



Information and Communications Technology Council Conseil des technologies de l'information et des communications

The Focus on Information Technology (FIT) Program: Gender-based Analysis

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Executive Summary

This study reviewed the Information and Communications Technology Council's Focus on Information Technology (FIT) program, materials and website in order to make recommendations about what could be done to increase the participation of girls in the FIT program. This "gender-based analysis" focused on the needs and circumstances of girls in high school that might affect their decision to participate (or not participate) in the FIT program. Since this decision could be affected by the beliefs and concerns of parents, teachers and counselors, these were also included in this analysis. The study was conducted in schools in the Toronto District School Board, where FIT is being piloted, and other jurisdictions where FIT will soon enter into pilot offerings.

Any gender-based analysis aims to learn how the experiences of males and females might or might not be different under similar circumstances to ensure that their different experiences are taken into account when developing or designing policies, programs and materials. Ideally, any program or initiative should benefit both sexes, but in practice, they are often unconsciously designed so that the value derived is unequal. When there is a substantial under-representation or absence of one gender, a gender-based analysis looks specifically to determine why this might be the case and what could be done to address this differential. In the case of FIT, it is girls that are under-represented in the program by their choice of other courses of study. The research shows that when it comes to technology, gender matters, and there are important differences between males and females in their technology use and choices. A gender-based analysis of the FIT program can therefore be useful in guiding how the FIT program is further developed.

This study was conducted between January and March 2009. It included a literature review of materials relating to women in technology (with a particular focus on high school girls and technology), and materials related to gender-based analysis. Previous ICTC research on gender and diversity was also incorporated into this analysis. Interviews were conducted with seven FIT high school teachers and several FIT experts, as well as subject matter experts in gender-based analysis and women in technology. Four focus groups with high school girls (two groups of girls in the FIT program and two of girls in Grade 9 technology) were conducted. An in-depth analysis of the FIT website and FIT materials was also conducted.

The study found that female underrepresentation in ICT work and school programs are a global phenomenon that has been documented for at least three decades. In short, males dominate computer-related schooling and the ICT sector is therefore predominantly male. Females are actually *declining* in the ICT workforce. Furthermore, the percentage of women in Computer Science programs is declining at a time when their participation in other scientific disciplines is increasing. Computer Science is only discipline where the percentage of women is lower than in 1992-93. Solving this complex problem is much bigger than the FIT program and this study cautions therefore that while it is a piece of the solution, the FIT program on its own will not be able to *solve* this problem.

High school technology courses can be critical for introducing girls to computers and ICT work. Unfortunately, in secondary schools, girls are more likely to enroll in clerical, data entry and business education courses, while boys take computer science and computer graphics courses. There are many reasons for these significant gender differences, including: the lack of a

supportive environment in ICT classes; girls' different learning styles; the design of computer science curriculum; limited understanding of ICT work and careers; and educator assumptions. Research shows that girls are *capable* of doing as well or better than boys in these computer classes. However, many girls have a “can do but don't want to” attitude about technology.

The focus groups and teacher interviews strongly supported what was found in the literature. They showed that the majority of the girls enrolled in FIT have parents in ICT who encourage them to take these courses. Girls also have significantly different learning interests with respect to computers. The study also found that in secondary schools, the FIT program cannot be divorced from other technology classes. FIT begins in Grade 11, but technology classes begin as early as Grade 9. Thus, by the time they reach Grade 11, many girls have made up their minds about technology. In general, technology is perceived by girls as “too boyish” and “geeky” and they don't really see the value of studying it. Furthermore, most career exploration takes place in Grades 9 and 10. By Grade 11, many girls have decided on an area of concentration, if not a specific career choice. The findings show that girls need a clearer understanding of technology courses and better guidance, as well as a technology curriculum in *all* grades (i.e., FIT and non-FIT courses) that respects their interests. There was general agreement that girls need to know more about careers that are available in ICT.

Based on the stated FIT objectives, there are some serious unmet needs when it comes to girls. Girls are not attracted to the FIT program as it is currently designed. And there is little available to students to help them learn about ICT careers. Furthermore, many girls take a circuitous route into ICT from other fields of study. For them, it may be more appropriate to ensure that they have a broad range of ICT skills on graduation from secondary school so that they may be encouraged to take some post-secondary technology courses, even if they don't major in computer science. The current design of the FIT program is problematic for girls who, as we found from the focus groups, approach their career selection very systematically and earlier in high school than boys and who, if they are going to experiment with technology courses, will do so in Grades 9 and 10, when it doesn't “count” towards university entrance. As presently taught, FIT is very technology-centric, and focuses on only a limited number of ICT skills, i.e., hardware, software and programming. These skills have low interest for girls.

