A woman with dark hair, wearing a green and white patterned sweater over a white collared shirt and a blue lanyard, is looking down at a tablet computer. She is in a server room, with server racks and cables visible in the background. The image is partially overlaid with a semi-transparent orange rectangle on the right side, which contains the title and subtitle text.

DE- COD- ING Diversity

*How to attract and retain girls
and women in tech education*

A guide for education providers



Who this
guide is for

- This guide is for education and training providers seeking inspiration to encourage greater numbers of women and girls into a digital technology education programme.
- Secondary school teachers, university lecturers, code club volunteers, and other community group leaders, potential employers, career advisors, industry professionals, recruitment personnel, students, and their parents, may find this guide helpful.
- This is not an academic report; nor is it the definitive word on the subject. It provides useful tips supported by what our focus groups told us would help attract and retain girls and women in tech education.

Read,
learn and
be inspired!



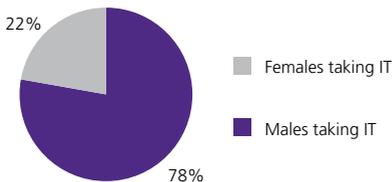
Why we
need more
women in
technology

Digital technology is the fastest growing industry in New Zealand, but women make up only 23 percent of people employed in the sector.

The business case for greater gender balance is strong. Tech firms that are gender balanced are up to 40 percent more profitable.

Women are 51 percent of the population. So including women in product development and decision-making ensures a broader understanding of the customer's needs and better targeted tech products.

In 2015, the tech sector added \$16.2 billion to New Zealand's GDP and employed 98,911 people. Tech roles are some of the highest paid in New Zealand, as well as the most flexible – a real selling point, particularly for women.

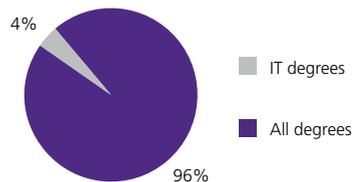


All sectors are being transformed through technology and skilled tech workers are wanted in a wide range of sectors. Government services are increasingly going digital too, changing the way services are delivered to customers.

Although women are now more highly qualified than men, the number of women studying technology remains low. In 2015, 1,600 people earned an IT degree, but only 350 were women. This proportion has barely moved in the past 20 years. In the same year, women gained 64 percent of all degrees awarded.

A creative and specific approach to attract women into the digital technology sector is needed, as well as a genuine commitment to diversity and inclusion to keep them there.

It all starts with technology education.



Data source: Ministry of Education



“It’s vital for New Zealand’s economic future that more women participate fully in technology. The first challenge is to inspire and excite more students, parents, teachers and principals about digital technology and the opportunities it creates for fulfilling careers.”

Graeme Muller
CEO, NZTech

How we gathered our information

- We surveyed 70 young women, aged 16-23, about why they took digital technology education, how tech education providers could better attract girls and women, and the barriers to girls and women choosing digital technology career pathways.
- We drew on local and international research and some identified practical examples from New Zealand and overseas.

What we found

Seven ways to attract girls and women into tech education

1. Get better at saying what's brilliant about a career in digital technology.
2. Show the range of jobs that use tech, the opportunities tech provides, and the kinds of people who have tech careers.
3. Be clear about requirements and any alternative pathways.
4. Take action to promote inclusiveness and openly celebrate and acknowledge the business benefits of diversity.



5. Provide opportunities for career advisors and parents to better understand tech pathways.
6. Avoid stereotyping.
7. Keep an open mind and encourage all potential students equally.
2. Mind your language. More positive encouragement will build confidence and retain women in tech education.
3. Promote teamwork. Group activities support learning and dispel the common perception that working in tech means sitting alone at a computer all day.

Four ways to retain girls and women in tech education

1. Support women in tech clubs.
If you don't have a club, promote initiatives that will support their learning, such as Rails Girls and She#.
4. Consider your teaching style. Recognise different levels of understanding, experience, and ability.



“We need diverse teams of technically capable grads with a passion to solve the really tough challenges facing people all over the world. I hope this guide inspires educators to help all students become the change makers, innovators and creators of the future.”

Sally-Ann Williams,
Engineering Community & Outreach Manager,
Google



Attracting
girls and
women
into tech
education

Explain why a career in digital technology is great

Many school students don't understand the range of roles a career in technology can lead to or its impact on the world.

