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AUTHOR Collis, Betty; And Others
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ABSTRACT

A nationwide survey of over 3,000 grade 11 students (approximately equal numbers of males and females) representing major urban areas in all ten provinces was undertaken to obtain baseline data on access to and usage of computers in each of three categories--recreational, nonrecreational home usage, and school--and to test a "manifold model" of computer-student interaction in a Canadian context. The impact of gender differences and of usage category differences on the overall system of computer-related attitudes and actions was a particular focus of the study. Regardless of the use to which computers are put, or the location--home or school--in which computers are used, grade 11 females in this sample are less likely than males to be frequent computer users. From a theoretical perspective the study supports a "manifold model" approach that represents the mutual interrelationships between various clusters of variables relevant to a young person's decision to make use of a computer, e.g., access, general and personal attitudes toward computers, social issues and values, computer self-perception, and use and user stereotypes. This model has considerable potential as a framework for subsequent refinements in the study of the relationships between Canadian adolescents and computers. (GL)

Gender Differences in Canadian Grade 11 Students' Interactions With Computers: Results of a National Study

Betty Collis
University of Victoria

Heidi Kass and Thomas Kieren
University of Alberta

Denis Therrien
Université Laval

Peter Wood
University of Alberta

Paper presented at the Annual Meeting of the Canadian Society for Studies in Education, Windsor, Ontario, June 5, 1988.

Abstract

A nationwide survey of over 3000 Grade 11 students representing major urban areas in all ten provinces yielded data to support significant gender differences in access to and usage of computers in each of three usage categories--recreational, nonrecreational home usage, and school. This presentation will summarize and synthesize a large set of descriptive data relative to gender differences in the three types of computer usage. These results can provide a national baseline data set for subsequent comparisons and research.

Gender Differences in Canadian Grade 11 Students' Interactions With Computers: Results of a National Study

Introduction

Canadian adolescents are now routinely exposed to computers, at home, in workplaces, in recreational settings, and in school. Expectations for the impact of this exposure have varied, from positive (opportunities to use computers in home and in school will improve future employability and current "productivity" in terms of school work and learning in general) to negative (computer use can lead to disruption in both personal and general social systems). The procurement of baseline data about computer use and computer-related attitudes by Canadian adolescents is necessary in order to begin critical longitudinal studies of these expectations. The overall purpose of the Computers and Canadian Youth Project (CCY), funded by SSHRC Grant #499-85-0021, and a series of studies before it also funded by SSHRC, was to obtain such baseline data and to use the data to test a "manifold model" of computer-student interaction in a Canadian context. The impact of gender differences and of usage category differences on the overall system of computer-related attitudes and actions was a particular focus of the study.

Objective

The purpose of this paper is to summarize the findings of the

CCY Project with regard to gender differences in computer usage and to examine the interaction of these gender differences with three categories of computer usage. The categories of usage examined in this study are recreational use, nonrecreational home use, and school use.

Theoretical Perspective

The theoretical perspective in which this study is grounded is the so-called "manifold model" for the portrayal of computer-young person interaction in a social context (Kass, Kieren, Collis, & Therrien, 1987). The model is diagrammed in Figure 1. It represents the mutual interrelationships between various clusters of variables all relevant to a young person's decision to make use of a computer. Any change in a parameter of this system can bring about changes in the rest of the system. Different types of computer use can substantially influence not only likelihood of access to a computer but also other variables in the system such as self-confidence or stereotypes of typical users. One of the purposes of the overall CCY Project was to test the manifold model. Results of these tests are reported elsewhere (Collis, Kieren, & Kass, 1988; Kass, Kieren, Collis, & Therien, 1987) and show the model to provide an effective fit for the data in terms of various hypotheses relating to gender differences in different usage categories.