While its *goals* are still very relevant, FIT needs to be adapted to more effectively meet the needs of girls (and likely, boys who also do not fit the typical “boy computer geek” mold). It is important to send clear messages to girls in all FIT materials. This report recommends that the focus of FIT should be on **attracting them to ICT work**, not on explaining the importance of ICT in the world today. Simply integrating technology with the other curriculum is not a solution. Further and more detailed recommendations for the program and its materials are included in the report.

Attracting more females to ICT work is a complex challenge and requires the commitment of the education system, colleges and universities, and the industry. In its role of acting as a catalyst to effect positive change in the ability of these stakeholders to address ICT human resources needs in Canada, the ICTC is in a key position to make a difference to girls. Through further, sensitized development of FIT, it can help address systemic barriers in each of these arenas, and encourage stakeholders to “do ICT differently”.

Introduction

The purpose of this study was to review the Information and Communications Technology Council's Focus on Information Technology (FIT) program, materials and website and to make recommendations about what could be done to increase the participation of girls in the FIT program. This "gender-based analysis" was designed to focus on the needs and circumstances of girls in high school that might affect their decision to participate (or not participate) in the FIT program. Since this decision could be affected by the beliefs and concerns of parents, teachers and counselors, these were also included in this analysis.

The study was conducted in schools in the Toronto District School Board, where FIT is being piloted, and other jurisdictions where FIT will soon enter into pilot offerings. It also examined previous research on girls and technology. Wherever possible, existing ICTC work was incorporated into this analysis.

What is Gender-based Analysis?

Gender-based analysis is the study of particular policies, practices, programs and materials in order to better understand their impact on the different sexes (1). It seeks to learn how the experiences of males and females might or might not be different under similar circumstances and helps to ensure that their different experiences are taken into account when developing or designing such policies, programs and materials (1, 2). Ideally, any program or initiative should benefit both sexes, but in practice, they are often unconsciously designed so that the value derived is unequal. When there is a substantial under-representation or absence of one gender, a gender-based analysis looks specifically to determine why this might be the case and what could be done to address this differential (2). In the case of FIT, it is girls that are under-represented in the program by their choice of other courses of study.

Although a gender-based analysis can suggest ways to improve female representation, there is no "generic girl" and therefore no quick fixes (3). Real girls need a variety of options that address different aspects of their circumstances. Sometimes a gender-based analysis, particularly in the health care field, will also include the impact of poverty, disability or ethno-cultural factors on participation. However, because of the short time frame of this study and the significant disparity in the participation of girls and boys in the FIT program, this analysis was limited to gender only.

It is important to understand two key concepts that underlie the goals of a gender-based analysis:

1. *Equality* is concerned with equal access to resources, i.e., the quality of an opportunity and experience should not be differentiated by sex (3). In schools, for example, computers should be equally available to both boys and girls.
2. *Equity* recognizes that what is fair is not necessarily equal since removing obvious barriers to access for females does not address inequitable treatment once they are given access, nor the culture which created inequities (3). For example, in schools, simply stating that computers are available to all does not mean that they will be equally used by both sexes because boys tend to dominate computer labs and their behavior in these labs can greatly inhibit girls'

participation. Inequities can therefore be unconsciously built into policies, curricula and everyday school practices (3)

Many people, including teachers, parents and students, are uneasy with gender inequity discussions. In particular, efforts at addressing equity are often perceived as discriminating against boys (3). However, without a gender-based analysis, females and males may be treated in the same way when it is inappropriate to do so, or they may be treated differently because of traditional stereotypes, when this is inappropriate.

Both of these situations were apparent in this study because, when it comes to technology, gender matters, and there are important differences between males and females in technology use and choices (2, 3). A gender-based analysis of the FIT program can therefore be useful to help guide the FIT Steering Committee in how it develops, evolves and implements FIT, sets priorities, and allocates its resources.

Methodology

This study was conducted between January and March 2009. It included a literature review of materials relating to women in technology (with a particular focus on high school girls and technology), and materials related to gender-based analysis. Interviews were conducted with seven FIT high school teachers and several FIT experts, as well as subject matter experts in gender-based analysis and women in technology. Four focus groups with high school girls (two groups of girls in the FIT program and two of girls in Grade 9 technology) were conducted. An in-depth analysis of the FIT website and FIT materials was conducted.

Females and Information Communications Technology

Female underrepresentation in ICT work and school programs is a global phenomenon that has been documented for at least three decades (12). There is also considerable documentation on this “gender divide” in Canada (4, 10, 12). In short, males dominate computer-related schooling and the ICT sector is therefore predominantly male (76%). Females are actually *declining* in the ICT workforce (24.7% Nov. 2008 vs. 26.3% in 2000 according to the ICTC’s November 2008 Labour Market analysis). Furthermore, the percentage of women in Computer Science programs is declining at a time when their participation in other scientific disciplines is increasing. Computer Science is the only discipline where the percentage of women is lower than in 1992-93 (5).

