

# **Women in ICT and Digital Technologies**

**An investigation of the barriers to women entering, staying, and progressing in the sector, and actions to ameliorate this**

## **Executive Summary**

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November 2016

## 1. Women in ICT: The problem

This report summarises research conducted to explore the under-representation of women in the ICT and Digital Technologies sector in Scotland, and the possible reasons for, and solutions to, this problem.

Women's representation in the ICT and Digital Technologies occupations<sup>1</sup> in Scotland (18%) is considerably lower than in other skilled occupations (39%), or the workforce as a whole (48%).<sup>2</sup> There is also a considerable degree of vertical and horizontal occupational segregation by gender within the sector. Men and women are equally likely to be in professional occupations within the sector, but men are more likely to hold managerial or skilled trade roles. Women are more likely to be in project management, web design or technician roles, with men more likely to be programmers and IT engineers. Gender pay gaps are evident, with median hourly pay of £17.68 for men and £14.89 for women. Previous research on gendered occupational segregation in the tech industry has suggested that the phenomena of segregation and pay gaps may be linked, as women are more likely to be in roles with (less well remunerated) 'soft' skills. It also cautions that women can end up pushed into or trapped in these roles because these skills are assumed to be inherently female.

The enduring gender disparity in the industry is at odds with the prevailing patterns and trends in female labour market participation more generally, and their participation in other skilled roles. Furthermore, it may be harmful to the growth and success of the industry itself. A systematic review of the literature on the business case for equality and diversity, on behalf of the Department for Business Innovation and Skills, found evidence that firms have reaped business benefits from equality and diversity, such as increased staff engagement and retention, and more creativity and better problem solving due to a wider range of perspectives. Furthermore, it widens the talent pool from which to recruit, and firms may be better able to adapt to increasing consumer diversity when this diversity is also reflected in its workforce. However, the authors of the review stressed that these benefits tend to only accrue where diversity is sufficiently well-embedded and managed.

The under-representation of women in ICT roles is an international phenomenon, and despite numerous initiatives to increase female participation, no country has achieved parity. Comparatively speaking, the UK sits somewhere around the middle, having neither the highest nor the lowest level of female participation.

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<sup>1</sup> This research takes the same definition of an ICT occupation as the annual 'Women in ICT Scorecard' produced by the Tech Partnership ([https://www.thetechpartnership.com/globalassets/pdfs/research-2015/womeninit\\_scorecard\\_2015.pdf](https://www.thetechpartnership.com/globalassets/pdfs/research-2015/womeninit_scorecard_2015.pdf))

<sup>2</sup> Data on women's participation in the sector is taken from the 2014 Annual Population Survey.

The Employment Research Institute was commissioned by Skills Development Scotland to conduct research into these issues. The research had three objectives:

- (1) To identify the current state of the knowledge available on women's representation in the sector, and the reasons why they are under-represented; in Scotland, and also in comparison with the UK, and a selection of comparator countries.
- (2) To establish, via consultation with a range of relevant stakeholder groups, the barriers to women entering, staying and progressing in the sector in Scotland.
- (3) To generate, based on the findings of the research, actions and recommendations for key actors, including the government, educational institutions, and public and private sector employers.

Desk-based research was initially carried out, to review the existing literature on gender disparities in the sector, and the data available on women working in the sector and studying the relevant subjects. Examples of initiatives in other countries that have attempted to improve female representation in the sector were sought.

An online survey was launched, to gauge the broad opinions of four key groups:

- Employers within the sector;
- Employees within in the sector;
- University and college staff teaching subjects relevant to ICT roles; and
- University and college students who are currently pursuing these subjects.

Survey respondents were asked to comment on the extent to which various aspects of the sector could represent barriers to women, and the scope for improving their representation. There were 522 respondents to the online survey; 72 employers, 184 employees, 100 college and university staff and 166 students.

The online survey was followed up with qualitative interviews and focus groups with employers (n=13), employees (n=29), and university and college staff (n=14), to explore the issues raised by the survey in greater depth. Qualitative research was also undertaken with: recruitment agents involved in placing people in the sector (n=11); secondary and primary school teachers who taught computing subjects (n=5); and relevant interest groups and professional bodies (n=9). These groups were consulted in order to gain further insight into the factors that may deter women from the sector at various junctures.

