GENDERED CHOICES

Motivation and degree choices of Computing and IT students: a gendered analysis

eSTEeM Project Final Report

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Executive Summary
This study investigates the gendered degree choices and motivations of Computing and IT students. An analysis of degree intentions carried out by the School of Computing and Communications as part of an Athena SWAN application, revealed a much higher proportion of women enrolled in the computing joint honours degree, where they study computing alongside a second subject (Q67), compared to the single honours Computing and IT degree (Q62). We carried out an online survey with male and female students who had completed TU100, the 60 credit key Level 1 module on both of those degree programmes in 2016/2017 (TU100 has now been replaced by two 30 credit modules TM111 and TM112). Questions focused on previous qualifications, experience of working in IT (or non-IT) related jobs, career intentions, and confidence. The online survey showed that a higher proportion of men were already working in the IT industry, whereas more women were looking to enter into an IT related role for the first time. This suggests that studying computing and IT on its own may be more popular with students with well-defined career intentions, and already situated in the IT industry, whereas the broader joint honours may be of preference to those not yet working in the industry and seen as offering wider work and skills development opportunities. However, there were also examples where women deliberately chose a combination of subjects offered by the joint honours degree to provide entry into more specific roles, such as data science. Our findings also show that a higher proportion of women than men had a previous STEM-related degree. Nevertheless, some women expressed confidence issues, in particular about entering into careers in the industry rather than their ability to study IT. This suggests that employability in computing, even among women who have successfully completed STEM degrees in the past, or are already working, continues to be influenced by structural gendered barriers and behaviours.

Keywords: Computing; motivations; degree type; gender; career;

Aims and scope of your project

- What were the main aims of the project?

There is a significant body of research in the UK and internationally about strategies to increase women's participation in IT and Computing and a number of theoretical explanations for under representation of women in IT and Computing higher education studies. Most of this research is focused on young women who are entering higher education for the first time, but little exists on the choices of adult women. What we do know from research about OU learners in general is that many of them are seeking to improve and/or change careers. Previous research has shown that women returners or career changers often seek qualifications as a means to retrain and take a new direction (Herman 2014, Ellen and Herman 2005, Herman et al 2011). So this study aimed to extend work in this area to look at the motivations of mature women students in IT and Computing, and aimed to recommend strategies of inclusion for future enrolments in this curriculum area.

- What were the more specific goals?

The project set out to examine the motivations and choices of male and female students and identify possible intervention strategies to redress gender disparities. As Figures 1 and 2 show (see Figures and Tables at end of report), there is an increasing gender disparity in the choice of degree programme. A higher proportion of women are choosing to study Computing and IT combined with another subject than for a single honours degree in Computing and IT. In fact, the proportion of women studying for the combined honours degree has increased from 25% to 35% in 5 years, and the proportion of women studying for the single honours degree has also increased, but only by 5% from from 12% to 17% in 5 years. This observation prompted us to try to understand the difference between the proportion of female students on the joint honours degree compared to the single honours degree. We wondered whether women and men had different motivations for studying computing as adult learners, particularly in the light of evidence that women's careers often follow a

non-linear trajectory, and that many women change careers after a career break. A second possibility we wanted to explore was whether women were choosing the joint honours degree because of having a lower level of confidence in their ability to succeed in a single honours computing degree. In other words, did the same factors that inhibit younger women from entering computer science degrees apply in the case of older learners – namely their perception of the gendered culture of computing education?

Activities

- *What was the overall approach (e.g. observe current practice, develop technology, plan and evaluate change, etc)?*

The overall approach included collecting and examining a number of primary and secondary data sources - to analyse existing enrolment data, and then to survey students about their motivations for study, and to discuss results with a Focus Group of women students.

- *What were the planned activities of the project?*
  The original proposal set out three phases

Phase 1 – literature survey of existing strategies/ interventions from other higher education interventions in order to provide evidence based enquiry.

Phase 2 – online survey of current women IT and Computing students at the OU to uncover motivations for enrolment on degree programmes. Understand demographics, careers stages and intrinsic motivations for study.

Phase 3 – focus group and interviews with sample of survey respondents

- *What changes did you have to make to your plan (aims, project activities, etc.) and why (e.g technical problems, difficulties in involving users/stakeholders, etc)?*
- *What data and evidence did you gather and how did you gather it (e.g. survey, interviews, focus groups, user studies, cultural probes)?*

Phase 1 We conducted a literature survey, but also wanted to gather initial thoughts from students as to the direction of the research. So we set up an online Focus Group using Adobe Connect. Turn out to this was poor (only two students attended in the end). Nevertheless the discussion was useful in shaping the direction of the survey questions.

