Conditions for Success? Gender in Technology-Intensive Courses in British Columbia Secondary Schools

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One thing is clear: claiming that current policies and practices aim to achieve 'equal opportunity' is not yet borne out in reality. The committee recommends that a program be developed to deal with these [gender] inequities. (British Columbia Ministry of Education, 1999, p. xiv)

Abstract: Gender inequities in technology are systemic in Canadian schools and workplaces (Status of Women Canada, 1997). Several recent analyses of British Columbia (BC) students' participation in technology-intensive areas of the public school curriculum have documented a range of these inequities (Braundy, O'Riley, Petrina, Dalley, & Paxton, 2000; Bryson & de Castell, 1998; Schaefer, 2000). In the BC Ministry of Education's (BC MOE) most recent technology policy report, *Conditions for Success* (1999), gender inequities are treated as symptoms of poor access, rather than as a systemic part of the school conditions themselves. Because the report's authors misapprehended the extent of inequities, BC MOE's Technology Advisory Committee recommended a distribution and integration of technologies to provide the new conditions for success in technology throughout BC's public schools. We argue that the inequities in the BC schools are systemic and cannot be understood without an adequate assessment of participation and performance data. We analyze provincial trends in gender-differentiated participation and performance of students in the technology-intensive courses of BC public secondary education, at a time in Canadian history when competence and confidence with a range of technologies are essential for full cultural participation.

More financial resources are being directed to technology than to any other area in public school budgets. For the period 1998 to 2004, the BC government committed $123 million to establish a Provincial Learning Network to network BC's 1,700 public schools and improve access. Other provinces made similar commitments to information technology. Alberta, for example, invested $85 million for the same time period. Inasmuch as girls continue to be under-represented in technology courses, they have not benefited from the comparatively large financial investments in technology. Policy makers in Canadian public education require access to sex-disaggregated data, in order to create and implement equity-oriented strategies in technology. The research described here represents a step towards the development of an information-rich database for monitoring technology course enrolments in Canadian schools and has both policy and scholarly implications.

Sommaire exécutif : Les inégalités sexuelles dans le domaine des technologies sont systémiques dans les écoles et les milieux de travail canadiens (Condition féminine Canada, 1997). En Colombie Britannique, plusieurs analyses récentes sur la participation des étudiants aux secteurs technologiques du curriculum des écoles publiques font état de nombreuses iniquités (Braundy, O'Riley, Petrina, Dalley et Paxton, 2000 ; Bryson et de Castell, 1998 ; Schaefer, 2000). Dans le plus récent rapport du ministère de l'Éducation de la Colombie Britannique, intitulé *Conditions for Success* (1999), les inégalités sexuelles sont traitées comme un symptôme plutôt que comme une composante systémique des conditions qui caractérisent les milieux scolaires. Les auteurs du rapport se sont mépris sur l'étendue du phénomène, et le *Technology Advisory Committee* du ministère de l'Éducation a recommandé une distribution et une intégration des technologies dans toutes les écoles publiques de la Colombie Britannique, afin de créer de nouvelles conditions assurant le succès des élèves dans le domaine des technologies. À notre avis, les iniquités dans les écoles de la province sont systémiques et ne peuvent s'expliquer sans qu'on procède à une analyse détaillée des données sur la participation et la performance. Nous analysons les tendances provinciales pour ce qui est des différences de participation et de performance dans les cours riches en contenus technologiques chez les étudiants et les étudiantes des écoles publiques de niveau secondaire, et ce à un moment de notre histoire où les compétences technologiques sont essentielles à une pleine participation à la vie culturelle.

Notre analyse des inscriptions chez les étudiants et étudiantes de la Colombie Britannique révèle de grandes inégalités frappant les élèves de sexe féminin dans tous les cours à contenus hautement technologiques, sauf dans ceux de gestion des informations (études commerciales) et ceux qui ont trait aux textiles (économie domestique) (Tableaux 1–3). Puisque les étudiantes continuent d'être sous-représentées dans la plupart des cours de technologies, elles ne profitent guère des investissements dont ces cours ont bénéficié. Il y a donc une double inégalité : les cours d'informatique et de technologies industrielles continuent à bénéficier de financements excessifs comparativement aux cours où prédominent les élèves de sexe féminin, et seule une faible partie des étudiantes profitent des avantages accrus que procure la réussite à ces cours. On voit partout la grande variété de cours technologiques à prédominance masculine, à l'exception des cours de gestion des informations et ceux qui ont trait aux textiles. Cette donnée est demeurée essentiellement inchangée malgré une politique explicite de promotion de l'équité sexuelle de la part du ministère de l'Éducation de la Colombie Britannique. En un mot, la situation des étudiantes demeure celle d'une sous-représentation et d'une « ghettisation » disciplinaire. Le statut des élèves de sexe féminin dans les écoles publiques de Colombie Britannique n'a pas évolué au cours des quinze dernières années. Et, bien que notre propos se soit limité au écoles de niveau secondaire, nous estimons que les inégalités dans le domaine des technologies caractérisent l'ensemble du système d'éducation, du curriculum K–12 à la formation des maîtres, sans compter l'emploi (Tableaux 1–3).