“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” (4)

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There is also a gender gap in ICT occupations. Women are more visible in database analysis, data administration, systems testing, web design, technical writing and training, analysts, graphic designers and project managers (5). They are underrepresented as technicians and in computer engineering. The well-documented “leaky pipe” begins in elementary school and continues into the workforce. Not only do girls drop out of technology courses, women exit from ICT jobs at twice the rate of men (5).

Solving this complex problem is much bigger than the FIT program. It is going to take a concerted effort from all stakeholders: employers, universities and colleges, educators, and industry groups to increase female participation to proportional rates. It is important to remember, therefore, that the FIT program on its own will not be able to solve this problem, but it should be seen as one piece of the solution.

Girls and Information Communications Technology in High School

High school technology courses can be critical for introducing girls to computers and ICT work (5). One study found that one-third of female Computer Science majors were influenced in their choice by a high school computing course (6). Unfortunately, in secondary schools, girls are more likely to enroll in clerical, data entry and business education courses, while boys take computer science and computer graphics courses (4). In B.C., for example, boys dominate technology courses, despite an explicit gender equity program (see Table 1). Other provincial data is not available by gender, except in Ontario, where the situation is similar (4). In addition to the fact that fewer girls enroll in these types of courses, the drop off rate between Grades 11 and 12 for girls is significant. The high number of girls enrolled in business and technology or technology-related “girl-friendly” courses, where computer use is emphasized is also noteworthy.

Table 1. Enrolment in BC Technology Courses by Sex (4)

	Gr. 11 Info Tech	Gr. 12 Info Tech	Gr. 11 Computer Tech	Gr. 12 Computer Tech	Gr. 11 Info Management (business)	Gr. 12 Info Management (business)
Boys	66%	79%	88%	90%	31%	26%
Girls	34%	21%	12%	10%	69%	74%

Research shows that the main reasons for these significant gender differences are numerous and include:

- **The lack of a supportive environment in ICT classes.** There are “strong (albeit unconscious) misogynous messages in modern computer science education” (7). Male teachers, a male-designed curriculum, and boy-dominated classrooms are highly intimidating for young teenage girls. “Curriculum, teachers’ expectations, and culture reflect boys’ pathways into computing, accepting assumptions of male excellence in the field” (6). Often, teachers, the curriculum and class-mates make assumptions about what girls “should already know” about technology and girls often feel confused and insecure as a result. Classes typically reflect a masculine perspective on technology in language, approach and images, e.g., techno-speak, the “geek lifestyle” (7).
- **Girls’ Learning Style.** Girls experience computing differently from boys. While many boys “burn with passion” for computers, girls tend to cede the field through disinterest and disaffection because the technical culture reflects values that don’t match their own (6). When courses require long hours, building things, or computer hardware, girls tend to reject “computer culture” before it rejects them. This is often seen in school computing centers that have been claimed as the territory of a subset of male students who are the school’s computer

experts. Girls, as outsiders, don't see how they and what they value can fit into the computer culture and curriculum (6).

Boys have a magnetic attraction for computers as young as kindergarten and their relationship with them is more intense and all-consuming than it is for most girls (6). Boys like to get inside the machine and tinker, learning it inside and out, while girls stay on the outside and limit their involvement. For them, computers are one interest among many (6). Boys have fun with computers and see them as big toys (6). For girls, the attraction is more moderate and gradual. Most girls come to computer science later in high school and don't have the same experience of falling in love with technology. Unfortunately, while girls consistently demonstrate that they are as capable of doing computer work as boys, the dominant computer science culture does not venerate lifestyle balance and the multiple interests of girls.

"The singular and obsessive interest in computing that is common among men is assumed to be the road to success in computing" (6). However, girls are "connected knowers" (i.e., holistic learners) and are more interested in knowing how technology can be applied to real world needs than "how things work" (8). They don't relate to the study of technology in the abstract (7). Thus, girls enjoy story telling that builds their problem solving senses rather than learning technology details. However, once they are "hooked", essential details can be taught (7). Overall, girls need to be first introduced to computer knowledge in context (9). Unfortunately, most educational programs myopically focus on the computer as a machine and fail to "connect the dots" to the real world of ICT work (5).