Phase 2 went ahead more or less as planned. We designed and carried out an online survey to which we invited students (male and female) who had completed the Level 1 module TU100. A total of 1250 were invited to participate

Phase 3, we conducted a final Focus Group – but did not carry out any one to one interviews. We attempted to arrange this as a face-to-face event, offering Milton Keynes and Manchester as potential venues. Whilst there was some interest from students in this, getting a reasonable number together at one venue proved to be too limiting so we conducted this focus group online using Adobe Connet.

Findings

A total of 253 students responded to the survey, (168 women and 85 men), giving a 20.2% response rate. Of these, 18 responses were incomplete, resulting in 235 fully completed surveys. 66% of respondents were women, compared to the 19% average figure for women taking the TU100 module, thus women were over-represented in the sample. This was not unexpected due to the survey being promoted as part of a programme to promote gender equality. In the sections below we highlight some of the key findings from the survey data

1. Women are more likely to choose the joint honours degree

Survey participants were studying towards several qualifications, but the two most common were the BSc Computing & IT (Q62) and BSc Computing & IT and another subject (Q67). 25 students (10%) were registered for the BA/BSc Open Degree, 16 (6%) on other diplomas and certificates, and the remaining 10 (4%) did not have a study intention beyond the module itself. The proportions (and numbers, n) of women and men who responded to the survey and were studying Q62 or Q67 are illustrated in Table 1 (see Figures and Tables at end of report).

The single honours degree (Q62) was the most common study intention of survey participants, however the proportions varied significantly between genders. 69% of the men were studying towards this degree compared to 39% of the women. This pattern was reversed for the joint honours degree. Nearly a quarter (23%) of the women stated this as their study intention compared to just under 8% of men. Women were also twice as likely as men to be studying for the Open degree.

These figures corroborate the enrolment statistics shown previously in Figures 1 and 2 and provide confidence that this sample was representative of the overall gender profile on these qualifications.

In subsequent discussions the results for women participants (n=168) are compared to those for men (n=85). In addition, the results for women studying Q62 (n=66) are compared to women studying Q67 (n=38). There were not enough responses from men studying Q67 (n=7) to enable a meaningful comparison of men with these two different study intentions.

2. Women were more likely to have previous STEM qualifications

Nearly a quarter of the women (22%) already had a previous degree. Of these, nearly half (44%) had a degree in another STEM subject. This was significantly higher than the male students of whom only 16% had a previous degree and of those, less than a quarter were STEM graduates (23%)

There was a small difference between women who had a previous degree who were now studying Q62, 23% (n=14), compared to those studying Q67, 19% (n=7), but as numbers are small it is not clear whether a previous degree was significant in which degree they chose.

3. Men were more likely to be already working in IT

Participants were asked what (if any) experience of working in the IT/Tech sector they had.

The results for women and men are shown in Figure 3. The figures illustrated are as proportions of gender total (not of the overall sample total). For example, 19% of women participants were currently working in an IT role.

Whilst the responses to this question for men and women follow a similar pattern, with the most popular option being 'Have never worked in IT but want to enter' followed by 'Currently working in an IT role', the results illustrate that men are more likely to currently be working in IT role than women (28% compared to 19%), whereas women are more likely to never have worked in IT (52% compared to 43%).

Results for the same question but comparing women studying the single honours BSc Computing and IT degree to women on the joint honours degree are shown in Figure 4.

The responses of both groups of women follow a similar pattern. Here, women who have never worked in IT are more likely to study the single honours degree (61%) than the joint honours

programme (44%) as are those who are currently working in an IT role (23% compared to 17%). However, women working in the technology sector but in non-IT role are more likely to study the joint honours degree (17% compared to 8%).

4. Degree choice was related to career intention

Participants were asked to rate their agreement with several statements about their reasons for choosing the degree programme that they were registered on (from 1 = Strongly disagree to 5 = Strongly agree).

- It will be useful for me to progress in my current career
- It will be useful for me for changing career direction
- I'm interested in a career in IT
- I am interested in the subjects offered in the modules
- It will give me more confidence in IT
- I wanted to study a wide range of subjects, not just IT

Figure 5 illustrates the results. An open textual comments box was also provided for participants to add other reasons than those stated.