Finally, a paper-based survey of secondary school pupils explored their attitudes towards studying computing and working in the sector.

## 2. The leaky pipeline

The issue of women's under-representation in the ICT and Digital Technologies sector originates well before the labour market itself. The gender balance in the sector reflects fairly closely the proportion of those qualifying in the relevant subjects. Respondents to the online survey identified the supply of women to the education from the industry as a key issue. A lack of women studying the required subjects at university was believed to be a likely barrier by 69% of employers and 71% of employees in the sector, and 65% of those studying on and 93% of those teaching on relevant courses. Respondents also thought the lack of girls studying the relevant subjects at school was an issue, although to a lesser extent, perhaps reflecting the importance of university education in this highly skilled area.

Women make up 18% of those in ICT roles, compared with 20% of those studying Computing Science at National 5 level, 17% at Higher, 13% at Advanced Higher, and 16% of those pursuing computing degrees at university.<sup>3</sup> The proportion of girls studying these subjects has not increased in recent years; in fact it has fallen, from 35% of Standard Grade entrants in 1995, to 30% in 2013, and a further drop to 20% with the introduction of the new National 5. Thus, although some further 'leakage' does occur at the transition from education to the labour market, the origins of the imbalance are well before this.

A drop off in interest among girls was perceived by some teacher respondents to happen in early adolescence. Indeed, the survey of school pupils found considerable ambivalence towards computing among girls aged 11-14. It is not perceived explicitly as a subject 'for boys' – only 11% (of both sexes) agreed with this statement. However, there are gender differences in attitudes towards the subject, and towards technology careers (Figure 1). Although the majority of girls said they like computing and think it is important, they were less likely to say this than boys. Furthermore, only around a third of girls feel they are good at it, or say their friends enjoy it – for boys, this is closer to two thirds. A stronger orientation towards ICT jobs was also found among those whose friends are interested in computers. These findings are important because previous research on girls' attitudes towards STEM careers has demonstrated the importance of feeling confident and identifying with the discipline in fostering positive attitudes.

In general, pupils were found to like computing lessons (75%), and to find them interesting (77%) and think they are important (78%). However, when asked to name their favourite subject, other subjects seemed to capture their imagination more, especially creative subjects. Although on the whole attitudes towards careers in technology are not negative, there is a lot of uncertainty about what they involve and require, and the type of people

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<sup>3</sup> Source: Data from the Scottish Qualifications Authority (figures for the year 2014/15) and Higher Education Statistics Agency (figures for the year 2013/14).

who do these jobs. Importantly, girls were less likely to perceive these jobs as exciting or able to make a difference, and more likely to perceive them as solitary. Even some of the study participants who were currently working in ICT roles reported that they had a negative impression of the sector when they were at school.

**Figure 1: Key findings from a survey of school pupils**

	Boys	Girls
Agrees with “ <i>I like computing lessons</i> ”	84%	56%
Agrees with “ <i>I am good at computing</i> ”	67%	35%
Agrees with “ <i>My friends enjoy computing</i> ”	61%	32%
Computing is mentioned as favourite subject	25%	9%
Aspires to an ICT job	31%	6%
Agrees that people who work with computers...		
... have exciting jobs	58%	41%
... can make a difference in the world	69%	53%
... spend most of the time working by themselves	20%	32%

A number of suggestions were put forward by educators and interest groups as to why computing at school might not be inspiring school aged girls. One was the curriculum itself, which was felt not to capture the creativity and range of applications of technology. This was felt to be particularly important in addressing gender balance, as women tend to be more drawn to the practical uses of computing than intrinsically interested in hardware or coding. It was suggested that, as technology is embedded in a range of areas of life – including sport, science, and the arts – it could accordingly be embedded within the teaching of these subjects at school, particularly in light of the popularity of these subjects among pupils. A lack of resources and insufficient number of specialist computing teachers were also cited as barriers to teaching pupils in a way that felt up to date and engaging. The importance of school computing being engaging was also emphasised by those working in the industry, some of whom said that their experiences at school had initially put them off.

