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Increasing the Enrolment of Women in IT at Fanshawe College

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Introduction

Women comprise over 50% of the population of Canada. At Fanshawe College, where I am a female professor in the School of Information Technology, approximately 95% of the students in my classes are male.

The number of women enrolling in Information Technology (IT) programs has been declining in recent years, although enrolment of females in other post-secondary programs is increasing. Technology is becoming ever-present in the lives of young people, including girls and young women, yet education and employment in technology fields are not attracting women.

Current research trends indicate:
- the skills shortage of IT professionals is real
- there is a growing importance of soft skills in the IT field
- enterprise technology is about business not just technology
- women lack awareness of IT jobs and opportunities
- focusing on increasing women's enrolment in IT is not enough

This lack of participation is a concern, and has caused me to investigate possible reasons, and to propose recommendations for increasing the number of women enrolling in IT programs at Fanshawe College.

Increasing the enrolment of women in IT programs will create opportunities for women that they might not considered as they face issues in obtaining and retaining IT jobs. Corporations will benefit from having a more diverse workforce and society as a whole will benefit as women can play an integral part in addressing the skills shortage in Canada and their participation in IT careers will support economic growth. Fanshawe College will benefit by seeking to better serve the needs of industry and the community. In addition, it will provide new programming for the School of Information Technology and a chance to attract a sector of the population generally not inclined to enrol in IT programs.

Rationale for Proposal

It is well documented that women are under-represented in the IT field in Canada. Extensive research has identified a variety of contributing factors for women's lack of participation. The reasons are many, varied, and often inconsistent or contradictory. Some of the most documented explanations fall under the following categories:

- general lack of information or inaccurate perceptions about IT and IT careers (Camp, 2000) (Teague, 2002) (Grant & Knight, 2007) (Peckham et al., 2007) (Margolis & Fischer, 2002)
- women's lack of ability or interest (Camp & Gurer, 2002) (McKinney et al., 2008)
- stereotyping and societal influences working against girls – peers, parents, media, culture (Sanders, 2005) (Tauth et al., 2004) (Binkerd & More, 2002) (Othman &Laith, 2006)(Ballard et al., 2006)(ITCT, 2008)
- lack of influencers & role models (Schimke, 2007) (Othman & Laith, 2006)(Wasburn, 2004)
- professions unappealing image – negative stereotype; geeky, boring, isolating (Grant & Knight, 2007) (Entwistle, 2002)(Grant & Babin, 2006)
- male dominated culture of IT (McKinney, 2008) (Ballard et al., 2006) (Sanders, 2005)
- unequal treatment, discrimination, hostile environment (Teague, 2002) (Besana & Dettori, 2004) (Othman & Laith, 2006) (Sanders, 2005)

Recent estimates suggest that women make up only 23% of the IT professionals in Canada (ITC, 2008). A recent study (April 2007) prepared by the Information Communications Technology Council (ICTC) states that 90,000 new jobs will be created in Canada in the next several years. IT jobs are expected to be among the fastest growing occupations through 2014.

During the period of 2008 - 2015 Canadian employers will be looking to recruit 126,000 – 178,000 new employees (ICTC, 2008). The absence of women enrolled in IT programs reduces the potential pool of available talent needed to address the skills shortage in the IT field.

According to ICTC many job applicants have the required technology skills but lack business and project management experience. The industry needs employees with the right mix of technical, business and interpersonal skills. The ICTC recommends "post secondary institutes must move immediately to integrated programs that address industry's need for candidates with business or alternate domain knowledge, interpersonal skills and technical skills. This is the combination that is in greatest demand by the industry across the country." For example, the *2008 IT Job Market & Salary Survey* report published by IT World Canada notes that business analysis and project management are among the skill sets in highest demand (Weiss, 2008).

Traditionally males have entered the IT profession through math and computer science. Many women have entered the field through different academic paths and non-traditional sources. In a recent study of the "Wired Woman" association, of the majority of members, who defined themselves as IT professionals, only 11% were computer scientists and none of them were engineers. Most came from non-traditional backgrounds and were self-taught or had taken some courses (Cukier et al., 2002). With this increased need for "alternate domain knowledge" and interpersonal skills the traditional entry points need to be reconsidered.

Managers of technology companies indicate well-rounded employees with a strong background in humanities are needed. This creates enormous demand for employees with strong business, and liberal arts skills such as communication, writing, problem solving, and analytical thinking (Leever et al., 2002). There are more females than males enrolled in colleges and universities in business and liberal arts, thus making it a logical place to recruit new IT talent.