The most popular reason for choosing their degree programme among both men and women was that the degree related to their interest in a career in IT However, for women, feeling that it would give them more confidence in IT was equally popular. A significantly lower proportion of men strongly agreed with this statement – which also represented the biggest difference between men and women across all statements.

Career change was a strong motivation for both women and men, with up to three quarters agreeing (rated 4 and 5) with the statement that the degree would help them 'change' career direction. Women were slightly more likely than men to agree that the degree would help them 'progress' in their current career.

5. Joint honours was an informed choice related to career strategy

We were particularly interested in why women were more likely to choose the joint honours. These two comments from survey respondents illustrate a deliberate choice that would meet their career objectives. Thus rather than coming from a lack of confidence, the joint honours can be seen as an intentional and informed choice.

> "[…] the combination of Computing & IT and Statistics was interesting to me as it fits well with a career in data science. I currently work in a completely different sector and I am considering moving into a different career. I also do it just because I do enjoy the subject, so not only for career reasons." (experience of working in roles with some IT component, but not an IT specific role)

> "[…] the joint degree (with mathematics as the second subject) was chosen mainly [because] the non-joint degree in computing does not offer a sufficient preparation in mathematics. I am aware that postgraduate institutions may want to assess my maths skills, if i want to progress into fields such as robotics and/or machine learning. Also, I enjoy mathematics very much and I was interested in studying something theoretical (such as pure maths) rather than coding only." (never worked in IT but wanted to enter)

6. Women express lower confidence in succeeding and keeping up

Participants were asked how they currently felt about taking the degree that they were registered on. They were asked to rate their agreement with the following statements (from 1 = Strongly disagree to 5 = Strongly agree).

- I feel confident with my ability to succeed on this degree
- I feel confident that I will be able to keep up with other people
- I feel aware of being in a minority on the degree because of my gender
- I feel I have a similar level of previous knowledge to others on the degree

Figure 6 illustrates the results for women (left hand bar for each response) and men (right hand bars).

Adding responses 5 (strongly agree) and 4 (agree) together for each of these statements shows that only 68% of women, compared to 81% of men, felt confident in their ability to succeed on the degree.

Similarly, women's confidence in keeping up with other people was lower than for men (60% of women compared to 72% of men). Despite this, slightly more women than men felt they had a similar level of previous knowledge to others on the degree, however this was quite low for both men and women with the majority selecting '3 = neither agree or disagree' to this statement.

Understandably, the majority of men did not feel they were in a minority on the degree; however, the proportion of women who felt aware of this was also quite low (30%).

There were various comments providing more detail on how participants were feeling about their studies. These two, from female students studying Q67, highlight concerns about time and personal responsibilities, rather than issues of confidence around the subject area.

> "[…] I was not aware that women are underrepresented and it does not change my view of my ability. My main concern is time availability. I do think some people are better prepared / have better previous knowledge but I did not consider gender in that thought. I have just seen messages on the forums of people that programme [in] different languages or have a stronger background in maths that I do not have. However, I believe I do have other strengths that they may not have and I feel confident about my ability"

> "I can't attend in person tutorials due to having children […]"

Other comments from women studying Q67 illustrated that they were confident in their studies, particularly the computing component.

> "I feel that the mathematics half of my degree is the most demanding time-wise, while the computing half is much lighter […]."

> "The degree I've chosen is "Computing & It and Business". I feel much more confident in Computing than I do in Business simply because I have studied Computing in the past and it comes more natural to me. However, even though Business is a tougher subject for me, I still feel like I am able to keep up with the other students in my class, even though it's more of an effort to keep up, but I do enjoy it so much and it feels I already feel like I've gained so much knowledge compared to the previous year."

Finally, the following comment emphasises that there are other possible demographics that could cause students to feel they were in a minority.

> "I am also aware of being one of the youngest students on this course (19 years old) and s some of the references in the learning materials do not relate to my experiences with IT"
> (Female student, Q67)

Focus group

The final focus group was undertaken online with 6 female students. Of these, four were employed full-time in IT related roles; one part-time in education; and one was a 'full time mum'. Three were studying a single honours programme: Computing and IT; three were studying a joint honours programme - Computing and IT and Psychology (one student) and Computing and IT and Business (two students).

Three main themes emerged from discussion.

