Championing Girls and Women in IT

A review of the challenges, opportunities and initiatives
The underrepresentation of women in IT and computer science education and careers is a major challenge worldwide. Despite decades of efforts to tackle this issue, progress has remained excruciatingly slow.

In some instances, it has even regressed.

As the world continues to embrace technology in all facets of society, it’s now more important than ever to ensure girls and women feel included and supported in the STEM sector.

But how?

This was the question that sparked our research – and uncovered real-life best practices in primary, secondary and tertiary education settings across the world.
What’s inside?

Underrepresented: A study on girls and women in IT

The why, what and how of our research on girls and women in STEM and IT-related education settings.

Issues that play a critical role

Individual, interpersonal and structural influences that make or break girls’ and women’s interest and pursuit of STEM/IT education and careers.

Best practice initiatives and strategies

Programs and initiatives from around the world with proven effective outcomes that we can learn from.
Message from the Associate Dean

(Equality, Diversity and Inclusion)

The Faculty of Information Technology at Monash educates one of the largest cohorts of women students in Australia. And together we continue to advance our mission of IT for social good – and our commitment to gender equality.

It’s an incredible opportunity. And with it comes considerable responsibility.

As a faculty, we need to ensure that we’re doing all we can to empower more women and gender diverse people to join us and feel included in a field that remains male-dominated.

And our efforts need to start even before our students reach us – to help society shift its perceptions and stereotypes that still exist of IT, computer science and the broader STEM fields.

As a sociologist embedded in IT, I understand the power of social norms, organisational culture and persistent gender stereotypes.

What’s more, I see IT as a social science as well as a technical one. After all, technology plays a huge role in everyday life and in facilitating change across many domains, including health, energy, climate change and cybersecurity.

Our faculty has a strong focus on supporting women students. But we know there’s still more we can do. And we want to direct our efforts in the best possible way, so we can achieve maximum impact.

That’s why our faculty’s Equity, Diversity and Inclusion Committee embarked on this research. To better understand the challenges that girls and women face in their IT education. And to review programs and initiatives that have had successful outcomes in making IT more accessible to girls and women.

It’s my great pleasure to share a summary of our research and findings with you. I hope this will help us all improve our own practice – and enable us to build a gender-inclusive future for IT.

Yolande Strengers
Associate Dean (Equity, Diversity and Inclusion)
Associate Professor (Digital Technology and Society)
Faculty of IT, Monash University
Underrepresented:

A study on girls and women in IT

According to the UNESCO report (Chavatzia 2017):

- The numbers that fuelled our research

Despite efforts to encourage more girls and women to pursue IT and STEM education and careers, the data continues to be disheartening.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
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<tbody>
<tr>
<td>35%</td>
<td>Of total enrolment in global STEM-related higher education were women</td>
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<tr>
<td>3%</td>
<td>Of all women students: were in ICT</td>
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<tr>
<td>8%</td>
<td>Of all women students: were in engineering, manufacturing and construction</td>
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<tr>
<td>5%</td>
<td>Of all women students: were in natural science, mathematics and statistics</td>
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<tr>
<td>20%</td>
<td>In Australia, the numbers weren’t very encouraging either: women enrolment rate in Australian computing programs in 2012 (a six-percentage-point decrease since 2000) (OECD study 2014)</td>
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<tr>
<td>65%</td>
<td>In Australia, the numbers weren’t very encouraging either: decline in ICT undergraduate women enrolment from 2001 to 2013 (Australia’s Digital Pulse by Deloitte Access Economics 2017)</td>
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<tr>
<td>19%</td>
<td>In Australia, the numbers weren’t very encouraging either: women enrolment rate in IT in 2019</td>
</tr>
<tr>
<td>18%</td>
<td>In Engineering &amp; related technologies in 2019 (Australian Department of Education, Skills and Employment 2019)</td>
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The purpose of our research

These figures suggest that the representation of women in IT-related degrees in Australia has mostly fallen – despite considerable efforts to increase it.