Background

The knowledge and technology sectors represent the fastest growing areas in the Canadian economy, in Canadian cultural production, and in Canadian educational curriculum development. In 1998, the high-tech sector's contribution to BC's GDP was 6.2%, 20 times the 0.3% expansion rate of the BC economy. High-tech sector job growth doubled during the 1990s, while overall job growth was 15%. But the high-tech sector is male-dominated. Only 20% of the high-tech positions in BC, Canada, and the United States are filled by women (American Association of University Women, 2000; Menzies, 1998; Ministry of Women's Equality, 2000; Schaefer, 2000; Status of Women Canada, 1997; Withers, 2000). Why, then, is it still the case, at the dawn of the twenty-first century, that a large number of girls and women (a) remain limited to domestic, clerical, medical, and service *uses of* technology and (b) occupy subordinate roles in many scientific and technical fields? While women are more likely than men to work in an occupation requiring significant amounts of computer use, girls in secondary school are only one-fourth as likely to complete a computer education course as boys. In the educational context, specifically, empirical evidence suggests that female staff and students (in comparison with males) (a) are disenfranchised with respect to access and variety of use, (b) are less likely to acquire technological competence and confidence, and (c) are more likely to be actively discouraged from playing a leadership role in technology (Braundy et al., 2000; Bryson & de Castell, 1998; Schaefer, 2000; Shashaani, 1994; Sutton, 1991; Withers, 2000).

In response to the persistent under-representation of girls and women in technology-courses, national (e.g., Status of Women Canada, 1998) and international (Huyer, 1997) organizations have emphasized the importance of developing and maintaining comprehensive national and regional sex-differentiated analyses of trends in students' participation and performance in technology. In the United States, analyses of key access and performance indicators have shown that girls make up only a small percentage of students in computer science courses. Girls are significantly more likely than boys to enrol in clerical and data-entry courses, the 1990s version of typing. Boys are more likely to enrol in advanced computer science and computer graphics courses (American Association of University Women, 1998, 2000). The proportion of female students taking the Computer Science College Board examinations did not increase between 1987 (17%) and 1997 (16%) (College Board, 1997; National Science Foundation, 1997a, 1997b).

Our analysis of BC's student enrolments in all technology-intensive courses documents inequities for girls across all but the information management (business education) and clothing and textiles (home economics) courses (Tables 1 to 3). Inasmuch as girls continue to be under-represented in most technology-intensive courses, they have not benefited from investments in these courses. And so there exists a double inequity: information and industrial technology courses continue to be over-funded in comparison to courses where female students predominate; only a small percentage of girls receive the benefits accrued through completion of these courses. In Canada, England and the United States, analyses of sex-disaggregated data have indicated similar findings regarding engineering, design, and the trades. For example, the percentage of women completing baccalaureate degrees in engineering increased in the United States through the 1960s and 1970s but has remained between 15%-20% of the total since the late 1980s (National Science Foundation, 1997b). Women account for about 15% of the total product and industrial design graduates in Canada and England and about 90% of the graduates in textile design (Clegg, Mayfield & Trayhurn, 1999). In Canada, women account for between 0.51% (sheet metal fabricators) to 3.5% (machinists, painters/decorators) of all apprenticeships, when chefs and hairdressers are removed from the calculations (Ministry of Women's Equality, 2000; Skof, 1994). The point of these indicators is not to belabour the under-representation of women but rather to stress the importance of sex-disaggregated data for accountability and policy making.