1. Employability

Overall, the participants felt that their study of a computing related degree had been, or would be, beneficial to their current employment status or career. Three of the six participants said their studies had definitely helped them to get their current job, including technical-related roles such as an e-Learning Developer and working for a digital company making websites. Of the six participants, four were studying with the aim of moving into, or progressing in, the industry. Two were particularly interested in obtaining more technical roles than their current jobs: one in information security and one as a developer. Another mentioned moving into higher management, and another was looking for online work as a software or web developer that could work flexibly around their caring responsibilities.

2.Confidence

The survey results had indicated a gender difference in confidence, in particular confidence to succeed and to keep up, so we explored this further with the focus group participants. For one career changer, the prospect of studying a technical subject was daunting but her confidence increased as the course progressed:

"from a technical perspective because my background is arts and humanities, I haven't really studied science or technology past GCSE a long time ago, so I certainly didn't feel very confident about the technical side of things, but I have been pleasantly surprised, which is great and I think my confidence has grown … I think the way that the courses are structured and the support that I have received has really helped to boost that confidence."

For another who had previous experience in the industry, lower confidence was not related to the computing or IT content, but was more likely to be about studying in general, for example

> "when I started I felt confident about IT, the computer side, but I think that is more because I have worked in the computer and technology sector for a good couple of years before deciding to do the course. The only thing I may have felt a little bit less confident about was just the general studying itself as being out of education for 5 years at that point. I think due to organising studying around work … that changed in the end and I felt fairly confident with it because I was able to organise everything"

Generally, being in a minority with respect to gender, whether at work or in their studies, was not felt to be a problem. Example statements included: "never ever felt I have been treated differently as a woman from the people I am working with" and that in the workplace teams

they were “just one of the dudes”. However, two participants did identify confidence issues around age: “I feel that age is more of an issue than gender” and “I don’t know if you could do something to boost confidence, particularly in the older, in the older woman trying to enter this field”. There was a feeling that more could be done to promote older women in marketing for university study in computing, or just women in IT generally.

Networking (see more below) was also mentioned as an area where participants felt out of their depth, in particular with respect to the ‘language of the industry’.

3.Community and networking
Face-to-face support and opportunities to network was a theme that came up several times during discussions. This started with one participant saying that there were not enough opportunities for interaction during their study, including meeting and getting to know other students. This is likely to be a more prominent issue amongst OU students, given they are studying at a distance, than if the issues were being discussed amongst students at a face-to-face university. However it highlights the point that face-to-face networking is an important aspect for developing students’ confidence.

Networking was returned to several times as being important – one participant found out about her current role through someone at a networking event. The BCS was mentioned as offering a mentorship program and this was thought to be a good idea, particularly for students in their final year of study, for guidance and introductions. Suggestions were made for social media groups, or sponsoring existing workshops and the need for face to face support of students. One student linked networking, age and confidence: “coming from outside the industry at a later stage of my life that the more contacts you have, the more confidence you can gain“.

- Do you have you any particular successes to report?

- Has your project generated any unanticipated outcomes or unexpected opportunities and how have you taken account of these?

- Have you informed key stakeholders (e.g. ALs, module teams, students on affected modules, OUSA, etc) about your project and its findings? See below

Impact

a) Student experience

- In what ways has your project impacted on student learning?
- How is your project contributing to increasing student success (i.e. retention, employability, etc.)?
- Have there been or will there be any benefits to students not directly involved in your project?

b) Teaching

- How have you affected the practice of both yourself and others within the OU?
- What has been the impact of your project outside the OU?

c) Strategic change and learning design

- What impact has your work had on your Unit's or the University's policies and practices?

  As a response to the suggestions raised in the Focus Group about networking opportunities, we reflected on how we could meet these needs in the online and distance education context. Two new strategies have been developed to meet this need. We ran an online webinar on Ada Lovelace Day with an invited panel of senior women working in the technology sector, and over 50 students attended with a lively question and answer session. And we have recently iniitiated an Industry Mentoring project for women students with industry mentors, again to support the transition into employment.

d) Any other impact

We secured funding for the pilot Mentoring project mentioned above, which will involve recruiting Alumni who are already working in industry as mentors working with our women students.