- **Computer science curriculum** in high school has traditionally reflected boys' interests and experience levels. Research shows that there has been practically no women's participation in curriculum decision-making about computer science curricula at either the secondary level or at college/university (6). In computer science classes, assignments and teaching examples often embed male-dominated interests and activities e.g., sports stats, card and number tricks (6). Texts tend to focus on technical details with little attention paid to the application and impact of the technology in meaningful, interdisciplinary problem-solving ways (6).
- **Limited understanding of ICT work and ICT careers in the "real world"**. Students, parents and school counselors often do not understand how students can benefit from studying computer science and it is seen primarily as a vocational skill (6). All three groups have a poor understanding of the real world applications of computer technology and ICT work. Girls know they will need to *use* computers but they don't understand what's really involved in developing applications and implementing them. In short, studying ICT is seen as irrelevant to the "real work" they want to do.
- **Educator assumptions**. Teachers and counselors are critical to identifying and recruiting girls but too many educators are looking for girls "who look like boys" in their talents so they look in all the wrong places for signs of being interested in computers (6). For example, they may believe that staying up all night programming is a sign of love for computer science and that not doing so is a sign one doesn't love it. The model of a successful computer science student is therefore viewed through a male prism (6). These assumptions are compounded by educators' inadequate information about the skills needed for ICT work. "Concern for family,

balance in life, novels, and a good night's sleep should not come at the cost of success in computing" (6).

Research shows that girls are *capable* of doing as well or better than boys in these computer classes. However, girls have a "can do but don't want to" attitude (6). While more of them (78%) than boys (75%) recognize that an understanding of ICT is important to success in business, they continue to believe that ICT jobs are boring, focused on coding (5). A recent study (2009) (10) reviewed 400 academic studies about girls and technology learning and concluded that it's not their ability that is different and that stops girls from pursuing careers in engineering or computer science, but it is a female preference for more people-oriented professions and significantly different lifestyle needs. As holistic learners, girls who are good in math also have many other strengths and therefore many career options (10).

The Current FIT Program

The FIT program was developed by the Information and Communications Technology Council (ICTC) in consultation with industry experts and educators. It has four main objectives (13):

1. To attract students and their parents to the world of ICT and have them consider it more seriously as an option.
2. To develop learning outcomes and materials (i.e., a "curriculum resource") designed for high school curricula related to ICT skills and knowledge, as well as essential and other useful business/entrepreneurial skills.
3. To increase the number of high school graduates choosing and qualified for ICT occupations on graduation and the number of high school graduates choosing to enter ICT programs at the post-secondary level.
4. To increase the number of females choosing ICT options in secondary and post-secondary school.

The FIT Resource Guide explains that FIT is a "vendor neutral secondary school program delivered through hands on learning... [It] engages students by having them work in teams to create and run a simulated business while completing projects in Grades 11 and 12". The current FIT program focuses on: PC maintenance skills, network support capability, administration technical proficiency, employability/essential skills, and business/ entrepreneurship attitude. A major focus of FIT is the development of transferrable, employability skills. These skills include: understanding of the computer industry; assisting in routine functions of supporting a quality information service delivery; maintaining PCs and related peripheral components; knowing where to purchase computers and supplies; communication; information management; thinking and problem solving; attitude and behavior; time management; continuous learning; working with others. The simulated business project involves developing a business plan for and operating a computer store. This project continues over the two years of the FIT program.

FIT has been designed to offer three different, but related concentrations:

- **Computers/networking concentration.** Here, students learn to trouble-shoot and repair computers to the software or hardware module level and perform first-line, basic technical support.
- **Database concentration.** Building on the first modules of the computers/networking concentration, the student works with a team to: design, plan, implement and manage a company data base and improve it efficiency and productivity.
- **Security concentration.** Building on the first modules of the computers/networking concentration, the student performs a basic security audit of networks, PCs and computer use policies to determine vulnerabilities; maintains and updates PCs in a manner that will harden them from computer viruses, pests, and malware

A FIT certificate is issued if the student completes the FIT learning outcomes as signed off by the teacher in addition to the courses needed for the above concentrations:

- **CompTIA A+.** This certification validates the skills needed by today's computer support professionals. It confirms a technician's ability to perform tasks such as installation, configuration, diagnosing, preventative maintenance, and basic networking and covers security, safety and environmental issues and communication and professionalism.
- **CISCO IT Essentials** provides a comprehensive overview of computer fundamentals including describing the internal components of a computer, assembling a computer system, installing an operating system, and troubleshooting. It also covers laptops and portable devices, wireless connectivity, security, safety and environmental issues, and communication skills.
- **CompTIA Network + or CISCO CCNA** recognizes a technician's ability to describe the features and functions of networking components and to install, configure, and troubleshoot basic networking hardware, protocols and services, e.g., IP, Enhanced Interior Gateway Routing Protocol, Serial Line Interface Protocol Frame Relay.

The FIT Program is supported by a Resource Guide, a Skills Achievement Passport (to document skills acquired), and the Discover IT website.

FIT is presently in pilot in four Toronto District Secondary Schools and one school in BC and one in Alberta. At least two of these are specialized schools, accepting only students with higher academic averages who wish to focus on math and science. As implemented in these schools, FIT is tied to four key courses in the Ontario curriculum: Grades 11 and 12 JAVA programming and Grades 11 and 12 Computer Engineering. Most teachers in the Toronto pilot schools stated that the certifications were very "heavy" for students to manage while going to school, especially the National FIT Plus certificate.