Method and objectives

We analyzed BC MOE records of secondary course enrolment (participation) and performance (marks) in technology-intensive courses for all years for which sex-disaggregated data were available. We also analyzed practices in schools where either a single program or multiple programs were in place to increase participation by female students. All middle and secondary schools were contacted by the research team, via both mail and e-mail ($N = 375$). An exceedingly small sub-set of schools ($n = 13$) was *self-identified* by administrators as having either a single program or multiple programs in place to increase participation of female students. This sample was unrepresentative and so small as to render any generalizations entirely suspect. However, teachers and administrators in these schools were contacted and interviewed about initiatives to increase the participation of female students in technology-intensive courses. Reports from these schools about gender-specific interventions were sketchy at best. We also contacted all of the provincial ministries of education in Canada to gain access to enrolments in technology-intensive courses, but only Ontario, in addition to BC, responded with useable data.

We have created a Web site (http://www.shecan.com) both to disseminate the results of this project and to engage members of all stakeholder groups in public discussions of our findings, as well as to publish research findings. Our findings and recommendations represent an interdisciplinary approach to investigating gender inequities that are national in scope and of great international interest. We believe that policy makers in Canada will benefit directly from the results of this research.

Findings

Key findings are as follows:

- With the notable exception of information management (i.e., business education) and clothing and textiles courses, boys dominate in most technology-intensive courses. This finding has remained essentially unaltered throughout the duration of an explicit BC MOE *gender equity* policy. In other words, the situation for girls remains one of under-representation and disciplinary ghettoization. The status of girls in BC public school technology courses has not improved over the last 15 years. While our focus was on secondary schools, we stress that gender inequities in technology are systemic in the educational system, from K-to-12 curriculum to instruction to teacher preparation and employment (Tables 1 to 3).
- Female students, relative to their absolute numbers as participants in technology-intensive courses, are *over-represented* in the upper categories of the performance scale (A and B) and *under-represented* in the lower categories of the performance scale (C to F). Statistically, the comparability of performance across the sexes is suspect, because the samples are not comparable to the extent that the female sample represents a very small minority of the total number of available participants. It may be that only the most able female students choose to participate in these courses. One cannot conclude from this finding that girls 'do better' than boys in technology-intensive courses (Tables 2 and 3).
- Interprovincial data for comparative purposes is generally unavailable. Record keeping is either sporadic across the provinces or ministries are unwilling to make their enrolment data public. Enrolments in BC's technology-intensive courses are similar to enrolments in Ontario's courses, except in Communications Technology, where female enrolments are nearly twice those of BC's enrolments in the parallel Drafting and CAD courses. Enrolment in Ontario's Technological Design course is also noticeably higher than in BC's General Technology course. More research is necessary to determine why there are differences (Table 4).

Table 1: BC Technology enrolments by course and sex, 1988, 1998

Course	% Female 1987–1988	% Male 1987–1988	% Female 1997–1998	% Male 1997–1998
Info Tech 12	23%	77%	21%	79%
Construction 12	4.2%	95.8%	6%	94%
Drafting & CAD 12	11%	89%	14%	86%
Technology 12	8%	92%	10%	90%

Table 2: BC Technology intensive courses and performance by enrolments, marks, and sex, 1997–1998

Course and Sex	#	%	% A–B	% C	% F
Construction 11 female	322	10%	65%	33%	2%
Construction 11 male	2,779	90%	55%	40%	5%
Construction 12 female	149	6%	71%	26%	3%
Construction 12 male	2,295	94%	59%	37%	4%
Drafting & cad 11 female	837	19%	79%	20%	1%
Drafting & cad 11 male	3,453	81%	62%	32%	6%
Drafting & cad 12 female	274	14%	82%	18%	0%
Drafting & cad 12 male	1,720	86%	56%	42%	2%
Electronics 11 female	33	3%	83%	17%	0%
Electronics 11 male	965	97%	57%	36.2%	6.8%
Electronics 12 female	22	3%	86%	14%	0%
Electronics 12 male	714	97%	70%	34.6%	3.5%
Metal fab/welding 11 female	192	9%	60%	37%	3%
Metal fab/welding 11 male	2,026	91%	50%	45%	5%
Metal fab/welding 12 female	75	6%	61%	39%	0%
Metal fab/welding 12 male	1,260	94%	56%	39%	5%
Power tech/auto 11 female	461	10%	40%	55%	5%
Power tech/auto 11 male	4,266	90%	44%	46%	10%
Power tech/auto 12 female	153	4%	51%	45%	4%
Power tech/auto 12 male	3,706	96%	51%	44%	5%
Technology 11 female	128	12%	67%	33%	0%
Technology 11 male	962	88%	46%	49%	5%
Technology 12 female	52	10%	75%	23%	2%
Technology 12 male	483	90%	61%	36%	3%

Source: BC Ministry of Education, Data Management and Student Services Branch, Report TRAK2952B.