After school clubs were cited as a good opportunity to allow pupils to pursue an interest in coding, and could potentially offer a single-sex environment in which girls could feel less ‘different’. The popularity of games design as a future career among male respondents to the pupil survey illustrates the potential of technical careers to capture young people’s imagination, perhaps because they can make a link from something they enjoy and is important to them, to a future career. The challenge identified was to find what might capture girls’ imagination in the same way – without simply making everything pink or restricting it to fashion and beauty. For example, the Lego league was given as an example of an initiative that engages girls because it gives them a chance to see how technology could be used to make a difference and solve a problem. Figure 2 gives some examples of initiatives that are either aimed specifically at girls, or have had success in involving them.

## Figure 2: Extra-curricular coding initiatives

*TechFuture Girls*<sup>4</sup> is an after school club for girls aged 9-14. Skills such as coding, cyber security, data management and video editing are taught through activities themed around music, sport, charity work and dance. The initiative is free of charge for schools as it receives corporate sponsorship, and has reached 150,000 girls in 4,500 schools in the last decade. 84% of girls involved stated they were more likely to consider further education or a career in technology as a result.

*Apps for Good*<sup>5</sup> partners with schools to deliver courses in the skills to make mobile, web and social apps. The organisation worked with 23,000 pupils in 470 schools in 2014/15. 48% of participants are girls. Role models are considered important; a quarter of volunteers are female, and a third of expert sessions are delivered by women. After taking part, 15% of female students said they were more likely to choose GCSE computing, and 29% were more interested in technology.

*Little Miss Geek*<sup>6</sup> runs tech clubs in inner city state schools. Over 5000 students have taken part, and one girls' school in London saw a 52% increase in girls taking Computer Science.

There is also a substantial gender disparity at university level, although this varies depending on the course, suggesting that some engage women more than others. Our study participants suggested that women do not apply for computing degrees because they feel it is not for them, do not identify with the image of a person who studies computing, and perceive that it is necessary to have been programming computers for years. Women who do enrol on computing courses may become discouraged if they feel they do not fit in with their course mates; they may feel isolated, or lack confidence, especially if they are surrounded by apparently skilled and confident male students.

Not all the computing students who responded to the online survey aspired to work in the sector, although most did, including the female students. However, female students displayed less confidence that they would be able to move into their preferred role. Data on graduate destinations shows a disparity in the proportion of male and female computing graduates who move on to ICT roles after graduation; 73% of male graduates from computing subjects are in an ICT role 6 months after graduation, compared with 58% of female graduates.<sup>7</sup> Interestingly, female graduates who move into ICT roles are more

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<sup>4</sup> [www.techfuturegirls.com](http://www.techfuturegirls.com)

<sup>5</sup> [www.appsforgood.org](http://www.appsforgood.org)

<sup>6</sup> [www.ladygeek.com/portfolio/little-miss-geek](http://www.ladygeek.com/portfolio/little-miss-geek)

<sup>7</sup> Source: Destinations of Leavers from Higher Education survey 2013/14, conducted by the Higher Education Statistics Agency

likely to have done so from a non-computing background than male graduates; just under half have a computing background, compared with around three quarters of male graduates. The remainder of female graduates entering these roles come from a wide range of backgrounds, including the creative arts, business studies, and the natural and social sciences.

Finally, it is worth noting that previous research in other male dominated sectors has suggested that women may be put off entering the sector at the recruitment stage. Studies have suggested that adverts in male dominated occupations tend to employ more masculine wording, and that masculine adverts can make women perceive jobs as less appealing or make them less inclined to apply. However more research in this area is needed, especially to explore these issues with respect to the ICT sector specifically.

### 3. Awareness and perceptions of the sector

Two key issues that emerged as potential barriers to women's participation in ICT were a lack of awareness of the opportunities available in the industry, and the potentially damaging effect of negative stereotypes on recruitment.

Although lack of awareness was not felt to be a barrier to women's participation by a majority of the online survey participants, a substantial minority nonetheless felt this was likely to be an issue; 44% of employees and 52% of employers in the sector, and 42% of those studying towards and 47% of those teaching on the relevant courses.

Follow up interviews with those working in the sector suggested that it is not necessarily a lack of awareness of the sector per se; rather, it is more of a misunderstanding about the nature of the work itself. Respondents stressed a number of aspects of their jobs that should be appealing to women, but they did not think were widely acknowledged – such as creativity, problem solving, teamwork, and making a difference – and expressed frustration at the way that tech careers were depicted in films and on TV. Representations of the sector in popular culture were felt to be not very positive or respectful, and this was particularly problematic due to a general lack of knowledge about the sector to counteract these stereotypes.