There are still programming jobs available; however, the growth potential is in the integration of technical, business and communication skills. Developing IT skills is only one part of the equation; the technology business requires graduates with an integrated skill set. If Fanshawe College is to successfully recruit women, it must recognize the diversity of women's educational backgrounds as credible entry points into IT programs. An integrated program where women's diverse backgrounds are recognized will create more market ready graduates who will begin to address the labour shortages in IT in Canada.

1. Increasing Female Enrolment in IT Programs is not enough

There is no question that women are capable of succeeding in the IT field. "We need to stop trying to change women and realize that it might actually be beneficial … if we change the way it is taught" - Jenny Slade communications director with NCWIT – National Center for Women & Information Technology (Hinmelsbac, 2008).

The AAUW Educational Foundation Commission on Technology, Gender, and Teacher Education Report *Tech Savvy: Educating Girls in the New Computer Age,* states that "not surprisingly, boys and girls are drawn to different kinds of involvement with technology." The following table outlines how the girls in the report identify a few of these differences:

Girls' Perspective on Boys and Computers	Girls' Perspective on Girls and Computers
• It's a toy	• It's a way to get things done
• Tend to play games and fool around	• Use as a source of information
• More likely to take things apart	• More likely want it ready for use
• Play more violent games	• Want more creative games
• Interact with the computer	• Interact with the world
• Interested in the inner workings	• Interested in the applications e.g. email, facebook
• Use as a substitute for building social skills	• Value face-to-face social interaction

In summary, "girls reject a computer culture that they see as primarily focused on playing with machines" (pg 19 -22). The gender differences are not in capability, confidence or frequency of use; instead lie in the fact that boys and girls view computers differently and use them in different ways. Boys had a more narrow view of computers (machines, toys, gaming, entertainment) whereas the girls saw them as much more multi-dimensional (connecting with friends, doing homework, research, gathering information, solving math problems, organizing ideas). To boys computers are source of power; for girls computers are a way to achieve an end result (Christie, 2004) (Verbick, 2002).

Therefore, recruiting women to programs that currently exist will not likely be successful, as the girls see current curriculum as being male oriented.

2. Growing Importance of Soft Skills – The New Hard Skills

The growing importance of soft skills in the IT profession is identified in various surveys of Human Resources professionals. In one survey two-thirds of the HR managers indicated they were more likely to hire an individual with strong soft skills but weak technical skills, than hire an individual with strong technical skills but weak interpersonal skills (9%) (Labour Market Bulletin, 2007). Employers want well rounded employees with a broad range of skills.

David Ticoll, Chair of the Information and Communications Technology Council (ICTC 2007) said only about nine per cent of companies are looking what he calls "technical IT skills, another 13 per cent are looking for IT networking skills, but 39 per cent are searching for candidates with business specific IT skills, and another 39 per cent of the firms are hiring candidates with leadership and consulting skills" (Labour Market Bulleting, 2007).

With the expansion of e-commerce, Web 2.0 and convergence technology the industry is changing and there is a demand for new skills and knowledge. More and more professionals are needed with skills that combine technical with business and communications. Emphasis has increased on interdisciplinary approaches and soft skills (Randall et al., 2002). IT employers consider soft skills such as the ability to communicate, work in groups, adaptability, and self motivation more important than technical skills for new graduates. There is a growing emphasis on the importance of "hybrid" workers who understand the implication of technology and how to apply it to business. In addition, a number of government reports have stressed the critical need for new skill sets (e.g. Advisory Council on Science and Technology's Report of the Expert Panel on Skills, 1999; The Canadian E-business Roundtable Report, 2000; and the Software Human Resources Council (SHRC) Report, 1998). "Each report emphasizes the importance of soft skills including content design and development, communications and interpersonal skills, and project management" (Cukier, 2003).

Tapia and Kvasn (2004) note, that there is a demand for high skilled creative IT workers. The industry lacks expertise in such areas as "management of technology, HR practices, leadership, communication, organizational and analytic skills." Many women have education, training and/or work experience in these areas and do not appreciate that these skill sets would be welcomed and valued if they were linked to IT expertise.

The need for these skills as integral to success in IT may encourage women with diverse backgrounds to consider integrating their abilities and strengths with IT skills. Clearly there is a market for such women.