Table 3: BC Technology intensive courses and performance by enrolments, marks and sex, 1997–1998

Course and sex	#	%	% A–B	% C	% F
Information tech 11 female	2,692	34%	67%	30%	3%
Information tech 11 male	5,264	66%	58%	36%	6%
Information tech 12 female	733	21%	76%	22%	2%
Information tech 12 male	2,734	79%	66%	29%	5%
Info management 11 female	760	69%	68%	31%	1%
Info management 11 male	335	31%	55%	39	6%
Info management 12 female	339	74%	71%	28%	1%
Info management 12 male	119	26%	57%	38%	5%
Clothing & textiles 11 female	1,643	96%	72%	24%	4%
Clothing & textiles 11 male	77	4%	48%	44%	8%
Clothing & textiles 12 female	735	98%	76%	21%	3%
Clothing & textiles 12 male	13	2%	38%	62%	0%

Source: BC Ministry of Education, Data Management and Student Services Branch, Report TRAK2952B.

Table 4: Ontario technology enrolments by secondary course, grade, and sex, 1996–1999

Course	Female 1997–98	Male 1997–98	Total 1997–98	Female 1998–99	Male 1998–99	Total 1998–99
Communications	21,173	47,822	68,995	24,221	50,590	74,811
	30.6%	69.4%	100%	67.7%	32.3%	100%
Transportation	5,394	50,609	56,003	5,400	50,913	56,313
	9.6%	90.4%	100%	9.5%	91.5%	100%
Construction Tech	6,067	35,283	41,350	6,702	37,453	44,155
	18.4%	81.6%	100%	15.1%	74.9%	100%
Tech Design	6,694	26,235	32,929	15,739	40,064	55,803
	20.3%	79.7%	100%	28.2%	71.8%	100%
Manufacturing	2,422	24,923	27,345	3,647	27,731	31,428
	8.8%	91.2%	100%	11.6%	88.4%	100%
Electronics	108	1,121	1,229	71	756	827
	8.7%	91.3%	100%	8.5%	91.5%	100%
Computer Tech	150	1,011	1,061	439	1,251	1,690
	14.1%	85.9%	100%	25.9%	74.1%	100%
Hospitality Services	8,164	9,077	17,241	9,397	10,294	19,691
	47.3%	52.7%	100%	47.7%	52.3%	100%
Cosmetology	11,962	1,536	13,498	12,769	1,720	14,489
	88.6%	11.4%	100%	88.1%	11.9%	100%

Source: Ontario School Report Course Enrolment, Ontario Ministry of Education

- Of the 375 secondary schools in BC that were contacted by the research team by both e-mail and regular mail, only 13 (3.4%) responded to our request for information concerning *any* local, school-based initiatives designed to increase participation by female students in technology-intensive courses. Clearly, there is good reason to be concerned that administrators at BC secondary schools are not addressing the problem of the significant and persistent under-representation of female students in technology-intensive secondary schools.
- One out of every 30 technology teachers and 1 out every 8 information technology teachers are female. Neither the BC Ministry of Education nor the university administrators in BC have demonstrated leadership in redressing these inequities, which correlate directly with enrolments in technology-intensive courses. While the research on gender and role modelling is contentious, there is no excuse for wholesale inattention to gender inequities in the technology education teaching force.
- In 1998 the BC Ministry of Education ceased to collect sex-disaggregated data on most courses in the secondary school curriculum, citing in explanation the cost of collecting these data, as well as their perceived use value to educational decision making. However, policy makers for Canadian education require access to sex-disaggregated data in order to create and implement equity-oriented interventions in technology.

Discussion

Girls and boys are required to take one or more of the applied skills courses in Grade 8 (business education, home economics, information technology, technology education) and most administrators have chosen to make *all* of these a requirement. Hence, the percentage of girls enrolling in Grade 8 technology courses in BC increased from 32% in 1986 to 42.3% in 1996. We are tempted to celebrate this as a milestone in gender equity in BC education history, but practices in some districts have remained unchanged. In Grades 9 and 10, where boys and girls elect the applied skills courses, girls' participation rates are one-third to one-half lower than in Grade 8. When given options, both girls and boys choose stereotypically gendered courses.

Requiring girls to take technology (or boys, home economics or business courses) is a solution to only part of the problem (Braundy et al., 2000).