"Hardly anyone [in my class] took digital technology as a subject because they never told us what would be done with it."

Tell the stories about successful women in tech so that young women have visible role models.

"There aren't many successful females in the industry who are household names, like Bill Gates. There is a shortage of women role models who are household names."

"Post more success stories on the website – show how women have changed the world. The CEO of YouTube Susan Wojcicki, for example, is a woman."

When asked what careers they planned to pursue, focus group participants favoured careers that were relevant and meaningful to their lives and those of others. They talked about working in industries and sectors where they could "make a difference".

"A job that's about social good is more important than money."

"You can change the world with nothing but knowledge and a computer."

Show the range of jobs that use tech, the opportunities tech provides, and the kinds of people who have tech careers

Use class exercises and assignments that make stronger links between digital technology and how it can solve real-world problems. For example, how artificial intelligence (AI) is revolutionising healthcare and giving people greater access to services in developing countries; how technologies are improving crop growth year round, preventing food shortages; the imminent and greater use of electric cars, and eventually autonomous cars.

Encourage students to choose the problems they want to work on.

"I would like to develop something that helps people enjoy getting and being fit."

"I'm interested in how technology can help people in third world countries."

"I'm interested in AI and its potential to help people."

"There are many examples of technology helping people with disabilities."

Describe careers in terms of the personal characteristics people need rather than focusing just on technical skills. For example, highlight that although problem-solving is important, the sector is also looking for people with good communication skills, who are team players, can show leadership, and are well organised and able to manage their time efficiently.

Be clear about requirements and any alternative pathways

Does the course require maths and/or physics? If so, to what level and how many credits are needed? Focus group participants were confused about prerequisites, particularly for physics and certain types of maths.

If you offer bridging courses or boot camps to help students meet course requirements, how do they access these and what are the entry requirements? Consider providing introductory classes for complete beginners – no prior experience necessary – or direct people to where they can complete introductory courses.

Provide detailed descriptions about course content and where the qualification can lead. This is particularly important for introductory courses where a student may be undecided or doesn't know about computer programming. With more information, students are more likely

to understand how the course will benefit them and better able to judge whether it's a good fit.

Take action to promote inclusiveness, and openly celebrate and acknowledge the benefits of diversity

"This is a big industry that needs more women in it. Market it!"

Companies that have women in leadership and governance send a strong message that they are progressive and recognise merit. These companies become employers of choice and more easily attract top talent.

Educators need to talk about the business benefits of diversity, especially in introductory courses. Diversity is about getting the best people and making them feel welcome.

"When talking about the benefits of diversity avoid the diversity hire – 'she got in because she's a girl' – message."

You can always ask your students how the course could be more inclusive. Make sure women feel safe in courses in which they are a minority and that they understand the process for handling matters that may arise. Perhaps have a code of conduct and talking to the class about acceptable and unacceptable behaviours?

Provide opportunities for career advisors and parents to better understand tech pathways and possibilities

Many of the young women surveyed described barriers imposed by their schools or their parents. Parents, in particular, didn't understand the types of jobs their children would be qualified to do, the availability of jobs, and what these jobs paid. Therefore, provide information for parents too.

"My parents tried to talk me out of it [tech] because they haven't used it [tech] in their job, but when they realised I was doing stuff I could actually use, such as building websites, and they realised digital technology paid a lot, they were supportive."

"My parents didn't want me to study digital technology. They wanted me to do law. They didn't believe I could get a job out of it. They didn't understand."

Young women said that the digital technology taught at school was either too basic or girls were actively discouraged from taking it.

"There wasn't a big push for it at school. Some high schools don't even consider it an option for girls."

"My class at high school did basic stuff, such as how to use Photoshop or build a website. I found it too easy so I taught myself stuff."

For tertiary providers, make sure schools have up-to-date information about your technology courses. Include content that clearly explains mandatory requirements and career pathways. Think about how women see your organisation. Identify the career opportunities you offer and ways to make them more attractive to women and girls.