3. Women Lack Awareness of the Diverse Employment Opportunities in IT

Generally, there is a lack of information about IT opportunities and choices; the field is poorly defined. The popular misconception is that IT is computer science equalling programming. For many women this is not seen as an attractive career option. In fact, Tapia and Kvasn (2004) state that women view IT as "difficult, isolated, lacking necessary social interaction … industry is male & stereotypical 'geek and nerd' domain."

An accurate and updated picture of IT is needed to reflect the current reality. Many professionals who work in the IT sector are not engineers or programmers. Most IT jobs are located in non IT companies; financial institutes, libraries, insurance companies, and manufacturing companies all require IT professionals. Therefore, enormous job opportunities exist for women in the IT domain. Denning (2000) suggested that there are over 40 specialties in the computing and information technology field. In the table below he breaks them down into 3 categories. Denning also notes trends towards interdisciplinary studies.

IT-Specific Disciplines	IT-Intensive Disciplines	IT-Supportive Disciplines
Artificial intelligence	Aerospace	Computer technician
Computer science	Engineering	Help desk technician
Computer engineering	Bioinformatics	Network technician
Computational science	Cognitive science	Professional IT trainer
Database engineering	Digital library science	Security specialist
Computer graphics	E-commerce	System administrator
Human-computer	Financial services	Web services designer
Interaction	Genetic engineering	Web identity designer
Network engineering	Information science	Database administrator
Operating systems	Information systems	
Performance	Public policy and privacy	
Engineering	Instructional design	
Robotics	Knowledge engineering	
Scientific computing	Management information systems	
Software architecture	Multimedia design	
Software engineering	Telecommunications	
System security	Transportation	

IT security is a growing area that may be of particular interest to women and could provide new opportunities. Based on their analysis, Myers and Woszczynski (2005), suggest that women were uniformly enthusiastic about IT security when they were made aware of this field. Women tend to be interested in fields with social impact and technology certainly impacts most of society.

It is important that the diverse and exciting career opportunities of the IT field be communicated. By providing better information and a clear definition of what IT really is, it will attract more women with varied backgrounds to the field and result in greater female representation.

Recommendations to Increase the Enrolment of Women in IT at Fanshawe College

1. Development of a New Program

What is needed to attract more women to the IT field and to begin to address the labour shortages is a complete overhaul of how IT is packaged and delivered at Fanshawe College.

As reported by IT World Canada (Menezes, 2007), at a recent panel of a select group of IT professionals organized by Cisco Canada, several messages were made clear: the skills shortage is real – and it's growing; the skills crunch does not equal job guarantee; what is needed is a total IT makeover.

I am proposing that an interdisciplinary program that integrates business, IT and human resource skills be developed for women.

Recommendations

- New program for women consisting of business, technology, leadership and human relation courses which meets industry needs
- Changes in the classroom pedagogy – students will learn to analyze and resolve business/IT challenges and then recommend appropriate IT solutions
- Project based and exploratory in nature
- Collaborative program that builds skills such as working in a team, managing conflict, working with diverse individuals
- Provide on-going support to women enrolled in this program through peer support, mentoring and counselling
- Create real life applications for learning in female supported workplaces e.g. summer internships, co-op positions, field trips

2. Creating a Community of Learners for Women

A community of learners for women is critical to the retention of women in IT programs (Margolis & Fisher 2002). At Carnegie Mellon University the Women@SCS was established to formalize a program of professional, networking & mentoring opportunities for women. A structure was established to ensure retention & success. It was noted that a critical mass of female students has had an influence in attracting and retaining female students.

Recommendations

- Develop a support system for women as part of their educational experience – this support system should include women currently enrolled in IT programs at Fanshawe College
    - create a physical space for women equipped with the technology where they may go to work, share challenges and solutions with other female students, discuss networking events or scholarship information etc. Such a space will reinforce their confidence and ability to learn, as males tend to dominate when present.
    - establish a regular meeting time where women discuss challenges, issues, strategies and successes with a female mentor, professor etc.
    - provide access to tutoring
    - appoint a female faculty mentor for each student
- Provide assistance in finding internships, coops and part-time employment with organizations that are committed to removing barriers for women in IT

3. Connecting with Female IT Professionals

Currently at Fanshawe, women represent less than 5% of the enrolment in the CTN, CTY, BIS and CPA programs. Interestingly, it is in Western cultures that young women perceive computer science as a technical and difficult subject (Adams et al., 2003). This belief is often reinforced by parents of girls, and computer science is seen as "nerdy," isolating, and boring. A lack of role models for young girls is another barrier to women training in this field. To counteract these barriers, relationships need to be established with females from an early age through to women who may be returning to the workplace or retraining because of job loss.