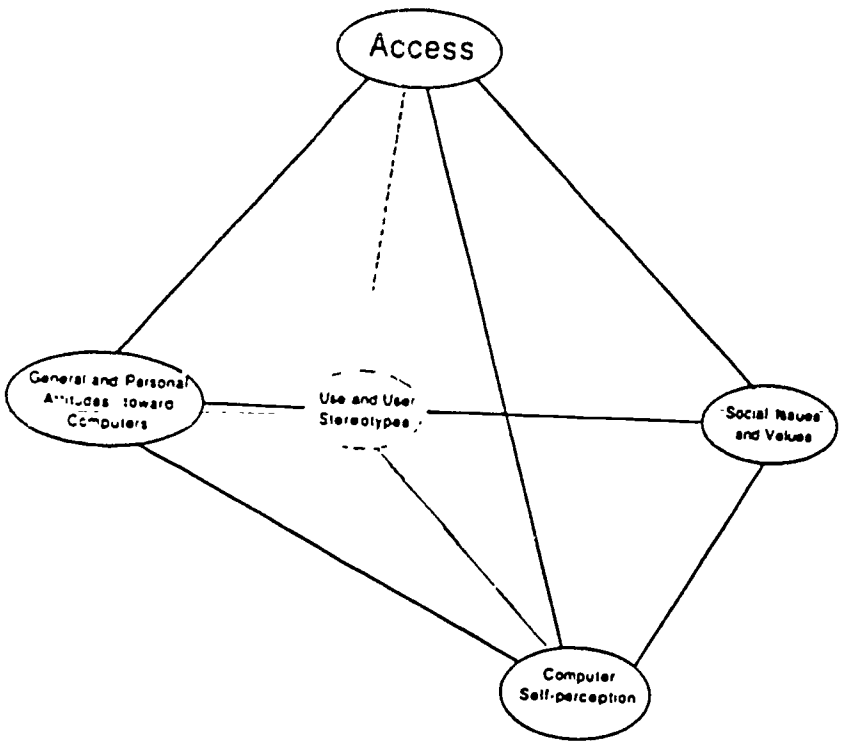

Figure 1. A Manifold Access Model of Human-Computer Relationships

Sample and Method

The instrument used for data collection in this study was developed and validated in a series of three large-scale pilot studies. The final questionnaire consisted of 120 items and was administered to 120 Grade 11 social studies classes in as many different secondary schools representing every major urban area in each province of Canada. The percentage of students responding to the survey in each region of Canada was approximately the same as the percentage of adolescents in those regions according to the 1981 Canada Census. There were approximately equal numbers of males ($\underline{N}$ = 1380) and females ($\underline{N}$ = 1428). The data were collected between November, 1986 and April, 1987.

Socioeconomic level was not assessed directly; however, students were more likely to be members of well-educated families than may be the case in the general Canadian urban population. Thirty-one percent of the students' fathers and 25% of their mothers had finished university or college and an additional 16% of parents had finished other training after secondary school. Approximately 65% of the parents had finished secondary school. The students were also more representative of higher achieving students than of their entire population, in that only 12% of the males and 9% of the females described themselves as having grades "below average" for their class. The students indicated high academic goals for themselves, as can be seen in Table 1.

Table 1

Postsecondary Education Plans

	Do not plan to continue	1-2 years	3-4 years (finish university)	More than 4 years	Do not know yet
Males	3.8%[a]	11.0	28.5	34.4	22.5
Females	3.4%	11.4	28.4	37.4	19.4

Note. $x^2 = 4.87$, df = 4, $p > .3$

[a]Percentages refer to gender group.

As can be seen from Table 1, the majority of the students in the sample plan to at least finish university (63% of the males and 66% of the females).

Results

The purpose of the remainder of this paper will be to summarize and synthesize data on gender differences relative to a series of aspects of computer-student interaction as realized in the results of the study.

Home Computer Access

Despite the general similarity of the educational backgrounds of the parents of the males and females in this sample, an

interesting gender difference occurs with respect to family ownership of a home computer. Fifty-six percent of the males indicated there was a computer in their homes in contrast to 43.8% of the females. This relationship between gender and home ownership of computers is significant, $x^2(2573,1) = 47.80$, $p < .001$ (using Yates' correction). These same gender differences are seen within each of the four geographical regions. Table 2 summarizes home ownership of computers by region and gender.