When producing your marketing material:

- Ensure a female presence in marketing images, voices on radio ads, at open days, and when staffing booths at career expos.
- Make sure the content is clear, easily understood and jargon-free.
- Avoid gender stereotypes, for example, pink, beauty, and domestic-related angles.
- Share examples of female tech graduates with local schools, through social media, and on your website.
- Offer taster courses for high school students; consider offering them to a cohort of girls, or ensuring a 50/50 gender split, so that girls feel welcome.

Avoid stereotyping, keep an open mind, and encourage all students equally

Avoid stereotypes in your verbal and written communication and your students will all feel welcome and seen as individuals.

The young women surveyed said it was important to change the idea of what studying tech meant.

“Break the stereotype of the nerd in a dark room who loves Lord of the Rings”.

Check with career advisors at schools to make sure they are offering all girls exposure to digital technology through field trips and workshops. Some young women we spoke to said that, as school girls, they were offered



workshops on barista skills, beauty therapy, early childhood education, and becoming a vet.

"I asked if I could see what programming was like, but was told it wasn't cost-effective to organise something for one person."

"A stereotype still exists that jobs in digital technology are unsuitable for women."

"A guest speaker at high school started talking about race car suspension, but then changed his example to baby bouncers because 'he was at a girls' school'."

Prepare and deliver material career advisors can use to promote courses to girls. Consider hosting a seminar or expo for career advisors specifically on digital technology.

Encourage schools to be more inclusive and support all girls to attend digital technology events, not just students from digital technology classes. It's important for educators to keep an open mind. Research shows that teachers often assume that boys will be better at tech than girls.

Remember to also talk to students interested in arts, humanities, and sciences about how technology connects all subjects.

Some further tips

Set expectations for professional behaviour

Make it clear that staff and students are expected to use inclusive language and appropriate images in their assignments and in communicating with each other. They also need to create an inclusive and inviting atmosphere.

"I was invited to join a coding group in secondary school, but nearly all were boys and the environment didn't feel right."

Attend to the physical and digital environments

Labs, classrooms, and social spaces can reinforce stereotypes about who the 'typical' computer science student is. So can webpages. Check out your programme's physical spaces, websites, and promotional material to see what messages they may be sending.

"There was only one digital technology display at a careers expo, which was very busy. The boys were physically bigger so it was hard [for us girls] to see and find out more."

Even positive stereotypes can hurt

Avoid stereotyping, even when making a positive comment, for example, "women are so good with ...". These kinds of comments can create or trigger a stereotype-based expectation of performance.



Keeping
girls and
women
in tech
education

Support women-in-tech clubs. If you don't have a club, promote initiatives that will support their learning, such as Rails Girls and She#

It's easy for girls to feel isolated in male-dominated courses, especially in their first year. Provide clubs or draw their attention to initiatives where they can feel supported. They will enjoy the course more and stay more engaged. Promote opportunities for women to network.

Use the directory of STEM initiatives – Learn, Discover, Connect – on the Ministry for Women's website at www.women.govt.nz.

"Computer Chicks was a very good support network. I would have dropped out otherwise."

"It's easy to feel isolated, especially in your first year. You don't see many people like you in your classes."

"In my first year, it took me six months to ask for help. For many women, there's a feeling that you have to prove that you can do it; that you deserve to be there. In clubs, you can talk about these things. It's important to get first years involved because they don't have a support network."

"Since starting software engineering, the club for women has been incredibly supportive and has kept me wanting to study it."

"The friends I have made have kept me motivated to keep going. I enjoy this degree because of them."

Mind your language. More positive encouragement will build confidence and retain women in tech education

Women may think they're not as good at technology as men, or that the opportunity for a career in tech is for the brainy few. One reason discussed is because girls may not have had as much screen time as boys growing up.

Social and cultural expectations also shape the aspirations and motivations of girls. As a result, girls can lose confidence in their technical abilities and opt out if they're constantly hearing that something is difficult.

"A lot of people say it's too hard; it's not if you put the time and effort into learning stuff."

"Don't position [technology] as hard; English is hard too."

"If you support them to give it a go, they will succeed."

"I was pulled aside by a tutor in a lab and told, 'You can do this; don't shoot yourself down'. This was helpful encouragement."

Girls who pursue technical courses say they often feel the need to prove that they deserve to be there by outperforming their male classmates.

“When you’re the only girl in the class, you feel like you have to represent all of girl-kind.”