The FIT Program and High School Girls: Findings

Senior girls in the focus groups and teachers were asked about how many girls were enrolled in the classes they took/taught. Table 2 illustrates a typical distribution of females from the sample in Toronto.

Table 2. A Typical Distribution of Girls in Technology Classes

	% Girls
FIT Classes	
JAVA Programming (non-specialty school)	12-30%
JAVA Programming (specialty school)	45%
Computer Engineering (specialty school)	0-2 girls
Computer Engineering (non specialty schools)	0-2 girls
Non FIT Courses	
Gr. 9 Technology (non-specialty schools)	35%
Gr. 9 Technology (required)	45%
Gr. 9 Business & technology	50%
Gr. 11 Business & technology	76%

Girls and FIT

- **Teachers stated:** Many of the girls taking FIT courses have parents in ICT who encourage them to take these courses. (In the focus groups, a very large majority of the girls taking FIT classes had one or more parents who work in ICT.)

Certification is a lot of extra work for the students. These are hard courses.

Computer science is constantly changing and constantly challenging. It requires a lot of student work, strenuous hours and time.

Boys are insane about computers; they get caught up with them and plough through. Girls are more multidimensional. Boys like toys and will do whatever it takes to play; girls are more practical about how and where they spend their time.

The courses required for FIT are promoted at an annual course fair. The content is not gender-specific but it is not appealing to girls. The course descriptions are written in very dry, technical language. Girls need to see the benefits of what they will get out of these courses.

The FIT Passport is not being used at present.

- **Student comments.** Both groups of Grade 11/12s understood they were or could be working towards a CISCO certification, though they said it was boring and “read only”. However, they felt certification would improve their marketability.

Girls and Programming

- **Teachers stated:** Girls may start out with programming but there’s a major drop off in the higher grades. Girls don’t really like programming. They want more options. Programming is

more challenging than other Grade 12 courses. The kids get lower marks and it lowers their average. Therefore, not taking computer courses is a calculated decision by girls since universities will accept students with only math. Programming is seen as having a limited range of opportunities and as very isolating.

High School Girls' ICT Experiences: Focus Group Findings

In Secondary Schools, the FIT program cannot be divorced from other technology classes. FIT begins in Grade 11, but technology classes begin as early as Grade 9. Thus, by the time they reach Grade 11, most girls have made up their minds about technology. Furthermore, most career exploration takes place in Grades 9 and 10. By Grade 11, most girls have decided on an area of concentration, if not a specific career choice. Information and Communications Technology classes (i.e., the FIT program) are options in Grade 11 and 12 and are not required for graduation or by any university or college for admission (even for Computer Science degrees and diplomas). Most university/college courses require six Grade 12 courses, of which English and two maths are typically required, leaving three options. If a student wishes to go into any science/math-based program, often two sciences are usually also required, leaving very little room for the two technology courses required by the FIT program in Grade 12. The comments below illustrate how information technology is currently taught in the Toronto FIT schools and some of the issues and challenges faced by girls when choosing technology courses (including FIT courses) during high school.

With regard to the complete technology curriculum throughout high school, the teachers interviewed believe that girls need a clearer understanding of what each course is all about and better guidance. There is a general recognition that Grades 9 and 10 are the “exploration years”, while Grades 11 and 12 are the “preparation years” for university/college. The FIT teachers interviewed believe that students need more of a chance to experience information communications technology in earlier grades. One stated, “If you can get them to take a class early on in high school, there’s a greater chance it will stick.” In the higher grades, the curriculum gives students limited opportunities to explore an interest that isn’t directly related to the career they see themselves headed for. For most students who are university-bound, courses need to be at or lead to a U (university entrance) level. Timetables are so full, there’s not enough time to take anything not at this level and as one teacher pointed out, “Most students would prefer a spare.”

Girls and Other Technology (non FIT) Courses

In Ontario, technology courses in Grades 9 and 10 introduce students to computer-aided design, computer animation and some programming. Students may also take Business and Technology in Grades 9 and 11, which introduces them to basic office software. It was beyond the scope of this study to analyze provincial information communications technology curriculum offerings. However, it is important to know that technology-related courses are offered to students in Grades 9 and 10 and beyond, which are not currently tied into the FIT program.

- **Teachers stated:** In Ontario, Grade 9 and 10 business introductory courses introduce students to ICT in a business environment (e.g., web design, research, communication). These are not as intimidating as other computer courses so many girls take these classes *but* there is little integration with traditional computing skills.

- **Students stated:** Information Technology courses are less related to real world applications than the other courses girls take (e.g., math, science). Most girls did not understand how much computers are used in different careers (e.g., nursing, fashion design, the environment) nor did they “get” that someone with knowledge of *both* computers and a work field needs to design these applications.

