and 10. Grade 7 students started using computers when they were younger as shown by the higher number who started at age 5 or younger. Overall, there is a significant influence of gender and grade in the start time of using computers.

Table II gives results on where students started using a computer. As in Table I, there is a significant influence for grade and gender in terms of where they first started interacting with computers. Interestingly, over 60% of grade 7 boys and girls, as well as grade 10 boys, started using computers outside of school, whereas only 44% of grade 10 girls did the same. The fact that the majority of grade 10 girls only started using computers when introduced to them at school indicates that the integration of technology into the classroom is important to ensuring that all students are capable of building technical skill. The results for the differences between grade 7 and 10 females, show that the trend for girls to use computers at home is shifting quickly.

TABLE I
AGE WHEN STARTED TO USE A COMPUTER*

Group	Age 5 or Under (%)	Age 6 to 10 (%)	Age 11 or over (%)
Grade 7 girls (N=464)	27.4	65.3	7.3
Grade 7 boys (N=406)	32.8	60.1	7.1
Grade 10 girls (N=306)	10.1	70.3	19.6
Grade 10 boys (N=251)	19.1	62.9	17.9

* Chi-square results for comparisons by gender and grade are statistically significant ($p<0.01$)

TABLE II
WHERE STARTED TO USE A COMPUTER*

Group	Home, Friends, Relatives, Work (%)	School (%)
Grade 7 girls (N=460)	61.1	38.9
Grade 7 boys (N=404)	71.0	29.0
Grade 10 girls (N=305)	44.3	55.7
Grade 10 boys (N=250)	62.0	38.0

* Chi-square results for comparisons by gender and grade are statistically significant ($p<0.01$)

The students were asked questions regarding their perceived ability when using a computer and the affinity they have for computers in general. The results show that both the males and females like computers since they have mean scores of 4.52 and 4.21, respectively, which means on

average they agree to strongly agree. However, the results also show that there is a significant difference between the males and females, with the males liking computers significantly more than the females. There is a significant grade effect, with the grade 7 group significantly liking computers more than the grade 10 group (mean scores of 4.49 and 4.15). The grade effect appears to correlate to the findings in Table I such that the grade 7 students started using computers earlier in general, which may mean that they have found a higher utility for the technology.

This trend also carries over to their perceived ability with computers. When asked if they were good at doing things on computers, the females, on average, agree but their mean score is significantly lower than that for the males (3.96 compared to 4.30). In addition, there is a significant grade effect such that the grade 7 students felt that they were significantly better at doing things on computers compared to the grade 10 students. This will be discussed further in the context of potential career choices.

In terms of computer usage, Table III shows the responses for the males and females in terms of the number of minutes per day that they used computers. Overall, there is a significant gender and grade influence on the time spent on a computer each day outside of school. About 30% of the students spend about 45 minutes to 1 hour on a computer. However, when looking at high computer usage, a larger number of boys than girls use the computers for more than 1 hour per day.

The activities performed when using computers is important to assess the relative importance and value placed on the computer. In that context, students were asked to rate a number of activities for the amount of time they spend on it. Table IV shows the mean scores for each activity by grade and by gender.

As can be seen, there is a significant gender difference in the usage of computers for email and assignments/work, with females scoring higher usage in both activities. The email usage suggests that girls tend to use computers more as a communication mode which bodes well for email mentoring programs, for example.

TABLE III
TIME SPENT PER DAY ON A COMPUTER*

Group	30 min or less (%)	45 min - 1 hour (%)	> 1 hour (%)
Grade 7 girls (N=460)	48.9	30.0	21.1
Grade 7 boys (N=405)	31.6	32.8	35.6
Grade 10 girls (N=306)	49.7	32.0	18.3
Grade 10 boys (N=252)	37.7	28.2	34.1

* Chi-square results for comparisons by gender and grade are statistically significant ($p<0.01$)

For surfing the 'net and playng games, there is both a significant gender and grade effect. For surfing the 'net, the boys are significantly higher computer users than the girls, and the grade 7 students are significantly higher users than the grade 10 students. In fact, playing computer games gives the largest differences across the groups. The males reported using computers for games over half the time that they are on the computers compared to girls. Similarly, the grade 7 students are clearly avid users of computers for games. Part of the explanation may be due to the proliferation of games that have become available over the past few years, with many of them targetted at the grade 7 age groups and more of these starting to be geared to female interests.

TABLE IV
TIME SPENT ON COMPUTER ACTIVITIES

Activity	Female students (N=769)	Male students (N=658)	Grade 7 students (N=869)	Grade 10 students (N=558)
Email[a]	2.48	2.03	2.23	2.34
Surfing the 'net[a,b]	2.49	2.76	2.71	2.48
Assignments/work[a]	2.84	2.60	2.78	2.65
Playing games[a,b]	2.70	3.51	3.35	2.63

a Values are significantly different for male and female students ($p<.01$)
b Values are significantly different for grade 7 and 10 students ($p<.01$)
Values: 1=none of the time; 2=less than half the time; 3=half of the time; 4=more than half of the time; 5= all of the time.