Focus group participants thought that educators could make more effort to normalise tech as something anyone can do – for example, by showing a snippet of code and what that snippet actually does – and help prevent women from feeling like outsiders by encouraging a more inclusive learning culture – for example, encourage students to step back, listen, and leave space for a new voice.

Promote teamwork. Group activities support learning and dispel the mistaken belief that tech people work alone at a computer all day

Design collaborative and mission-based tasks that have goals students

need to accomplish and achieve, and problems to solve. Support teamwork in class for challenging assignments.

“The first and second years [studying Computer Science at university] were quite challenging because the projects weren’t done as a team. My third year was much easier and done more as team projects, which is more enjoyable.”

When allowing team work, be explicit about the criteria for success and behaviours you expect to see, for example, it’s not a competition and speed is not a factor. Often women may enter a course with less hands-on tech experience than men and so may be slower, but still have the required aptitude to succeed.

Group activities also help to dispel the misconception that digital technology is anti-social.



“Promote the social and networking aspects of career paths in technology.”

Another approach for easing students into technology is ‘pair programming’.

Pair programming is a software development technique where two programmers work at the same computer. One writes the code (‘the driver’ – often the person with the least experience so no-one gets left behind) while the other assesses the code as it is being created (‘the navigator’). The programmers may switch these roles frequently, making pair programming a highly collaborative method of software development.

“Many people have the misconception that software development is done in isolation and you’re on a computer all day – it’s more than that – promote it.”

Pair programming has been shown to benefit all students but is considered particularly useful as a method for improving female retention because it addresses limiting factors like lack of confidence and the view that computer programming and computer science is competitive and anti-social.

Consider your teaching style. Does it recognise different levels of understanding, experience, and abilities?

A common complaint among the young women surveyed was that tutors assumed that everyone knew what was being discussed. If someone asks a question in class, explain what’s being asked before answering. Some students try to show how much they know by asking long questions and dominating class time. Manage the discussion by asking them to discuss the issue with you after class. Or use it as an opportunity to explain to and involve the whole group. For example, Harvey Mudd College went from averaging 10 percent women computer science majors to 40 percent. See [Case Study page 22](#).

“Teaching style should provide context, create an environment where people don’t go off on tangents because it alienates part of the class. Be inclusive.”

“Train teachers not just in knowledge, but in how not to alienate girls.”

Don’t allow comments or jokes that belittle women, their knowledge, or their contribution to the class.

“Teachers who get to know students and get students talking and working together are great.”



Case studies

Isabelle Taylor from University of Canterbury

Studying towards a Bachelor of Engineering with Honours in Software Engineering

A summer internship at Google in Sydney is just one sign that Isabelle is set for an exciting life as a software engineer. She heard about the opportunity at the Google Women in Tech event, which was held at the University of Canterbury.

“It was an incredible experience that taught me so much about working in the industry and made me sure that this is what I want to do with my life,” she says.

It was not always such a clear-cut path for Isabelle. She had always planned to go to university, but was not sure what to study.

“I tried some programming in my digital tech class at high school. It was the only thing I had tried that truly interested me and something that I could imagine doing for the rest of my life. I had found my passion! My parents took some convincing – law had been my second option – but they came around to the idea.



“There are so many great things about software engineering. I enjoy the problem-solving aspect, and the way I can work through a problem logically to find a solution. I also love that it can be combined with so many other things. Software is used in hospitals, to fly planes, play music, animation in movies, and so much more.”

Isabelle opted to take a Bachelor of Engineering degree at the University of Canterbury, which upon graduation means she will be a qualified member of the Institution of Professional Engineers New Zealand.

“I have lived in Canterbury for my whole life. University of Canterbury has such an awesome engineering department it was the obvious choice. The lecturers are usually very passionate about their subject and keen to help you learn. Of course it also helps that it is a really cool campus!”

Isabelle is heavily involved in wider student activities, winning an Emerging Leaders' Scholarship and joining some of the many clubs at the University.

"It can feel a little isolating being a woman in a computer science or engineering lecture, but I joined Computer Chicks and Women in Engineering and met some awesome people. When I'm not studying, I enjoy socialising with friends, reading a good book, baking yummy food, and playing netball."

Isabelle's advice to students considering software engineering as a discipline is to try it in the first year.