Table 2

Computer in the Home, by Region and Gender

Region	Male	Female
Western	52.1%[a]	36.4%
Central (Ontario)	49.7	38.0
Quebec	32.9	29.9
Atlantic	57.0	38.5

Note. [a]Refers to percentages of gender/region sample having a computer in their homes

Gender differences can also be seen with respect to the purchase of software for a home computer. Overall, 45.7% of the males compared to only 21.8 of the females indicated they had

personally purchased computer software or hardware. This proportion was generally replicated in each of the four regions. Of those students with home computers, gender differences in being involved with personal purchase of software or hardware are even more pronounced. Within each region 77% of the students with home computers who had also personally purchased hardware or software were male and only 23% were female. The relationship between gender and having a computer available to use at a friend's house was also significant, $x^2(2568,1) = 32.78$, $p < .001$ (using Yates' correction). These results, taken together, clearly document that males more than females have access to computers outside of the school setting and are associated with purchases for those computers. However, regardless of gender, parental educational level is strongly associated with home computer ownership. Table 3 summarizes this relationship and shows that students with home computers are more likely to have parents and especially fathers with university degrees whereas students without home computers are much more likely to be from homes where parents have not completed university.

Table 3

Association Between Parents' Educational Level, Ownership of Home Computer, and Gender of Grade 11 Respondent

Educational Level	Male		Female	
	with home computer	without home computer	with home computer	without home computer
Completed University				
Father	41.5%[a]	25.0%	39.3%	24.6%
Mother	31.8	19.7	30.9	20.9
Completed Other Postsecondary				
Father	17.5	14.1	17.3	14.7
Mother	19.0	14.7	20.8	16.8
Completed High School				
Father	14.9	19.5	13.9	18.4
Mother	22.8	27.0	24.4	24.9
Other or Don't Know				
Father	25.0	41.4	29.5	42.3
Mother	26.4	38.6	23.9	37.4

Note. [a]Refers to percentage within each gender/computer status group.

A more detailed examination of gender differences in home access to computers should also include the variable of personal choice with regard to usage as well as the variable of having a computer to access. Table 4 shows the relationship between gender and home access to and use of computers.

Table 4

Frequency of Home Computer Use

	None available	Never use it although available	Once or twice a year	Once or twice a month	Once or twice a week	More than twice a week
Males	49.8%[a]	4.1	6.9	10.1	11.2	17.8
Females	64.6%	6.0	10.0	9.0	6.2	4.1

Note. $x^2(2566,5) = 166.84$, $p < .001$.

[a]Percentages refer to gender group. Percentages vary slightly from table to table because of missing data on variables.

It can readily be seen that males are two to four times more likely than females to use a computer once a week or more, whereas females are more likely than males to either have no access to a computer, or to choose not to use it even if available. However,

the proportions of males and females who have a home computer and use it once or twice a month are very similar.

Task-Oriented Uses of Computers

Nonrecreational Uses of Computers. Of the 637 males and 463 females who indicated they had a computer at home, the majority indicate they do use the computer to do something else other than recreation. Table 5 shows the responses of the students to a general question about using a home computer for something other than recreation, and two specific questions relating to the common home tasks of word processing and printing or desktop publishing (i.e., printing something like posters, invitations, or cards).

Table 5

Task-Type Uses of Home Computers

	Not used at all, or not used for anything but recreation	Used a few times: In general	Used a few times: For word processing	Used a few times: For printing	Used Often: In general	Used Often: For word processing	Used Often: For printing
Males	13.5%[a]	45.7	34.0	42.5	40.8	38.3	28.3
Females	27.5	49.2	43.1	45.3	23.1	20.3	17.8

Note. [a]Percents based on sample within gender having access to necessary hardware and software at home.

Gender Differences in Home Task Uses

Two hundred seventy-two of the males with home computers and 230 of the females indicated they could not do word processing or printing tasks because their home systems did not include a printer. As can be seen by a comparison of male and female percentages in Table 5, the significant relationship between gender and general frequency of nonrecreational computer use ($x^2(1100,2) = 53.49$, $p < 0.001$), is influenced by the overrepresentation of females among those who have access to a home computer but do not use it at all or do not use it for nonrecreational purposes, and the underrepresentation of females compared to males among those who use a home computer "often" for nonrecreational purposes. These same imbalances relate to use of a word processor ($x^2(775,2) = 27.22$, $p < 0.001$) when word processing facilities are available at home, and to desktop publishing or printing tasks ($x^2(546,2) = 8.63$, $p < .02$), again when facilities are available at home. There are no meaningful gender differences in the proportions of students having access to computers, printers, and appropriate software for word processing and printing tasks at home and who try them "a few times." After they do try them, however, significantly more males than females persist and become regular users. In summary, with regard to nonrecreational and noneducational home uses of computers, females

have less access than males through the fact of being less likely to have a computer and appropriate software and peripherals available at home, but also are less likely than males to make initial use of available facilities, or to persist with regular use after initial experiences.