Girls’ Learning Differences with Information Communications Technology

Teacher interviews and the focus groups supported the findings in the literature that girls have different learning needs and interests when it comes to technology:

- **Teachers stated:** Girls want to see themselves in the story. They’re not interested in pure computer science. There are few female role models for them in our culture. Computer science and engineering are seen as a male profession. Average girls do not take computer courses.

Girls are uncomfortable if there are only a small number of girls or no other girls in a class. They find it very stressful and feel insecure. Girls are more likely to take technology courses if their friends recommend them.

The computer area is dominated by boys playing games. Girls don’t like these types of games. They are advanced network users and like impersonation applications and activities that require them to multitask. The ideal curriculum would blend some of these activities with more traditional computer training.

Boys are kinesthetic learners and like to be hands on. Girls take a more systematic view of programming and concentrate on simplicity, process and marks. Boys want and need to learn individually; girls would learn better in teams.

- **Students stated:** Most girls in Grade 9 said they wouldn’t take another computer course. Reasons included: “it’s a heavy load”; “I hear it’s too difficult”, “you get engaged in it and forget about other work”; “we were shown the different types of courses we could take (implication they’re not interesting)”; “it’s nerve-wracking when things don’t work”; it’s hard and frustrating”; “I’m not good at building things”. All felt that science was more relevant. “Computers are a boy thing”.

An Illustration

One Grade 9 technology course was taught by the body shop teacher. Girls had to go to the body shop and felt scared. It is focused on building things using CAD and basic programming. Girls stated they are neither good with building nor interested in it. Projects included: building a rocket and building a car that floats. Neither was interesting to girls. They would be more interested in group projects that are more basic and don’t assume prior technology knowledge. The terminology can be intimidating. One girl didn’t know what “aerodynamics” was. Girls want more projects reflecting their interests. Because of starting behind their male counterparts, they found this course “frustrating” when they didn’t know what to do.

A smaller number of older girls felt computing courses gave you good skills. Asked what types of ICT courses would interest them, the older girls wanted independent study courses while the younger girls were interested in graphic design and art, animation and video editing.

Asked what could be done to make computing/ technology courses more interesting to girls, Grade 9 girls had few insights. They suggested using computers to do “makeovers”. They also thought existing courses were “too isolating” and wanted more group projects and more involvement with people. Grade 11 and 12 girls suggested making the projects more “real world” and adding more girls. “No girl wants to be in a class by herself”. Adding projects that would connect them more with people would help. Generally, their friends saw computing skills as “useless” that they “won’t need”. Classes with broader social interest and a real world context would be more interesting. At present, programming is taught as an abstract set of skills. More needs to be done to connect these skills with how they can be used in careers or in the world. Real life examples and applications are important. One girl noted: “All we are doing is what we’re told to do”.

Girls also suggested they would like more female teachers because their male teachers don’t always understand how girls learn and think differently. They noted that boys know a lot more going into technology classes than girls. The girls complained that the boys often speak in “technobabble” and have a hard time communicating what they know. This is also true of male teachers who make assumptions about what girls should already know, particularly at the start of the class. Both make girls feel intimidated and stupid asking questions.

Girls are willing to put up with tough courses but only if they help them get where they want to go. In general, technology is perceived by girls as “too boyish” and “geeky” and they don’t really know what is involved with it.

Girls and ICT Careers

There was general agreement among teachers and students that girls need to know more about careers that are available in ICT. They would like to see a website describing them and suggested videos of males and females talking about their jobs. Links to the skill sets and courses needed might be helpful. All girls were interested in better understanding career paths they could take.

- **Teachers stated:** In person presentations to girls about future careers are “somewhat useful” but girls need to hear this from many different perspectives, not just one. You need to “bombard” them from many sources. Girls were shocked when they heard about how much money they could make in ICT and they didn’t realize the broad applications of ICT jobs.

Girls just don’t see ICT in their future so it’s hard to encourage them to get their toes wet. Girls look at their future careers and professions differently than boys. Girls look at the “essence” of a job and determine if they want this for themselves. Most girls do not want to be computer support technicians.

- **Students stated:** All the girls in each group felt they were going to university or college. Most expected to use specialized computer applications while there, though some of the younger ones weren’t sure whether this would be necessary. Girls are very serious about their courses and course selections from Grade 9 on. They are interested in future careers. Many have used “career cruising” software extensively. They are interested in getting good marks

“Do they use computers in nursing?” - Grade 9 student.

and having a balance in their schoolwork (i.e., not spending too much time on technology courses to the detriment of others). Girls appear to be more practical and focused on courses that will benefit their planned careers. They want to see more discussed about IT careers earlier in high school, e.g., Grades 9 and 10.