"If you're not sure that it's for you then take COSC 121 (Introduction to Computer Programming) and try it out. You might love it, and if you don't then at least you leave with a basic understanding of what computer programming involves."

Article reproduced courtesy of Canterbury University

Case study: Kat Black, Film motion capture specialist



Visual effects artist Kat Black used to imagine her name rolling up the screen at the end of a movie. People told her it was an impossible dream, but she's made it happen through a combination of hard work, commitment and self-belief.

Kat had her big break in the highly competitive motion capture industry at 24 years old, landing a job at Weta



Digital in Wellington. Two years later, she has 11 movies – including *The Hobbit*, *Dawn of the Planet of the Apes* and *The Hunger Games* – to her name.

After being promoted a year ago to her dream role as a Composer, she says her new role at Atomic Fiction, maker of *Star Trek Beyond* and *Dead Pool*, provides lots of challenging and exciting learning opportunities

Kat knew what she loved doing when she left school, but wasn't sure she could turn it into a career. It's really important to show a good work ethic.

"When I left school everyone else was going to university but I just wasn't sure, so I worked at New World for six months."

After six months working in a supermarket, she took the plunge.

"Media and film was the thing I loved the most when I was in school, so I studied animation and multi-media at Natcoll (now YooBee School of Design) then went on to do advanced video post-production."

"I was given all the tools to make something amazing. There were times when I was working 50 hours a week and had a part-time job on top of that for 25 hours a week. But, by the end I had this great piece of work that was priceless."

That piece of work opened doors. Kat got the chance to work on an

interactive map for Te Papa, which then led to another interactive map for the DVD extras on the western *Good for Nothing* by Mi Films, and then to her job at Weta.

"I kept on applying saying I wanted to work there, and each time I had more experience to add I'd apply again. In the end I had an amazing showreel from all the work I'd done and references from people who knew I worked really hard."

Kat was "thrown in the deep end because it was crunch time for *The Hobbit*", and quickly picked up skills, just the background she needed to pick up her new contract.

She now has her sights set on compositing, and has the opportunity to train in it after hours at Atomic Fiction.

"That's really top dog stuff. Motion capture is at the very start of the pipeline because the film is raw, you haven't textured or done any lighting for it yet. Compositing is at the very end, you have meetings with the director and put all the components together to make the final shot."

Kat says she's discovered sticking to what you want is the key to success.

"Now I've figured that out, there's no limit to what I can achieve. It's exciting, because I know I can get what I want by just keeping at it."

Harvey Mudd College, University of California, Berkeley



Over a five-year period, Harvey Mudd College went from averaging 10 percent female computer science majors to 40 percent.

The Computer Science faculty led the effort in 2006 by redesigning the introductory computer science course to focus more on creative problem solving. Instead of traditional homework, the faculty assigned team-based projects so that students coded together. Most importantly, they made the courses fun and emphasised ways in which computer science could benefit society.

The following are some of the changes the College made to attract and retain female students.

Remove the 'macho effect'

To create a supportive environment for women and other students with no coding experience, the introductory course was split into two sections: those with prior programming experience and those without. Teachers worked to eliminate the

'macho effect', where a few more experienced students intimidate others because they seem to know so much more.

Provide role models

To strengthen female students' interest in computer science, 25 first-year women were given the opportunity to attend the Grace Hopper Celebration of Women in Computing, the largest conference focusing on women computer scientists. At the conference, students meet a variety of role models – successful women working in tech and enjoying it.

Create early research opportunities

The College created research projects for students with little computer science experience and encouraged female students to apply. These projects allowed female students to apply their knowledge, boost their confidence, and deepen their interest in computer science.

Demystify success

In most places, particularly in industry, the path to success can be unclear. People outside the dominant group are often not included in social activities where there's a natural flow of information. Demystify the industry by opening up the conversation beyond the dominant group about what people do to succeed in the tech sector.

The content for this case study was adapted from a speech given by Harvey Mudd College President Maria Klawe at the University of California at Berkeley in January 2016.

A stereotype
still exists that
jobs in digital
technology
are unsuitable
for women.

Let's change
that!

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PO Box 10 049
Wellington 6145
New Zealand

Tel: (04) 915 7112
Fax: (04) 916 1604

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www.women.govt.nz
info@women.govt.nz

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