Educational Uses of Computers

Use of Home Computers for Homework. Computers can be used for educational purposes at home and at school. It is possible that some of the usage of home computers for programming and for word processing that has been already described in the context of recreation or nonrecreational, tool-type usage may have been done entirely in response to educational purposes relative to school assignments. To probe this further, the students were asked if they had ever done homework using a computer at home. Of the males with access to a home computer who responded to this question, 33% answered "never," 27% answered "once or twice," and 40% answered "more than twice." The corresponding proportions for the females with access to a home computer are 50%, 30%, and 20%. These proportions reflect a significant relationship between gender and use of a home computer for homework, $x^2(1059,2) = 50.72$, $p < 0.001$, and indicate again the same pattern that has been seen in other sets of responses: Females have less home access because of fewer systems available to them, are less

likely to make initial usage even when a system is accessible, and are less likely when systems are available to become frequent users than are males. As was seen before, approximately the same proportions of males and females with access to a home computer have tried to use it once or twice for homework; it is the males, however, who are likely to persist.

Use of Home Computers for Voluntary Learning Activities. The students who indicated they had access to a home computer for educational purposes were asked if they had "ever tried to learn something on a computer at home that was not part of a homework assignment." The same patterns of response were obtained as occurred for homework usage. Twenty-one percent of the males indicated they never used their home computers for "voluntary" learning compared to 31% of the females, whereas 45% of the males as opposed to only 27% of the females indicated persistent usage for home, voluntary learning. Again, approximately the same proportions of males and females (34% and 42%) tried this type of usage once or twice but did not persist. The overall relationship between gender and voluntary learning-related usage of home computers was significant, ($x^2(1082,2) = 37.18$, $p < 0.001$).

Gender Differences in School Usage of Computers. Frequency of school usage of computers also varies significantly with gender. Table 6 summarizes the students' responses to an inquiry

of "on the average, how much time each week (5 school days) do you spend using a computer at your school?" Table 7 summarizes their responses to the question "to what extent have you been frustrated by not being able to use a computer at school?"

Table 6

Frequency of Use of School Computers in Average Week

	Never	Some weeks never, some occasionally	Some weeks a lot	Usually once or twice a a week	Usually more than twice a week
Male	55.9%[a]	13.7	5.6	6.3	18.7
Female	70.7%	10.4	2.5	5.2	11.1

Note. $x^2(2555,4) = 67.86$, $p < .001$.

[a]Percentages relate to gender group.

Table 7

Satisfaction With Frequency of Use of School Computers

	Satisfied with never using one because never want to use one	Satisfied because have access whenever I wish	Dissatisfied once or twice	Occasionally dissatisfied	Frequently dissatisfied
Male	39.4%[a]	27.1	22.1	7.6	3.8
Female	54.6%	22.2	15.6	5.5	2.1

Note. $x^2(2541,4) = 61.87$, $p < .001$.

[a]Percentages relate to gender group.

The major impression obtained from an inspection of Tables 6 and 7 is that the majority of the Grade 11 students in this sample make no use at all of school computer resources and are generally not too concerned about it. Significantly more of the females (71%) than the males (56%) are nonusers of school computers, $z = 5.22$, $p < .001$. Furthermore, Table 7 shows that 39% of the females and 55% of the males who never use school computers do not feel frustrated by their lack of usage. Overall only 25% of the

males and 16% of the females are regular users of school computers, and only 33% of the males and 23% of the females indicate any dissatisfaction with their quantity of usage. The dissatisfied students within each gender were equally divided between those who had no access and those who already had extensive access but wanted more. For both males and females, these percentages relating to usage and to dissatisfaction are low and suggest both that school use of computers has little impact on the majority of students and that the majority of students, male and female, are not particularly concerned about their lack of contact with school computers.