Overall, the results reinforce the generally held belief that students are integrating computer technology into their school and home lives.

Future Career Characteristics and Plans

Previous research conducted on engineering students [8], showed that female engineering students had some different perceptions about important characteristics of a future job. Specifically, the female engineering students rated the ability to contribute to society significantly higher than their male counterparts, while the male engineering students rated 'to be paid well' significantly higher than the females.

Similar questions were posed to the Grade 7 and 10 students and the reponses are shown in Table V. In this case, the males rated 'earning a great of money' and 'high status in society' as significantly important for a future job that they would like, compared to the females. However, it should be noted that both of the groups of students rated this as being important as shown by the average response scores. The results of the 'earning a great deal of money' are consistent with [8].

Both the males and females felt that working on challenging projects and learning new skills and new things were important for a future job that they would like, and this did not differ significantly for the grade 7 and 10 students.

TABLE V
IMPORTANCE OF CHARACTERISTICS FOR FUTURE CAREER CHOICES

Characteristic	Female students (N=771)	Male students (N=659)	Grade 7 students (N=872)	Grade 10 students (N=558)
Allows me to earn a great deal of money[a]	4.24	4.53	4.38	4.37
Has high status in society[a,b]	3.88	4.16	4.07	3.92
Provides enough money to support me and my family[a]	4.63	4.73	4.66	4.70
Gives me a chance to work on challenging projects	4.12	4.12	4.11	4.12
Allows me to be my own boss most of the time[a]	3.76	3.99	3.90	3.81
Gives me a chance to learn new skills and new things	4.23	4.28	4.27	4.22
Gives me an opportunity to make the world a better place[a,b]	4.24	4.01	4.18	4.07
Gives me the ability to combine career and family[b]	4.12	4.04	4.15	3.97

a Values are significantly different for male and female students ($p<.01$)
b Values are significantly different for grade 7 and 10 students ($p<.01$)
Values range from 1 (strongly disagree) to 5 (strongly agree).

When asked about the importance of having a job that gives an opportunity to make the world a better place, there was a significant influence for gender and grade. Females felt significantly stronger about this compared to the males, and this is consistent with other studies of older students [8]. In addition, grade 10 students are significantly less interested in this as a job characteristic.

Questions were posed to the students about their future educational and family plans and the results are given in Table VI. Both males and females felt that it was likely that they would finish high school then go to university or college, although a significantly higher number of females felt it was likely. Similarly, significantly more females thought it likely that they will do more than one university degree, although there is also a significant grade effect with the grade 7 students believing that they will do more than one university degree more so than the grade 10 group.

TABLE VI
FUTURE PLANS

Future Plan	Female students (N=770)	Male students (N=659)	Grade 7 students (N=872)	Grade 10 students (N=557)
Finish high school, then go on to University or College[a]	4.64	4.45	4.57	4.53
Do more than one University degree (e.g. Master's, PhD, become a medical doctor, lawyer)[a,b]	3.85	3.60	3.86	3.55
Get married[b]	4.16	4.21	4.25	4.08
Have children[b]	3.93	4.04	4.06	3.86

a Values are significantly different for male and female students ($p<.01$)
b Values are significantly different for grade 7 and 10 students ($p<.01$)
Values range from 1 (strongly disagree) to 5 (strongly agree).

There is no significant difference between the males and females when they responded to how likely they are to get married and have children. Both groups had high mean scores for these two questions that shows that most of them consider it likely that they will get married, and slightly less think that they will have children. However, there is a significant grade effect, such that the grade 10 students were significantly less interested in getting married and having children compared to the grade 7 students.

Career Choices

The students were given 13 career options and they were asked how likely it is that they would choose each one of them. There were five possible responses for each career option, ranging from strongly disagree (value of 1) to strongly agree (value of 5). Table VII shows the top six career choices for the grade 7 female and male students along with the mean response for each group. Table VIII gives similar values for the grade 10 students.

For the grade 7 females, the career with the highest rating (3.43) was artist, which had identifiers of designer, interior decorator, musician and actor. In contrast, the highest rating for the males (3.38) was information technology (IT), which had identifiers of computer engineering and computer scientist. These two selections are in stark contrast to one another and fall into traditional career patterns for both groups. Although there are numerous efforts to attract more women into IT fields, the mean response from the female group to this career option was 2.51. This may be in part due to the relatively narrow definition given to IT in this study.

The second highest rating for the females was given to health professional (3.20). This is not too surprising given the percentage of women studying medicine has increased sharply with at least 50% in most medical programs. Health professional was the fifth highest selection for men with a mean response of 2.50.