Of the girls in the older groups, most expected to take one or more computer science courses in university, though none planned to major in computer science. A number of girls were planning to go into engineering and other sciences. Some of the reasons *not* to major in

None of the girls in any of the focus groups knew what systems analysis is.

computer science are: “programming is hard”, “it’s very challenging”, “it’s very time consuming”, “the course work is heavy”. Some older girls felt that being a girl might be an advantage in a technology

career because there were so few of them.

Table 3 summarizes the findings of both the literature review and the interviews and focus groups.

A Technology Gender-based Analysis (GBA) Tool for the Future FIT Program & Materials

As part of this study, a gender-based analysis tool was developed for use in evaluating future FIT initiatives and materials. A gender-based analysis tool is both a process and an outcome (1). Its goal is to identify the issues that are important to girls in technology and which of these are important to a particular facet of the FIT Program (2). The tool should also be used to ensure problem areas are addressed and insights are integrated into ongoing aspects of this project (2).

In addition, the tool can:

- Act as a guide for identifying when consultations are needed (2).
- Assist specialists in designing programs that consider the different needs of males and females (4).
- Identify what is already known about gender differences in this area (4).
- Serve as a mechanism for incorporating female views (4).
- Facilitate discussion about what can be done to encourage equitable participation (4).

Appendix B provides a Gender-based Analysis Tool for future use by the FIT Program

Table 3. What Girls Want: A Summary of Literature, Focus Group and Interview Findings

<p>More girls. A critical mass of females in technology programs; girls don't want to be the only one in a class. Encourage gender specific experiences with technology.</p>
<p>More supportive teachers and counselors. Remove the intimidation factor – better education and resources for technology teachers. More female role models and teachers. Eliminate assumptions about technology knowledge, technical language, and what it takes to be interested in computing.</p>
<p>Enriched pedagogy. Adapt all aspects of ICT education to female learning needs and interests. Stop asking what is wrong with females and start asking about female interests in and uses of computer technology. Incorporate female interests into technology courses and activities. A broader view of computer science. Provide multiple ways to “be” in computer science programs.</p>
<p>Broader technology curriculum, more clearly linked to the real world and to jobs, including more projects, analysis, web and data activities and their applications as well as a focus on soft skills like project management, technical writing etc. More awareness in both the curriculum and the culture of the many facets of computing. Girls want to see technology work in practice, contextualized, with role models and career information. Strong linkages between the relevance of IT and real world needs and jobs.</p>

Opportunity to explore technology opportunities before choosing a career focus (i.e., in Grades 9/10).

Broad understanding of the variety of IT *jobs* linked to the real world of work and applications.

Greater collaboration between secondary schools, universities and colleges in adapting their curricula to female needs and interests.

Industry recognition and change. Broader definitions of ICT work to be more inclusive of multidisciplinary point of view and applications of ICT. Explicit and visible recognition of the current imbalance by industry and a positive message to girls. Better definition of fundamental ICT skills (industry and employers).

Better labour market and career information for girls, parents and counselors, widely available online. Better understanding of the variety of jobs and opportunities that exist in ICT. Stronger emphasis on soft skills for certain ICT positions. (e.g., analysis, project management, technical writing).

Conclusion

This study has shown that FIT needs to be adapted more effectively to meet the needs of girls (and likely, boys who also do not fit the typical “boy computer geek” mold). It is important to send clear messages to girls and these must be clearer and more consistent in the teacher support materials, the descriptions of FIT, in the FIT materials and on Discover IT website. The focus of FIT should be on **attracting them to ICT work**, not on explaining the importance of ICT in the world today. (While ICT is used in many different occupations, those who simply *use* ICT applications are not ICT workers. As noted above, girls *already* dominate as users of ICT applications.) Therefore, simply integrating technology with the other curriculum is not a solution. This approach “represents a naïve assumption that technology is merely a tool that students don’t need to study”. While there is nothing wrong with this approach, merely informing students of how and where technology is used in a variety of fields is *not* the same as learning ICT skills.

Attracting more females to ICT work is a complex challenge and requires the commitment of the education system, colleges and universities, and the industry. In its role of acting as a catalyst to effect positive change in the ability of these stakeholders to address ICT human resources needs in Canada, the ICTC is in a key position to make a difference to girls. Through further, sensitized development of FIT, it can help to address systemic barriers in each of these arenas, and to encourage stakeholders to “do ICT differently”.

Recently, Carnegie-Mellon University set out to do just this and has increased the number of females in their Computer Science program from 7% to 42% in *just five years* (see Appendix for details about how it did this). Thus, while difficult, change can be accomplished. However, as the leaders of the Carnegie Mellon program stress, changes must be made in a consistent fashion in many areas. Ensuring that the work done in the FIT program is aligned with other work the ICTC is doing with industry and colleges and universities would help achieve this consistency of messaging to girls.