Use of School Computers in Subject Areas and in Computer Science Courses. There is considerable emphasis now being given in the professional literature to the diffusion of computer applications throughout curriculum areas rather than the concentration of computer experiences within a specific computer science or computer studies course. To what extent do the students in this sample indicate their school computer experiences are infused into their classroom routines and to what extent are the experiences reflective of enrolment in computer science or computer studies courses? Table 8 indicates the students' overall appraisal of where in their school experiences they have used computers.

Table 8

Educational Contexts of School Computer Use

	Used in:				
	Math classes	Science classes	Social Studies classes	English classes	Computer Course
Male					
Never	78.0%[a]	85.6	91.0	84.0	Yes =
Once or twice	13.8	9.6	5.7	8.5	64.7%
Occasionally	6.4	3.2	2.2	5.0	
Frequently	1.8	1.7	1.0	2.5	
Female					
Never	83.6%	92.3	94.6	88.3	Yes =
Once or twice	11.2	5.3	3.2	8.4	54.4%
Occasionally	3.6	1.5	1.5	2.5	
Frequently	1.5	.9	.8	.8	

Note. [a]Percentage of gender group in each category.

Significant ($p < .001$) gender differences in frequency of usage within content areas appear in all the types of classes shown in Table 8. The gender difference in science usage, $x^2(2556,3) = 29.30$, probably reflects the tendency of Grade 11

females to elect biology instead of physics or chemistry and the similar tendency of Grade 11 males to elect physical sciences rather than biology. Computer applications are more established in the physics classroom than they are in biology, perhaps reflecting the subject matter and perhaps reflecting the fact that physics teachers are more often males familiar with computers and biology teachers more often are females who may be relatively less familiar with computers.

These data show most clearly that little or no computer usage opportunities are occurring for most students within the contexts of their regular courses. The great majority of students report that they have never used a computer as part of their math, science, social studies, or English classes and there is little regional variation in this pattern other than Quebec being consistently less represented in the relatively small amount of use that does occur compared to the other three regions. It would seem likely then that most school experiences with computers occur within the context of specific computer courses, courses that have been or are being taken by 65% of the males and 54% of the females in this sample. This computer-course orientation of school computer use is supported by another question the students were asked: "Have you ever used a computer at school to learn or review subject matter?" Only 21 (1.7%) of the 1,258 males and 11

(.9%) of the 1,293 females said they did this frequently, and only 72 (5.7%) of the males and 52 (4%) of the females said they used computers "occasionally" to learn or review subject material. Eighty-two percent of the males and 87% of the females said this had never occurred for them throughout their school careers.

Types of Activities Done with School Computers. Since some students do indicate regular use of school computers, and since use of computers for learning has already been seen to be of minimal impact, what are the students doing when they access school computers? Table 9 summarizes the variety of the school activities involving computers reported by the Grade 11 students in this sample. For completeness and contrast, information about using school computers for learning and reviewing subject matter, and for recreation, both of which were discussed earlier, is re-presented in Table 9.

Table 9

Use of School Computers

	Word processing	Learn or review	Spread-sheet or data base	Program-ming	Recrea-tion
Male					
No	55.9%[a]	81.7	72.4	38.0	29.1
Once or twice	18.6	10.9	13.1	19.1	23.2
Occasionally	14.9	5.7	8.5	16.9	24.8
Frequently	10.6	1.7	6.0	26.0	22.9
Female					
No	66.0%	87.4	83.2	47.3	31.1
Once or twice	16.7	7.7	8.7	21.7	35.9
Occasionally	10.3	4.0	4.7	14.4	22.5
Frequently	7.0	0.9	3.4	16.7	10.6

Note. [a]Each percentage refers to portion of gender group relative to each application.

Significant ($p < .001$) gender differences in usage patterns were obtained for each of these categories: for recreation,

$x^2(2525,3) = 94.76$; programming, $x^2(2559,3) = 43.56$; word processing, $x^2(2552,3) = 32.04$; spreadsheet/data base usage, $x^2(2553,3) = 44.66$; and for learning and reviewing subject material, $x^2(2551,3) = 16.47$. However, the overall impression obtained by examining Table 9 is that recreation and programming are the uses to which school computers are most often put for both males and females. Word processing, often seen as particularly valuable for female students in that it relates well to females' generally positive attitudes toward writing and communication, is used less often in school by females than by males in this sample.