Recommendations

- Inform and educate young women in elementary school as to the opportunities in IT. For example, the one day conference "Girls Rock IT" was highly successful as it brought 200 female elementary students to Fanshawe where they learned that girls could enjoy and be successful with technology. This type of program needs to be expanded to reach out to female students across the province in order to shatter the stereotypes and allow girls to see that IT is a part of every job.
- Expose young women to the diversity of career options that are available to them. Girls need to know that studying computer science does not mean that their only option is to become a computer programmer.
- Establish that technical skills are integrated into all business and that these skills will be useful in all occupations. IT should not be seen as a "stand alone" skill set.
- Provide professional development to teachers to expand their knowledge of the IT field and how it integrates with business, and the opportunities it has for young women.
- Work with the IT industry and business to sponsor career fairs for students and parents with the intent of expanding parent knowledge of opportunities in this field.
- Mimic the successful grade 9 program "Take your Kids to Work" only have focus on IT and female students.
- Liaise with women working in the IT field who are willing to represent the industry to young women.
- Create shadowing opportunities for young women so that they will understand how IT is integrated into business.

4. Positioning IT as a "Second Career" for Women

IT is an expanding field and offers many opportunities to women. Women are more likely to enter the IT field later in life from non-traditional sources. Many choose educational programs that do not directly lead to IT careers.

Women who are retraining often bring to IT "the ability to speak, negotiate, influence others, write, analyze, manage projects or programs, and lead cultural change" (Orlov, 2008). By adding IT expertise to women's previous skill set, they are well positioned for many of the careers in the computing and information technology field.

Recommendations

- Market to women (unemployed, international, immigrant, returning to school) the availability of IT programs
- Market IT programs through the government's Second Career initiative
- Consider multiple points of entry by enrolling in
  - this new program
  - the current programs
  - bridging to current programs (women may lack prerequisite IT knowledge that would be required for success in regular IT programs)
  - certification programs e.g. MSOffice, MSCE, Cisco

In summary, this report demonstrates that an integrated IT approach for women would address the underrepresentation of women in the IT field, and would begin to address the labour shortage facing Canada in the IT sector. This includes developing a new IT program, creating a community of women learners, connecting women with female IT professionals and positioning IT as a second career for woman. As Jo Sanders succinctly said, "the issue for education is to remove the barriers that are interfering with girls' and women's access to technology and success in it" (Sanders, 2005).

An extensive review of the literature has been conducted and has supported the need for this approach. The literature is full of many reports, studies, programs, websites, and initiatives directed at increasing the participation of women in IT. They have focused on academic culture change, course and curriculum changes, mentoring and role model programs, active recruitment, and interventions with girls at a young age.

 Many of these initiatives in Canada have been highly successful in their local areas:
- Government initiative - ICTC forums Women in ICT funded by the Government of Canada's Sector Council Program – national forums were developed as a result of key research & findings and brought together stakeholders to address attraction & retention – the objective was to begin to develop an action plan that increases the number of women in the ICT education and industry (ICTC, 2008)
- Microskills (Toronto) provides IT training for women particularly low income and immigrant women (www. microskill.ca)
- Earl March secondary school in Kanata has had success increasing enrolment and interest through all female IT classes (Crombie et al., 2000)
- outreach programs established to spark interest of young women - IBM – workshops and summer camps (Excite program), Microsoft DigiGirlz, Fanshawe's own Girls Rock IT
- The Wired Woman Society – 2000 plus members across Canada – programs and activities to support: networking, education and mentorship for women in technology (www.wiredwoman.com
- SWIFT – University of BC - initiatives for students from middle school to colleges and beyond (Davis et al., 2002)
- WICS at Simon Fraser University – to unite women in Engineering at SFU by nurturing strong academic & social bonds - mentorship program, high school outreach, corporate(networking)opportunities (http://cgi.sfu.ca/~wics)
- Alternative routes to Computing (ARC) – Computer Science work-study program at UBC
- SCWIST (Society of Canadian Women in Science & Technology) – promote, encourage and empower women working in science and technology (www.scwist.ca)
- CCWESTT (Canadian Coalition of Women in Engineering & Science Technology) – promoting women and celebrating their contribution to the fields of science, engineering, trades and technology (www.ccwestt.org)
- NSERC(The natural Sciences & Engineering Research Council)