APPENDIX A: Attracting Girls to Computer Science – The Carnegie-Mellon University Experience

(After *Unlocking the Clubhouse*, J. Margolis and A. Fisher, 2002)

Carnegie-Mellon University increased the enrolment of female students in its undergraduate computer science program from 7% to 42% between 1995 and 2000, by implementing a comprehensive, female-positive series of changes to its curriculum, academic practices and teaching. This appendix outlines how they accomplished this. Readers are cautioned that approaches that are appropriate at the university level may not be so for secondary schools.

The university:

1. **Recognized and dealt with the “Experience Gap” between males and females.** Because relatively inexperienced females found it highly distressing to be in the same classroom as more experienced males, Carnegie-Mellon introduced a curricular change for first year students. This provided them with four different ways to enter the curriculum, depending on their level of experience. (Note: While this resulted in increased satisfaction for all students, it did require less experienced students to take an extra semester to “catch up”.)
2. **Recognized that prior experience does not predict success.** Carnegie-Mellon changed its admissions policy so it would not necessarily give a strong preference to experienced students.
3. **Paid more attention to good teaching.** Better and more senior teachers were asked to teach the earliest courses in the curriculum, where females were having the most distress. A unit on diversity and gender equity was introduced into Teaching Assistant training.
4. **Contextualized computer science.** Carnegie-Mellon modified its curriculum to situate technology in realistic settings, exploit the connections between computer science and other disciplines and to offer diverse problems and teaching methods that would appeal to a broad variety of learning styles. Several courses were designed with these goals in mind:
 - a. An “immigration course” to present students with a broader view of computer science.
 - b. A software engineering course using the entire class (30-50 students) as a single development team to work with an outside “client” to define requirements, design a system and implement a prototype.
 - c. A course on wearable computers that integrated elements of industrial, mechanical, electronic and software design and enable the class to work with an industrial client.
 - d. A course on designing virtual worlds stressing the interdisciplinary nature of this work.
 - e. A course on the social impact of computing that engages student with non-profit groups in the local community, applying their skills to community issues.
5. **Created an environment where alternate models of living and working are valued and respected,** i.e., students are not expected to spend abnormal amounts of time on their

computer science courses. Stress the multidimensional nature of computer science work and ensure that staff and faculty are aware of the difficulties females face in this area.

6. **Continually monitored curricular trouble spots.**
7. **Provided peer tutoring for courses that are particularly troublesome for females.**
8. **Held social and other events for females in the program to encourage cohesion and lessen social isolation.**
9. **Recruited female “friendship circles”, so girls feel less isolated in their classes.**

APPENDIX B

A Gender-Based Analysis Tool for Girls and Technology

	YES	Parti-ally	NO	N/A
Equality Questions				
Does this item* portray females equally in IT roles?				
Does this item use gender-inclusive language (e.g., student)?				
Does this item use male and female examples equally?				
Equity Questions				
Does this item include examples and projects of interest to girls, e.g., textile, fashion design, as well as things like robotics?				
Does this item include several real world examples?				
Does this item equally reflect ICT activities of more interest to girls, e.g., web design, systems analysis?				
Does this item reflect girls' career aspirations, i.e., relevance, helping people, security?				
Does this item assume a knowledge of technology that someone not in the field would not know?				
Does this item use technical terms and concepts that a technical novice might not know, e.g., hardware names, "aerodynamics"?				
Does this project/program require hardware assembly or construction skills?				
Does this course/activity require more time commitment than a similar non-ICT course/activity?				
Does this item include "girls only" components where girls can participate without feeling intimidated by what they don't know?				
Does this item support a "female style of learning", e.g., connected to the real world, collaborative?				
Does this item provide links to existing programs that encourage girls in science & technology?				
Does this item clearly link learning outcomes to real ICT jobs?				
Does this item adequately reflect the business competencies required by modern ICT work?				
Does this item provide resources for teachers, parents, counselors and employers that reflect how girls' skills and holistic learning style are required by modern ICT work?				
Does this item provide supportive resources to schools that are reflective of girls' needs? (e.g., projects, career paths)?				
Does this item include specific initiatives to increase girls' participation?				

	YES	Parti-ally	NO	N/A
Have females participated in setting the objectives of this item and in its design and testing?				
Does this item stress the development of technical skills only?				
Does this item address girls' concerns about IT work? E.g., isolating, long-hours, insecure, geeky?				
Does this item send a positive message specifically to girls?				
Does this item stress the need and opportunity to include female role models?				
Does this item draw the link between IT skills and jobs using these skills?				
Is this item part of an overall systemic approach to attracting girls to try IT?				
Is female participation in this program/website measured?				
Does this item focus on "how things work" rather than "real world needs"?				
Does this item stress "knowledge in context"?				
Do girls themselves feel comfortable with this item?				
Does this item reflect multiple career paths into ICT roles?				

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