*"Shows like the IT crowd haven't done us any good"* (Employee)

There was some concern, particularly among educators, that computing is seen as a low status career path, with unclear career progression, and it is not currently a mainstream aspiration for young people. They felt that it was necessary to raise the profile of the sector in order to attract more young people – and convince their parents that it is a good career choice. The pupil survey suggested that the attitudes of a young person's family about their future did influence their aspirations. For example, those who were encouraged to use computers at home were more likely to say they aspired to an ICT job.

*"I don't think there is enough knowledge as to what these roles actually involve. I think there is still the stereotype of, you know, the kind of geeky programmer sitting in his anorak in front of his computer for 12 hours a day. And there isn't maybe enough clarity as to the breadth of the types of roles that exist in that industry."* (Employer)

It was felt that this problem could to some extent be addressed by better links between schools, universities and the sector. Teachers felt that those working in the sector could better promote the opportunities within it, and communicate these to pupils, parents and teachers. Employers expressed an interest in doing so, but did not necessarily know how to

go about it. However, as one employer pointed out, it is a difficult sector to define, and it can be difficult to explain what these jobs are, especially to young people.

A majority of respondents to the online survey felt that more female role models would be likely to help encourage more women into the sector; 86% of employees and 78% of employers in the sector, and 93% of staff teaching on and 76% of students studying the relevant courses. Exposing girls to female role models might help them to envisage themselves in the sector, but any role model needs to be relatable and credible, or it may do more harm than good.

*“Unless you can see somebody that has [made it], you don’t think it’s possible, and that starts from a really early age. If all you’re looking at when you’re choosing your Standard Grades is a bunch of guys in caps, you might be a girly girl and want to be a developer, but where do you see that? You can’t see that anywhere, you can’t see it on TV.” (Employee)*

*“As long as they look cool. I think image is a big thing, so if you had a female role model going into a school and she looked quite geeky, the kids are going to go ‘ha ha geeky IT person’, so I think it’s important to get the right type of role model.” (Employee)*

These negative stereotypes may be enough to put young girls off pursuing a career in ICT, but it does not mean that they are lost to the industry forever. Some of the female research participants who were working in the industry had initially done something else before moving into ICT roles, as it was not apparent to them at an earlier stage that this career might be for them. Routes into the sector varied; some were offered training by employers, others taught themselves or attended intensive ‘boot camp’ style training courses. This suggests that there is scope to feed the pipeline not just at the school and university stage, but also from other industries.

## 4. Issues in the working environment

Most women working in the sector consulted in the course of this research were very positive about their jobs. However there were elements of their working conditions that they considered to be potentially off-putting to women entering or staying in the sector.

One of these was the long hours demanded in some jobs. In the online survey, 46% of employers and employees in the sector, and 38% of students studying the relevant subjects, said this was likely to be a barrier. Part-time working among women in the sector is relatively rare (16%) compared with other skilled jobs (33%).<sup>8</sup> Another issue raised by female employees was the inconsistent way in which flexibility has been embraced by employers in the sector; despite many roles being potentially very flexible, some employers still looked unfavourably on requests for flexible working. Previous research has also raised these issues of an expectation of long hours, and a lack of flexibility.

One aspect of the work that created time pressure was the need for constant learning on the job, to keep up to date with new technologies. Some of those who had taken time off to care for children found it particularly difficult to keep up, although most felt that re-skilling was entirely possible for those with the required generic competencies. Respondents also noted that they were often in competition with colleagues who are very committed, perhaps to the point of obsession, with what they do; it is therefore difficult to compete if you want a balance between life and work.