- CATAWIT – mentoring, networking and professional development for women in technology (www.catawit.ca)
- WinIT – Women in Information Technology – support girls & women who want to explore careers in IT (www.wittnn.com)
- CIPS Women in IT program – objective to change the negative perceptions high school girls have of IT (www.cips.ca/women)
- Accelerate Canada – fosters the creative technology to drive business benefits or solve real-world business problems (www.acceleratecanada.ca)
- Information Technology Management program at Ryerson University – program dedicated to business management, information and communication technology (www.ryerson.ca/itm/welcome.htm)

There are many, many more examples in the US but perhaps the Carnegie Mellon is an example to model after – revised course and curriculum, as well as established a program of professional, networking & mentoring opportunities for women (Margolis & Fischer, 2002).

What is needed is a comprehensive program that incorporates the best ideas and practices of all these documented initiatives. This will require resources and much commitment from Fanshawe College and the faculty in the School of Information Technology.

Interestingly, the AAUW (2000) commission believes that in crucial ways what is "good for girls" would be good for all us. The commission "believes that girls' experiences with computers in education speak to problems faced by a wider range of learners—girls and boys, men and women—as they encounter information technology." This approach to IT education may provide useful insights into the design and delivery of other IT programs at Fanshawe College.

References

1. AAUW Educational Foundation Commission on Technology, Gender and Teacher Education <u>Tech Savvy: Educating Girls in the New Computer Age</u>, 2000 www.aaug.org/2000/tech/

2. Adams, J., Bauer, V., and Baichoo, S., <u>An Expanding Pipeline: gender in Mauritius</u>, SIGCSE 03

3. Ahuja, M., Herring, S., Robinson, J., and Ogan, C., <u>Exploring Antecedents of Gender Equitable Outcomes in IT Higher Education</u>, SIGMIS 04 2004 ACM Press

4. Arellano, Nestro <u>Canadian IT Jobs Market Heats up as Employers Prepare to Meet Talent Crunch</u>, May 27, 2008 - www.itbusiness.ca

5. Arellano, Nestro Article – <u>IT Talent Shortage "hurting" most Canadian Companies,</u> Sept. 23, 2008 – www. itbusiness.ca

6. Ballard, J., Scales,K., Edwards, M., <u>Perceptions of Information Technology Career Among Women in Career Development Transition</u>, Information technology Learning & Performance Journal , 24(2)

7. Beck, John, <u>Forming a Women's Computer Science Support Group</u>, Technical Symposium on Computer Science Education 38th SIGCSE symposium pages 40-404 2007

8. Besana, G., and Dettori, L., <u>Together is Better: strengthening the Confidence of women in Computer Science Via a Learning Community</u>, Consortium for Computer Sciences in Colleges 2004

9. Binkerd, C., and More,M., <u>Women/Minorities in Computer Science: Where are they? No Attention, No Retention</u>, Consortium for Computing in Small Colleges 2002

10. Blum, L., <u>Transforming the culture of computing at Carnegie Mellon</u>, Computing Research 2001News, 13(5), 2-9

11. Blum,L., and Frieze, C., <u>In a More Balanced Computer Science Environment, Similarity is the Difference and Computer Science is the Winner</u>, Computing Research news Vol17(3) May 2005

12. Burger, C., Creamer., E., and Meszaros, P., <u>Reconfiguring the Firewall: Recruiting Women to Information Technology across Cultures and Continents</u>, November 2007

13. Camp, Tracy, <u>The Incredible Shrinking Pipeline</u>, Communications of the ACM, 2000 40(10), 103-110

14. Camp, T., and Gurer, D<u>., Investigating the Incredible Shrinking Pipeline for Women in Computer Science</u>, NSF Project 98120, 2002

15. Chan, V., Stafford, K., and Chen, G., <u>Gender Differences in Vancouver Secondary Students' Interests Related to Information Technology Careers</u>, www.cs.ubc.ca

16. Christie, Alice, <u>How Adolescent Boys & Girls View Today's Computer Culture</u>, *NECC 2004*

17. Cohoon, J., <u>Recruiting and Retaining Women in Undergraduate Computing Majors</u>, ACM SIGCSE Bulletin Vol34(2) 2002 June pg 48-52