In BC's senior secondary courses, the current percentage of girls enrolled in technology-intensive courses remains extremely low, while performance data indicate that those female students who participate in these courses do better, on average, than male students in these courses. In Information Technology courses, the participation of female students is 34% of total students enrolled in Grade 11, declining precipitously to 21% in Grade 12, yet female students in Information Technology continue to earn A and B more often than their male peers. Girls represent 74% of the enrolments in information management courses and 98% of the enrolments in clothing and textiles courses (Tables 1 to 3). One could make an argument for enrolling more boys in these technology-intensive courses.

Total enrolments in the most popular technology courses dropped by 20% between 1987 and 1998, but the percentage of girls increased by 2.4%. The percentage of girls enrolled in Grades 11 and 12 technology courses increased from 7.9% in 1987 to 10.3% in 1998. In Grade 11 and 12 Construction the enrolment of girls was 10% and 6% respectively in 1998. The enrolment of girls in Grade 11 Electronics was 3.6%; for Grade 12 the percentage of the total dropped to 3.0%. Despite the relevance of electronics to high-technology careers, this course has never been able to overcome the average 3 to 4% enrolment of girls. Girls' enrolment in Grade 11 Power Technology was 10% and in Grade 12, 4%; in Grade 11 Metal Fabrication, 9% and in Grade 12, 6%. Drafting and CAD courses had significantly higher enrolment rates than the other technology courses (19% in Grade 11 and 14% in Grade 12). Enrolments of girls in the senior, general technology courses increased by 3% between 1987 and 1998, while total enrolment increased by 26% in the same decade. Enrolments of girls declined in the Construction, Electronics, Metal Fabrication, and Power Technology courses. There is work to be done if we are to be accountable for equity as a policy initiative.

Girls in secondary school courses in BC have proved that they have high levels of knowledge and skill, so it is not an issue of technophobia. In Grade 11 Construction during 1997–1998, the percentage of girls awarded A was 29.7%, while the percentage of boys awarded A was 21%. In Grade 12 Construction during that year, 45.7% of the girls were awarded A-level final marks and 27% of the boys were awarded A-level marks. If girls have proven themselves willing and able to succeed in technology, then what is the problem, or more specifically, what is the solution?

Recommendations

Public knowledge of trends in the gender-differentiated participation and performance of girls and boys in technology-intensive courses in Canadian schools can underwrite accountability and support intelligent and informed interventions. This knowledge can facilitate policy initiatives aimed at redressing current inequities. Ought an equitable representation of females and males in technological careers and practices to remain a pipe dream? The BC MOE's *Conditions for Success* (1999) report articulates a vision for the integration of information technology in the public school curriculum at all levels, and this is one place where the report's authors are uninformed. 'Technology should be integrated into curriculum rather than having technology as a separate course,' the Technology Advisory Committee mistakenly recommended to BC MOE (p. vii). Here is the naïve assumption that technology is merely a tool; students do not need to study technology (Petrina, 2002). It was not until Grade 11, the Technology Advisory Committee suggested, that a course in information technology should be available for students to choose. While there is nothing patently wrong with the integration of technology into all subjects, integration is irrelevant to equity. We argue that only through structural interventions (such as courses) and systematic instruction will systemic inequities be adequately addressed. Current gender inequities are, in part, the result of the mere integration of technology and the resultant unstructured, unsystematic way in which technology is addressed in the schools. Research has repeatedly demonstrated that boys dominate technology use in contexts of integration and regular classroom use and that teachers have proven reluctant and unable to integrate computers into the K-to-12 curriculum (Ungerleider, 1997, p. 13). So our recommendation is the antithesis of that of the Technology Advisory Committee. We recommend that more courses be made available and be required for girls rather than fewer, but the caveat is this: access and outcomes must be redefined by equity. Access to technologies must follow access to equities; equities must precede outcomes. Equity is amorphous as a value, but it is also structural as a policy. Equity can have accountability. To redress inequities, we recommend accountable, gender-specific, intensive experiences in technology for all boys and girls rather than chance integration. When the BC MOE removed the acclaimed *Information Technology K–7* and *Technology Education K–7* curricula from the schools in 1998, another potential gender intervention was abandoned. The curriculum was pulled from the shelves of the schools (including the ministry's Web site), structure was destroyed, and the result was maintenance of the *status quo.* The decision to stop the collection of enrolment data in 1998 made evidence for accountability inaccessible. These are hardly conditions for success in any subject!

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