*"I find it difficult to imagine competing with people who play games and program in their spare time... who spend all day at work and then more time at work, and that's them happy with that, and that's fine, but with all the other things I would like from my life, I'm not going to be able to compete with that type of person, with that kind of enthusiasm and intensity. So maybe I'll have to settle for being middling in this career."*  
(Employee)

The fact that the sector is male dominated is both itself intimidating, and also potentially leads to elements of the working culture becoming gendered, consciously or not. In the online survey, 79% of employees and 69% of employers in the sector, and 69% of students studying the relevant courses, thought that the sector's male dominated culture was likely to put women off. In general, the women working in the sector who participated in this study said that they did not mind working in a male dominated environment per se. However, it did make them feel different, and some said that it made it harder for them to feel a sense of belonging, or part of the team. There was also a feeling that the lack of women in general is a problem, that it should not be that way. There was not necessarily

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<sup>8</sup> Source: Annual Population Survey 2014

perceived to be a laddish or macho culture; only a minority found this. However, there are implications for working practices and culture when decisions are made by men, for a predominantly male workforce.

*"It emphasises that feeling of maybe nobody really understands me here."* (Employee)

*"I don't have a problem with it because I got used to it, but I certainly don't like it, I'd love to see more women involved in technical roles, because I think there's a massive problem in how we approach the workforce from a society point of view."* (Employee)

Previous research has noted the role of gendered informal networks in giving men an advantage in competitive workplace environments, and compounding the issue of women feeling that they do not fit in. Female networks can help women build confidence and feel more a part of the sector. Although some respondents expressed ambivalence about female-only networks, those involved in existing networks enjoyed meeting like-minded women, and felt that it was good for confidence and morale, although they noted the challenge of maintaining these networks against competing demands on their time. Mentoring was also mentioned as something that could be beneficial in boosting confidence and facilitating progress in the sector; 80% of female employees who responded to the online survey thought this would help.

Discrimination was not perceived as the most important barrier to entry, but more something that could present negative experiences. It was thought to be a likely barrier by 51% of employees in the sector, but only 40% of employers, and by 57% of female employees but only 42% of male employees. This disparity is revealing, and is related to the way in which bias against women in a male dominated sector may be present, but not necessarily acknowledged as such.

The research suggested that discrimination does exist in the sector, sometimes blatantly, but more often in more subtle forms. Those who had experienced outright discrimination reported negative assumptions about their skills and performance by management, clients, recruiters, and people in the sector more widely at events and conferences. Some also reported being patronised or ignored at work, or treated differently after having children. However, most female employees did not feel discriminated against; it was more that they felt out of place in many cases, and subject to the type of unconscious bias described above.

## 5. Conclusions and implications

Women make up only 18% of those in ICT and Digital Technologies occupations in Scotland. They are under-represented relative to their representation in the workforce, and compared to their proportion in other skilled occupations. Gendered occupational segregation and pay gaps exist within the sector. This research set out to explore this disparity, in consultation with key stakeholders and those working in the industry, as well as the 'future workforce' of current school pupils and computing students.

The origins of the imbalance lie in the low uptake of computing subjects at school and university. Women make up only 16% of those pursuing computing degrees, and uptake at school level has fallen in recent years. Secondary school girls are not overwhelmingly negative towards ICT at school, or to the possibilities of ICT careers, but they are more ambivalent than their male counterparts. They appear not to be engaged by the curriculum, although a number of extra-curricular initiatives have seen good uptake and stimulated enthusiasm among girls. Women studying the subject at university may experience isolation and a feeling of not belonging, and they are less likely to move into an ICT role after graduation (58% do, compared with 73% of male computing graduates).

The research suggested a number of features of the sector that may put women off entering it, or staying in it, and may explain in part women's lower representation:

- Negative perceptions of people who work in the sector – the nerdy young male of popular and media stereotypes;
- A lack of visible female role models in the industry;
- An expectation of long working hours and a lack of flexibility;
- A male dominated workplace, that is both itself intimidating, and potentially leads to gendered working cultures and practices;
- A feeling among female employees in the sector of not belonging; and
- In some cases, direct instances of discrimination, or negative assumptions about their competences on the part of employers and clients.

The solution to this imbalance is therefore likely to lie in:

- Getting girls engaged in computing and increasing uptake at school level;
- Increasing awareness of opportunities in the sector among secondary pupils, in partnership with industry;
- Supporting female students in further and higher education, offering mentoring and networking opportunities and promoting opportunities in the industry to them; and
- Making employers and those working in the sector more aware of the benefits of diversity and family friendly working practices, and encouraging employees and employers in the sector to challenge unconscious bias.