Women in Science, Technology, Engineering and Mathematics

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Outline

• What is the Problem?
  – Survival of scientists in STEM fields, especially women
• What is the overall global trend regarding women’s entry into STEM fields?
• The Canadian Situation
• What are the barriers to women’s participation in STEM fields?
• Work-personal Life Balance
Despite increase in educational enrolment of girls

- Women are underrepresented in the fields of science, technology, engineering and Mathematics/computer science (STEM)
  - most pronounced in the areas with a strong mathematical component such as physics, pure mathematics, computer science and engineering.
  - these fields are generally perceived as having a “male” culture

- A relatively small number of scientists do reach the top tiers of their professions
  - but the majority confront a “glass ceiling” which is thicker in some fields of STEM as compared to others
  - the career pipeline continues to leak women because women are dropping out of science at every stage of their careers
  - the playing field is still far from level for women and men

What is the problem?
Global Trends

• Representation of women decreases as they go up the career ladder: the leaky pipeline
  – sexism deeply rooted in STEM culture

• Low representation of women in many STEM post-secondary fields and careers
  – despite trends in increased levels of education of girls in primary and secondary levels
  – girls are outperforming boys in most fields of education

• Research indicates
  – new educational methods benefiting girls because they perform better in open-ended, process-based tasks built on realistic life situations
  – boys tend to do better in traditional learning methods and in standardized tests
Global trends

• Expectations (and life choices) for females are defined by gendered sociocultural factors and attitudes:
  – Women tend to remain in the education system longer while men join the workforce.
  – Marriage, childbearing and childrearing years conflict with career
  – Women’s different patterns of production (research and publications) are a result of their reproduction functions
  – This has implications for careers in physics and mathematics where most original work done in early years
  – Work and family still conflicting situations for women

• Men trained in STEM fields choosing better paid jobs-
  – women filling up vacancies
Where is the problem?

• “Gender” only recently on the agenda of the global science community
  – Became an issue probably due to economic implications
  – Gender in Science first taken up in UNESCO World Conference in Science, Budapest, 1999

• Problems very similar around the world

• However, social and cultural differences in Eastern and Western societies make a difference
Women's Participation in Higher Education, 1970-2010

Survival Skills for Scientists
Women’s Share in Science and Engineering, 1970-2010

Survival Skills for Scientists
Women’s Share of Natural Science, 1970-2010

Survival Skills for Scientists
Women’s Share in Engineering, 1970-2010
Things are changing

• Due to
  – global legislation
  – evolving social attitudes, social legislation
  – both male and female champions
  – research and statistics

• Feminist theories have challenged
  – the traditional male perspective in knowledge creation
  – the male view of the world as an universal category and representing all of humanity
  – biological determinist theories
  – the patriarchal structure of science, its theory and practice

• Emphasis on
  – the social constructivist nature of knowledge
  – the link between knowledge and power, and production of knowledge as being imbued with relations of power
  – the need to break down hierarchies, change boundaries and definitions
Trends in Canada

• More females in the biological sciences but less in technical subjects
  – feminization of biosciences and health
• Low enrolment in “hard” sciences, especially physics and engineering
  • hard sciences and technology still depicted as “male” domains in curricula, lack of role models
  • plateauing of female participation in engineering programs (also in U.S.)
  • declining participation in computer studies (also in U.S.)
  – Increase in younger women going to STEM fields
• Concern about high dropout rates of boys.
Canadian Women in STEM

% Women in Canadian Work Force
Canadian Census 2001

- Total labour force: 46.8%
- Life science professionals: 34.7%
- Physical science professionals: 28.1%
- Computer & information systems professionals: 27.6%
- Technical occupations related to natural & applied sciences: 20.4%
- Total engineers: 11.1%
- Trades, transport & equipment operators & related occupations: 7.0%
- Construction trades: 3.2%

Survival Skills for Scientists
Who are the STEM degree holders in Canada?

• STEM university degree holders aged 25-64:
  – Immigrants: 50.9 %
    • 59.3 % engineering degrees,
    • 55.7 % math and computer sciences degrees,
    • 39 % science and technology degrees.
  – Non-immigrants: 49.1 %

• Canadian born
  – Men: 67.4 %
  – Women: 32.6 %

(Source: Statistics Canada, 2013)
Chart 1
Number of STEM university graduates aged 25 to 34, by sex, 2011

Note: STEM includes science, technology, engineering, mathematics and computer science.
Why do we have this problem?

- There are two main issues involving gender imbalance in STEM fields:
  - The two issues are related

1. Gender bias:
   - due to socialization/school culture leading to biased attitudes regarding women’s abilities and aptitudes: Male students’ perceptions of themselves higher than females
   - these limit women’s aspirations, opportunities and access to possibilities.

2. The leaky career pipeline: women who enter the professions with the required credentials generally face:
   - sticky floors and glass ceilings
   - exclusion from and invisibility in prestigious and leadership positions in all spheres but particularly in some science fields (e.g. Physics), Engineering and Technology.
   - Work-life conflict
I'm trying to write a theory program and you want dinner!?
Why do we *still* have this problem worldwide?

*Legislation cannot change the hearts of people, but it can restrain the heartless*  

Martin Luther King, Jr.