As such, the Faculty of IT at Monash embarked on this research to better understand:

- what steers girls and women towards or away from IT
- how women experience their IT education and why they stay or leave
- what programs and initiatives help to improve their perceptions, experiences and career opportunities in this field.

Our research approach

In our study, we referred to peer-reviewed research published since 2000 from two academic databases – Scopus and ProQuest.

We also looked at publicly-available research summaries and evaluations of specific initiatives by reputable agencies and educational institutions. And where available, we included our own initiatives.

Our focus was on primary and secondary schools, as well as undergraduate tertiary education.

Most of the studies had been carried out in the USA. But three major areas were relevant to the Australian context:

- Issues known to influence girls' interests and decisions to undertake a STEM/IT degree
- Women’s experiences while pursuing STEM/IT majors
- Domestic and international best practice initiatives and strategies relating to recruiting and retaining women in STEM/IT fields.
Through our research, we uncovered a complex and nuanced range of challenges that girls and women face in STEM/IT.

The three main factors that play into encouraging or discouraging girls’ and women’s interest and pursuit of STEM/IT education and career are:

- Personal, social and cultural challenges
- Experiences in STEM/IT undergraduate education
- Initiatives and strategies
**Personal, social and cultural challenges**

Influences that can affect girls’ or women’s interest in pursuing STEM/IT include:

- their personal perceptions, attitudes and interests towards careers in STEM/IT and the fields more generally
- their self-efficacy and prior exposure to STEM/IT fields
- support (or lack of) from the woman’s social network, including family, peers, role models and mentors
- structural factors such as the quality of teaching and teachers
- portrayal and messaging in movies and video games
- gender stereotypes that favour men and male traits in IT.

**Experiences in IT undergraduate education**

These negative experiences increase the chances of women discontinuing or withdrawing from their STEM/IT degrees:

- Unwelcoming environment – a cold campus or ‘chilly climate’
- Regular encounters with gender bias
- Low sense of belonging
- Lack of social and peer support
- Unequal or biased treatment
- Difficulty obtaining help
- Concerns with teaching style
- Perceived lack of employment-focused content.

**Initiatives and strategies**

When done right, certain domestic and international efforts have shown positive outcomes in recruiting and retaining women students. Successful interventions include:

- outreach programs for girls in schools to build their interest and capacity in IT and computer science
- adjusting admissions policies in universities to recruit more gender balanced cohorts
- securing institutional support in terms of funding, guidance and philosophical or cultural advocacy
- establishing dedicated scholarships, networking and mentoring programs for women
- developing and incorporating diversity-related activities in the yearly evaluation of a faculty’s performance and annual reports
- revising curricula (especially first year units/introductory courses) to be more gender inclusive, remove ‘geek’ stereotypes and emphasise real-world applications
- commitment to inter-university partnerships that promote experience sharing
- concerted efforts in enhancing a gender-inclusive culture and attracting more students from underrepresented groups.
We reviewed many programs and initiatives from around the world (including Australia) that aim to improve girls’ and women’s interest in, and ability to pursue, STEM/IT.

Some interventions implemented have been effective in addressing girls’ low levels of interest and self-efficacy in STEM/IT – as well as women’s underrepresentation in STEM undergraduate education.

Best practices in recruiting and retaining women in STEM/IT higher education include:

- reaching out to girls in schools
- strategic recruiting into undergraduate degrees
- facilitating positive experiences for women in STEM/IT education.

The following pages highlight notable examples under each of these strategies that we identified through our research. Many institutions in Australia and around the world have replicated, adapted and adopted some of these initiatives.
Reaching out to girls in schools

Promoting girls’ interest in computer science

**Girls on the Go**
Miami University (US, 2012)

This was a week-long residential summer program to introduce high school women students to computing – and invite them to work with computer scientists.

The program significantly increased girls’ confidence and understanding of jobs in computer science.