As programming appears to still be the dominant use of school computers in this sample (despite the clear trend in society and in professional usage of computers away from programming and toward applications software), differences in programming experience are of interest. Sixty-nine percent of all the males in contrast to 57% of all the females indicated they could use BASIC, and 28% of the males compared to 18% of the females indicated they could use another language such as Pascal. Both these differences in proportions are significant, $z = 5.15$ and $z = 4.28$, $p < .001$.

Other Predictors and Nonpredictors of Usage of School Computers. It can be seen that virtually all the students who are frequent users of school computers are or have been enroled in a

computer course. Although self-selection makes it impossible to isolate personal interest variables from computer course participation, the computer course appears to be the filter through which nearly all school access, at least for secondary school students, is allocated.

What else might predict student usage of school computers? Various factors do not discriminate between frequent school users and nonusers for both males and females. Students' postsecondary academic plans do not predict school usage for either females ($x^2(210,4) = 7.41$, $p > .11$) or for males ($x^2(410,4) = 7.40$, $p > .11$). Similarly, neither fathers' nor mothers' educational backgrounds discriminate between frequent school users and nonusers. However, for males, frequency of home usage does seem to be associated with frequency of school usage of computers. Table 10 shows the relationship.

Table 10

Relationship Between Home and School Use of Computers, by Gender

Gender/Home Usage Group	School Use				
	Never	Some weeks never, some occasionally	Some weeks a lot	Once or twice a week	More than twice a week
Frequent home users					
Females	54.9%[a]	17.3	3.0	9.8	15.0
Males	38.1%	17.4	7.1	7.1	30.2
Home nonusers[b]					
Females	78.2	5.1	1.3	2.6	12.8
Males	76.9	11.5	5.8	3.3	1.9

Note. [a]Percentage refers to gender/usage group.

[b]Based only on students who have a home computer but never use it.

Gender differences can be clearly seen in these responses. Males show a fairly consistent relationship between home and school use, especially with regard to frequent usage. Only one of the 112 males who use a school computer more than twice a week was

in the group of males who never use a home computer even when they have access to it. However, females are more complicated. More than half of the females (54.9%) who make frequent use of a home computer do not use school computers at all, in contrast to only 38.1% of the males who make frequent use of a home computer but who do not use school computers. Only 15% of the frequent home-using females are frequent school users compared to 30.2% of the frequent home-using males; furthermore, a third of the frequent school-using females were in the group who have access to a home computer but never use it. Females appear to make a distinction between their home and school usage of computers in a manner that males do not.

Summary of Access Description and Relationship to Affective Considerations

Regardless of the use to which computers are put, or the location--home or school--in which computers are used, Grade 11 females in this 1987 cross-Canada sample are less likely than males to be frequent computer users. Some potential explanations for this may relate to school policy and practices about computer use, policies which either deliberately or unintentionally focus computer usage in computer courses and in programming and recreational uses in lab settings, all of which have been shown repeatedly to be associated with a "masculine" bias surrounding computer use. When an experience becomes gender-typed, there is

considerable evidence to suggest that students of the nonassociated gender will be inclined to avoid it. One of the significant components of female underrepresentation in secondary mathematics and physical science, for example, has often been identified as females' perception of math and physical science as "masculine" subjects. It would seem that, as long as school computer use is concentrated in discrete computer courses which emphasize programming (and are typically taught by male mathematics teachers), this "masculine" image is being reinforced. The reinforcement is intensified by the fact that significantly more males than females actually use school computers.

Significance of the Study

This study is valuable as a systematic and timely collection of computer-related data from a representative sample of urban Canadian Grade 11 students. From a theoretical perspective the study supports a "manifold model" approach that has considerable potential as framework for subsequent refinements in the study of the relationships between Canadian adolescents and computers. From a practical perspective, the baseline data, only some of which are summarized in this paper, provide evidence that gender-related inequities in computer access do exist for Canadian adolescents and these differences in access patterns can be seen both at home and at school.

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