- Absence of active discrimination is not enough: positive action is needed

- Broadly speaking the following CULTURAL and ATTITUDINAL factors must be considered:
  - The image of science
    - *Specifically how women view science*
  - How society views girls and science
  - The culture of science
  - The perception of opportunities leading from science
  - Disadvantages faced by women: “chilly climate” in STEM fields
    - Factors that drill holes in the career pipeline

- Studies and observations indicate that in STEM the pipeline is leaking women at every stage:
  - In the educational pipeline girls in middle school are not inspired by science subjects
  - The sharpest drop is after high school
  - Next large-scale attrition is at the point of entrance to grad school
  - For female researchers career breaks, tenure and promotion are points of attrition
  - Work-life balance
"No, I'm not a secretary I'm a company president. Are you a secretary?"
Canadian Women

Some Canadian Initiatives

- Government, industry, post-secondary institutes, unions, local councils, NGOs working together to effect change
- Sharing critical information on the many positive policies and practices that are already in place
- Gender-based analysis for policy development
- Specific programs:
  - **NSERC Chairs for Women in Science** (matches private sector contributions) and Engineering program (96) to increase participation, provide role models
  - **University Faculty Awards** - 25 annually each 5-year term to promising female and Aboriginal researchers in Natural Sciences and Engineering, NSERC provides $40,000 towards salary and benefits and money for Discovery grant
  - **Wisent Canada- UK exchange program** administered by Royal Societies of Canada and UK, funded by major funding agencies and DFAIT, now Japan-Canada exchange program

Survival Skills for Scientists
Canada

Women’s rights movements in West closed gap between public and private spheres

Is there Gender Equality?

- Decades of campaigns for equality in workplace and at home have still not succeeded in closing gender gap
- On the whole women still underpaid, overworked, and frustrated: “have-it-all dream turned into a do-it-all nightmare”
- BUT more women going to higher education and health fields: more leaders
- Women have more opportunities and choices than ever before
Crucial Issues for STEM careers

• Urgent need to recognize that
  – that men’s and women’s career experiences are different because motherhood is a pivotal issue
  – that “difference” should be treated with “equity” rather than “equality”
  – that women often lack mentors

• Need to change definition of success and criteria assessing excellence
  – now based on male standards and characteristics
  – recognize female characteristics such as collaborative work, people oriented activity, emphasize quality rather than quantity in publications
  – recognize special situations women face in their career trajectories
Crucial Issues for STEM careers

Need to look at how science is organized-
- What possibilities for a life as well as a career?
  - Work and live smarter not harder
- How would science be structured if the perspectives of women were mainstreamed?
- Science might take on
  - the needs of the great majority of the world’s population
  - create conditions for sustained and sustainable economic and technological growth
What happens when we do not reconcile work and personal life?

• We have work-life conflict

• Typically defined as follows:
  – Role Overload
  – Role Interference
  • Work Interferes with Family
  • Family Interferes with Work

• Recent studies show
  – Work outcomes decline
  – Cost to society is considerable:
    • absenteeism
    • medical expenditure
    • low production
  – Conflict increased over last decade

  1991/2001 Studies of Canadian Workforce
To what extent is work-life balance an issue in Canada at this time?
Who pays the cost for overburdened workers?

Society

• Personal Cost to Women
• Price women have to pay for entering workforce is
  – Overwork
  – Lack of leisure
  – Stress-related problems both physical/mental
  – Competition at work: women have to work harder to succeed because professional success has been masculinized – both in presentation (expected behaviour) and in style (e.g. leadership style)

Survival Skills for Scientists
Need for Work-Life Balance

• Historically men have done both – i.e. have a family life as well as work
• For women, this has been a question
  – can they or should they do both?
  – if they do both, how can they reconcile the two spheres?
• So, while men and women both have multiple roles, the need to balance work and personal lives is greater for women because they still tend to have primary responsibility at home
• Yet, to balance the two they need to have control over their own destiny and life chances (decision making, time, ability to make choices)
Fundamental Question

• How does one reconcile work and personal lives?
• Answer depends on one’s values: what is most important for you? Family? Profession?
• Goals need to be prioritized: nobody has time for everything, some things will be sacrificed- need to compromise
• “Time Famine” vs “Time Affluence”: Having free time most desired by people (Pew Research)
• Rethink work: challenge assumptions how things done
• Research shows answer is co-operation/collaboration: work in teams at home and at work
How do we optimize goals?

• Once priorities are established, at least three issues become important
  – Organizational skills: time management, ability to share, delegate, be team player (reduce stress)
  – Level of energy and focus: health and genetic make-up – most important, need to work on that
  – Multitasking ability: combine tasks if they do not interfere: e.g. build in exercise in daily routine, plan activities to optimize contact/quality time with family, plan weekends…
Other factors

• Several factors help achieving balance
  – Interpersonal skills (reduces tensions, complications)
  – Understanding partner (most important)
  – Support from family, friends (children, parents)
  – Government policies (childcare, health benefits, maternity benefits)
  – Work place policies (sensitivity to women’s needs, promotion policies, benefits)
  – Career path (SSHRC)
Conclusion

- Now generally recognized that there are social and economic costs for the underutilization of the talents of half of humanity
  - Societies cannot afford to be deprived of half the world’s brainpower: the abilities and potentialities of women scientists, engineers and technologists
  - Under representation of women in science and technology creates an imbalance in society

- The issue of gender disparity is of significance in all modern societies
  - The disparity is most significant in fields related to the knowledge economy – STEM

- Recognition of the value that women bring
  - by enhancing diversity through a
    • wider range of approaches
    • problem definitions
    • strategies
Merci