18. Cohoon, J., <u>Women in CS and Biology</u>, SIGCSE'07 2002 pg 82-86

19. Cohoon, J., Toward improving female Retention in the Computer Science Major, Communications of the ACM, Vol44(5) May 2001 Pg 108-114

20. Cooke, D., A Multidisciplinary Information management and Systems Program: Perils or Peril? CITC4'03 Oct 2003 p13-22

21. Crenshawe, T., Chambers, E., Metcalf, H., and Thakkar, U., A Case Study of retention Practices at the University of Illinios at Urbans-Champaign, SIGCSE 08

22. Crombie, T., Abarbanel, T., Anderson C., Getting Girls into Tech Classrooms, 2000 www.eddigest.com

23. Cukier, Wendy Constructing the IT Skills Shortage in Canada: The Implications of Institutional Discourse and Practices for the Participation of Women, SIGMIS Conference '03, P24-33

24. Cukier, W., Shortt, D., and Devine, I., Gender and Information Technology: Implications of Definitions, Journal of Information Systems Education, 2002 Vol 13(1) p 7-15

25. Davies, R., Hancock, M., and Condon, A., Perspectives: Canadian Women in Computer Science, 2002 www.pages.cpsc.ucalgary.ca/~msh/papers/canadawomenincs.pdf

26. Denning, Peter, "The profession of IT: who are we?", Communications of the ACM, 2000 44(6):27-30

27. Entwistle, M., Augustana Women in Computing Science (AWCS): A Program to Encourage Women in the Pursuit of Technical education and Careers, Consortium for computing in Small Colleges, 2002

28. Frenkel, K., Women & Computing, Communications of the ACM

29. Frieze, C., and Blum, L., Building an Effective Computer Science Student Organization: The Carnegie Mellon Women@SCS Action Plan, SIGCSE Bulletin, 2002 34(2), 74-78 www.cs.cmu.edu/~cfrieze/paper.html

30. Frieze, C., Blum, L., Hazzan, O., Dias, M., (2006) Culture and Environment as Determinants of Women's Participation in Computing: Revealing the "women-CS Fit", SIGCSE'06 , 22-26

31. Frieze, C., and Treat, E., Diversifying the Images of Computer Science: Carnegie Mellon Students Take on the Challenge, Proceedings of the 2006 WEPAN Conference 2006

32. Goode, J., Increasing Diversity in K-12 Computer Science: Strategies from the Field, Proceedings of the 39th SIGCSE technical symposium on Computer Science Education, 2008 Pg 362-266

33. Grant, D., and Knight, l., Young Women's Misinformation Concerning IT Careers: Exchanging One Negative Image for Another, Informing Science Journal, vol. 10, 2007

34. Grant, K., and Babin, R., Factors Impacting the Supply and Demand of IT Workers in Canada and the US, 2006 Edsig

35. Himmelsbac, Vawn, Why Women are Leaving IT Aug. 1, 2008 Computerworld Canada www.itwolrdcanada.com

36. Huyer, S., Women, ICT and the Information Society: global Perspectives and Initiatives, Women and ICT June 2005

37. ICTC (Information & communications Technology Council, <u>Taking Action on Women in ICT, in ICT National Forums Action Report</u> March 2008

38. ICTC (Information & communications technology Council), <u>IT Enrollments and Retention: situation report</u> August 2008

39. ICTC (Information & communications Technology Council), <u>Outlook for Human Resources in the Information and Communications technology Labour Market, 2008 o 2015</u> October 2008

40. Jessup, E., Sumner, T., and Barker, L., <u>Report from the Trenches: Bringing more women to the study of computer science,</u> Journal of Women and Minorities in Science and Engineering Vol11(3) 2005 www.cs.colorado.edu

41. Kirk, M., and Zander, C., <u>Bridging the Digital Divide by Co-creating a Collaborative Computer Science Classroom, Journal of Computing Sciences in Colleges</u> Vol18(2) Dec 2002 p117-125

42. Labour Market Bulletin, <u>An Analysis of the London and surrounding area Labour Market,</u> April –June 2007, Government of Canada

43. Lang,C., McKay, J., and Lewis, S., <u>Seven Factors that Influence ICT Student Achievement</u>, ITiCSE '07

44. Leever, S., Dunigan, M., and Turner, M., <u>The Power to Change is in Our Hands</u>, Journal of Computing Sciences in Colleges 2002 Vol 18(2) P 169-179