**Remote Mentor**
Graz University of Technology (Austria, 2018)

This program targeted two groups of girls. The first group (aged 14 to 15) used an app to create their ideas via storyboards during computer science and arts lessons – and received advice from student mentors.

In addition to RemoteMentor, a second group (aged 11 to 14) was introduced to coding through the ‘Girls Coding Week’. Participants generally reported positive outcomes.

**Go Girl, Go for IT**
Queensland University (Australia, 2000)

First launched in Queensland and then expanded to other states across Australia, this event featured informative sessions with industry professionals. It had a positive impact on the secondary schoolgirls’ feelings and intentions about ICT careers.

**Technology Day Camp**
University of Minnesota (US, 2006)

Middle-school girls and other underrepresented groups received real laboratory experience through robotics lessons and university life.

This was run by graduate student volunteers and increased their interest in technology and desire to pursue a career in the industry.
Introducing women role models

**Digital Divas Club in Victoria**
Monash University, Deakin University and Swinburne University of Technology (Australia, 2010—2014)

A woman IT professional visited participating schools to share her educational and career pathway and experiences. Undergraduate women IT students were also assigned to each class as an **Expert Diva**.

**GETSMART**

University of Tampa (US, 2008)

The university held campus-based events to promote IT women executives as role models to middle and high school students and their parents. They also held discussions about STEM careers and school experiences.

**Digital Divas Club in Victoria**
(Australia, 2010—2014)

This initiative involved 10 diverse high schools, including girls-only schools across Victoria. They redesigned school curriculums to generate positive perceptions around computing in early school years – and dispel the stereotypical masculine and geeky image of IT.

The program also focused on teaching problem-solving aspects rather than programming languages, and content was designed to promote positive experiences regarding self-efficacy and persistence with computing courses and career decisions.

Promoting gender-inclusive school education
### Adjusting admission policies

<table>
<thead>
<tr>
<th>University</th>
<th>Country</th>
<th>Years</th>
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<tbody>
<tr>
<td>Carnegie Mellon University</td>
<td>US</td>
<td>from the late 1990s</td>
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<tr>
<td>The university changed its admission policy, replacing experience with aptitude-oriented criteria. They also started accepting students with little or no background in computing or programming. Thanks to this change, women’s enrolment rates in computer science rose from 7% to 42% and attrition reduced to less than 10% – the same low level as men.</td>
<td></td>
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<tr>
<td><strong>Women and Computing Initiative</strong></td>
<td>Norway</td>
<td>from 1996</td>
</tr>
<tr>
<td>Norwegian University of Science and Technology</td>
<td>Norway</td>
<td>from 1996</td>
</tr>
<tr>
<td>The university imposed an annual quota of extra places exclusively for women – and allowed up to a 10% reduction in credit points for admission. Enrolment of first-year women students increased from 5.7% to 37.7% that year.</td>
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<tr>
<td><strong>University of Texas at Austin</strong></td>
<td>US</td>
<td>from 2013</td>
</tr>
<tr>
<td>The university offered scholarships to first-year women students. During tours at the Computer Science Department, prospective women students were paired with current ones. The number of women enrolled doubled in one year.</td>
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<td><strong>Northwest Missouri State University</strong></td>
<td>US</td>
<td>2005</td>
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<tr>
<td>The university introduced a new interactive Digital Media bachelor program – combining computer science, art and mass communication. 35% of students enrolling in this new bachelor program were women, compared to just 15% women enrolled in the computer science department.</td>
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### Targeting prospective students
Delivering accessible introductory computing courses

**Bridge programmes**

Stanford University (US, early 2000s)

The university developed an introductory course for first-year students to address the misconception about computer science.

As a result of these recruitment initiatives, an impressive pattern of women enrolment in computer science was reported. For five years since the program’s implementation, women represented half of the participants and 17 out of 22 participating women later chose to major in computer science.

**Beauty and Joy of Computing**

Berkeley University (US, 2010–2012)

The university organised special classes for non-technical major students, half of whom were women. These classes highlighted the impact of computing on the world and ran programming exercises for pairs of students.