The third highest selection for the females is 'other professions' which includes lawyer, accountant, architect and stock broker. This is the second choice for the males, and in fact, there was no significant difference in the responses from the females and males for this particular career option. As in the health professional case, these professions have been relatively successful at attracting women into their programs, and in law programs in particular, there is a strong balance between men and women. The third highest choice for the males was science or math-related professional, which is consistent with traditional career choices of men. The mean scores of the career options that were ranked fourth, fifth and sixth for the females and males fall below 3, which means that they are starting to disagree with this as a career choice in general.

Although not shown, the percentage of females that selected 'agree' or 'strongly agree' to the information technology career option was 25%, compared to 58% of the males. For the science or math-related professional, the percentages are 29% and 49%, respectively. This particular group will be further studied to assess the relationships with achievement data and their responses to the math, science and English questions.

For the grade 10 students, the career choices had some variation compared to grade 7 cohort. For the girls, the first three career choices remained similar, however 'Human Services' and 'Healthcare Worker' received higher mean scores. This is of particular importance considering that these are more traditional female career paths. Of note is that 'Science or Math-related Professional' (ranked 7th) and 'Environment-related', which are both described through science and engineering careers, decreased in rankings. However, in terms of overall mean score, there is no significant difference between the grades 7 and 10 girls and the grades 7 and 10 boys.

In terms of an information technology career, only 14% of the grade 10 females selected 'agree' or 'strongly agree' to this option, compared to 52% of the grade 10 boys. This is a significant drop off in the interest of girls in information technology, while it is not significant for the boys.

Careers such as homemaker scored very low for the entire group. In particular, the girls showed that they do not see themselves as homemakers in the future.

CONCLUSIONS

This paper presented some findings from a large-scale research project being carried out to investigate the personal and educational factors that contribute to junior and senior high school participation and high achievement in the sciences for both males and females. A sample of approximately 1,400 grade 7 and 10 males and females, from urban and rural backgrounds, was selected and analyzed with respect to computer usage and affinity, characteristics of a job that the students would like, future plans, and career choices.

Several significant findings were discussed around the key questions analyzed. Of particular note are the future career interests of the girls compared to the boys whereby, in general these career interests are falling along traditional paths. Research in to other areas of interest in the Eccles model is being carried out, and further findings will be reported in the future.

TABLE VII
TOP SIX CAREER CHOICES FOR GRADE 7 STUDENTS

Rank	Female Students		Male Students	
	Career (identifiers)	(mean score)	Career (identifiers)	(mean score)
1	Artist *(like designer, interior decorator, musician, actor)*	(3.43)	Information Technology *(like computer scientist, computer engineer)*	(3.38)
2	Health professional *(like doctor, dentist, veterinarian)*	(3.20)	Other professions *(like lawyer, accountant, architect, stock broker)*	(3.25)
3	Other professions *(like lawyer, accountant, architect, stock broker)*	(3.09)	Science or math-related professional *(like engineer, architect, geologist)*	(3.17)
4	Environment-related *(like forestry, marine biologist, environmental engineer)*	(2.89)	Protective or military service *(like police, officer, firefighter, military)*	(2.70)
5	Human services *(like teacher, social worker, counselor)*	(2.80)	Health professional *(doctor, dentist, veterinarian)*	(2.50)
6	Science or math-related professional *(like engineer, architect, geologist)*	(2.72)	Artist *(like designer, interior decorator, musician, actor)*	(2.49)

Values range from 1 (strongly disagree) to 5 (strongly agree).

TABLE VIII
TOP SIX CAREER CHOICES FOR GRADE 10 STUDENTS

Rank	Female Students Career (identifiers)	(mean score)	Male Students Career (identifiers)	(mean score)
1	Artist *(like designer, interior decorator, musician, actor)*	(3.37)	Science or math-related professional *(like engineer, architect, geologist)*	(3.37)
2	Health professional *(like doctor, dentist, veterinarian)*	(3.21)	Other professions *(like lawyer, accountant, architect, stock broker)*	(3.32)
3	Other professions *(like lawyer, accountant, architect, stock broker)*	(3.04)	Information Technology *(like computer scientist, computer engineer)*	(3.30)
4	Human services *(like teacher, social worker, counselor)*	(2.97)	Protective or military service *(like police, officer, firefighter, military)*	(2.75)
5	Healthcare worker *(like registered nurse, physical therapist, pharmacist)*	(2.89)	Environment-related *(like forestry, marine biologist, environmental engineer)*	(2.61)
6	Environment-related *(like forestry, marine biologist, environmental engineer)*	(2.89)	Artist *(like designer, interior decorator, musician, actor)*	(2.52)

Values range from 1 (strongly disagree) to 5 (strongly agree).

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