45. Lewis, S., McKay, J., and Lang C., <u>The Next Wave of Gender Projects in IT Curriculum and Teaching at Universities</u> ACM International Conference Proceedings Series 2006 Vol 165 P 135-142

46. Locher, Margaret, <u>Idea for Attracting Young People to IT Careers</u> May 07, 2007 www.cio.com

47. Margolis, Jane and Fisher, Allan, <u>Unlocking the Clubhouse:the Carnegie Mellon Experience</u> SIGCSE Bulletin, 2002 34(2),79-83

48. McKinney, V., Wilson, D., Brooks,N., O'Leary-Kelly,A., Hardgrave B., <u>Women and Men in the IT Profession</u>, Communications of the ACM , Feb. 2008 51(2) 81-84

49. Menezes, Joaquim, <u>Five things to know- and do- about the IT skills Crunch</u>, IT World Canada – Oct 25 2007

50. Mody, P., and Brainard, <u>Successful Initiatives Promoting Gender Equity in Engineering</u>, Women and ICT   June 2005

51. Myers, M., Woszczynski, A., and Shade, S., <u>Opportunities in IT Security</u>, 2005 *SIGMIS_CPR 05*

52. Orlov, Laurie, <u>How to Attract Women to Enterprise IT Jobs</u> Sept. 20, 2007 www.cio.com

53. Orlov, Laurie, <u>Why should Women want to be in IT</u> Feb. 15, 2008 www.itbusiness.ca

54. Othman, M. and Latih, R, <u>Women in Computer Science: NO SHORTAGE HERE</u>, Communications Of the ACM March 2006 Vol49(3)

55. Peckham, J., Stephenson, P., Harlow, L., Stuart, D., Silver, B., and Mederer, H., <u>Broadening Participation in Computing:Issues and Challenges</u> ITICSE 2007

56. Randall, C., Reichgelt, H., and Price, B., <u>Demography and IT/IS Students: Is the Digital divide widening</u>, 17ty Annual Conference of the International Academy for Information Management 2002

57. Sanders, J., <u>Gender and Technology in Education : A Research Review</u>   June 2005 www.josanders.com

58. Sanders, J., <u>Gender & Technology in Education: What the Research tells Us</u>, Women and ICT, June 2005

59. Schimke, D., Desidn, <u>Implementation and Evaluation on an Online Community to Foster Girls'' Interest and Participation in STEM</u>, GROUP 07

60. Schindler, Esther <u>How to attract more women to IT jobs</u>, April 3,2008 – www.itbusiness.ca

61. Smith, Briony, <u>The debate o how to increase the number of women in IT rages in Canada</u> March 31, 2008 – Computerworld Canada www.cio.com

62. Smith, Briony<u>, Wanted:89,000 IT Employees</u> April 4, 2008 www.itbusiness.ca

63. Tapia, A. and Kvasn,L., <u>Recruitment is Never Enough: Retention of Women & Minorities in the IT Workplace</u>, SIGMIS Conference '04 P84-91

64. Teague, J., <u>Women in Computing: What brings them in, what keeps them in it?</u>, SIGCSE Bulletin Vol 34 (2) 2002 pg 147-158

65. Tennant, Don<u>, IT workers aplenty – but true talent "lacking"</u> Feb. 2, 2008 www.itbusiness.ca

66. Todd, K., Mardis, L., and Wyatt, P., <u>We've Come a Long Way Baby! But Where Women and Technology are Concerned, Have we Really?</u> Proceedings of the 33rd annual ACM SIGUCCS conference on User Services, 2005 p380-387

67. Trauth, E., Quesenberry, J., and Morgan, A., <u>Understanding the Under Representation of women in IT: Toward a Theory of Individual Difference</u>, SIGMIS 04

68. Verbick, Tabatha, <u>Women, Technology and Gender Bias</u>, Journal of Computing Sciences in Colleges Vol 17(3) p 240-250 2002

69. Wasburn, Mara, <u>Is Your Classroom Woman-Friendly</u>, College Teaching, Vol 52(4) Fall 2004

70. Weiss, Todd, <u>You need the "right skills" to land that IT Job</u> Oct. 21, 2008 www.itbusiness.ca

71. Wilson, Brenda, <u>Improving Comfort Level of females in the First Computer Programming Course: Suggestions for CS Faculty</u>, Journal of Computing Sciences in Colleges Vol 23(4) April 2008 p28-34