This program successfully attracted students from non-technical majors.

**Bridge programs**

University of Illinois Urbana-Champaign (US, since 2010)

To target women without prior experience in programming, the university developed new CS+X degrees (equivalent to ‘double degrees’ in Australia) such as CS+Anthropology, CS+Astronomy, CS+Chemistry and CS+Linguistics.

The annual enrolment rates of women have risen 27% to 30%.
Facilitating positive experiences for women in STEM/IT education

Revising teaching methods and curricula

Harvey Mudd College
(US, from 2008)

The college introduced a new curriculum in its beginner computer science course to show major intellectual and societal contributions of computer science in various disciplines and applications. Students were also given substantial programming experience.

The result? A steady enrolment rate of 40% women in computer science majors, and an increase in the number of women taking additional computer science courses.

University of California
(San Diego, 2008–2012)

Students worked in fixed pairs for programming assignments in the introductory class over the term. They had to meet and do their assignments together every week, before receiving feedback from a lab tutor.

This initiative saw an 18-percentage-point increase in retention rate of all students studying computing – among women, the rate increased from 73% to 87%.

Go WEST
University of Southern Queensland
(Australia, 2008-2009)

The university built a mentoring and support network between industry, academia and schools. It also partnered with a local council to discuss collaborative mentoring and industry experience.

Plus, it launched a SmartWomen/Smart State award application workshop, and provided financial support to women academics to compete in Computer Society ICT Awards.

Women@SCS
Carnegie Mellon University
(US, from late 1990s)

Women who enrolled at the School of Computer Science enjoyed peer-to-peer advice sessions and interviews. They also participated in workshops to prepare them for their future careers.

Providing professional development opportunities

Women in Technology (WIT) Mentoring program
Monash University
(from 2019)

Participating women students in the Faculty of IT were paired with alumni and industry mentors for career guidance and personal development support. It grew from a pilot of 50 students / 50 alumni mentors to become a flagship Equity, Diversity and Inclusion program – contributing to the development of 310 students by 2021.
Promoting women’s learning experiences and sense of computing identity

<table>
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<tr>
<th>University of Washington-Seattle</th>
<th>Santa Clara University</th>
<th>Women@SCS Carnegie Mellon University</th>
<th>STAIRSTEP Lamar University</th>
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<tr>
<td>High-performing women students were invited to a tea session to socialise with industry advisers and alumni. The university also recruited women in 40% of all teaching assistant roles to facilitate students’ learning in the classroom and lab. It saw a significant increase in women’s graduation rates from 21% to 26-27% during the initiative’s implementation.</td>
<td>The university held an informal luncheon for women in computing majors every term - as well as an annual Women in Engineering dinner. They also sponsored student attendance at the Grace Hopper Celebration Conference - the largest event for technical women in computing. Thanks to these initiatives, the university saw a high rate of women enrolments in 2013, which made up 33% of their junior classes in computing majors.</td>
<td>Its Big/Little Sister Program for undergraduates matched first-year women students with a senior one for mentoring support. It also hosted a Faculty-Student lunch series for women to meet and interact with their role models informally.</td>
<td>Women and at-risk undergraduate students were given STEM research opportunities – including a stipend of USD$1,500 per semester. Participants also acted as coordinators in outreach programs targeting local high schools and community colleges. Participants performed better in their computer science courses, and attrition rates were lower. Students also reported a stronger sense of community.</td>
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To make meaningful change, it is critical that we understand the needs and challenges facing girls and women, as well as other disadvantaged and underrepresented genders and groups in this field.

At our faculty, we’re now using this research to inform the ongoing improvement of our student outreach activities, programs and curriculum.

But while this review was conducted to help us improve our initiatives and strategies, we believe our findings will provide valuable insights for other educational institutions as well.

We hope this research will help you take effective action to address the chronic underrepresentation of women in IT – and provide an equitable, inclusive and diverse environment for all students.

Read our full research report now