List of deliverables

Herman, C., Donelan, H. , Thomas, E., Hughes, J and Woodthorpe, J. *Gendered motivations and choices in computing higher education*, **UK Computing Education Practice Conference,** Durham University, 11th Jan, 2017

Herman, C., Donelan H., Hughes J, Jefferis, H. and Thomas E., *Gendered motivations and choices in computing*: **Horizons in STEM Conference,** University of Hull *28-29 June 2018*

Herman, C., and Morris, C. *Getting in and getting on: gendered participation and achievement in STEM learning* at **eSTEeM Annual Conference** Open University, Milton Keynes, April 2018

Herman C., Donelan H, Jefferis H, Hughes,J., Thomas, E., *Gendered enrolment patterns in IT* **eSTEeM Conference** Open University, Milton Keynes, 24th April 2018

Herman, C., Donelan, H., Hughes, J. and Jefferis, H. *Entering STEM in later life: examining the motivations of adult women studying computing,* **4th Network Gender and STEM Conference**. University of Oregon, Eugene, July 31 – Aug 2, 2018

Herman C., Donelan H, Jefferis H, Hughes,J., Thomas, E *Career change or career progression? Motivations of women studying computing as adult learners* Paper submitted (July 2019) to **International Journal of Gender Science and Technology** Special Issue Reimagining Who Does STEM

Report/ presentation to C&C School meeting in December 2017

Ada Lovelace Day Women and IT networking webinar October 11th 2018

Figures and tables

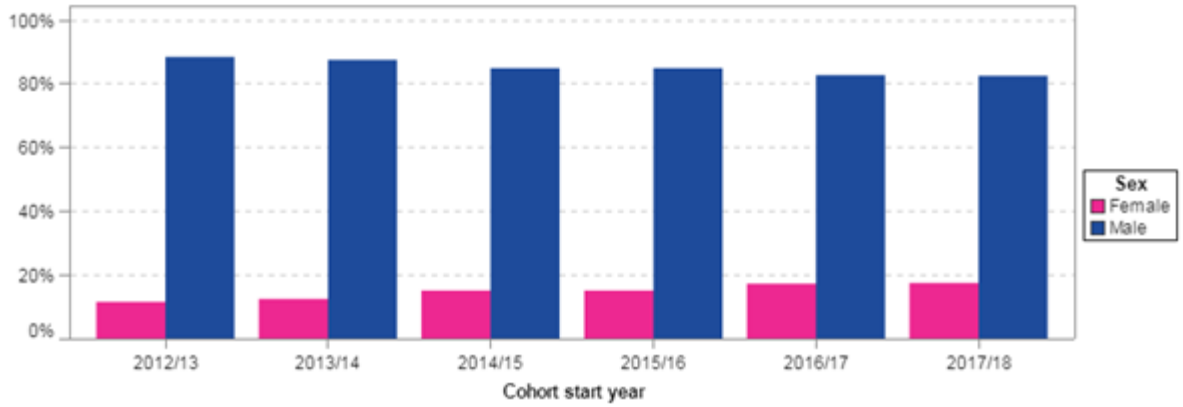


Figure 1: Proportion of women and men enrolled on single honours Q62

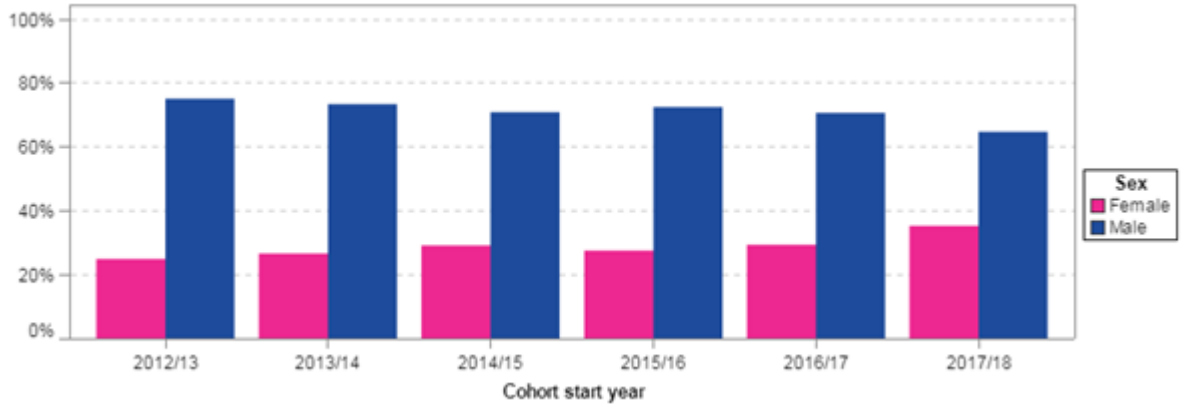
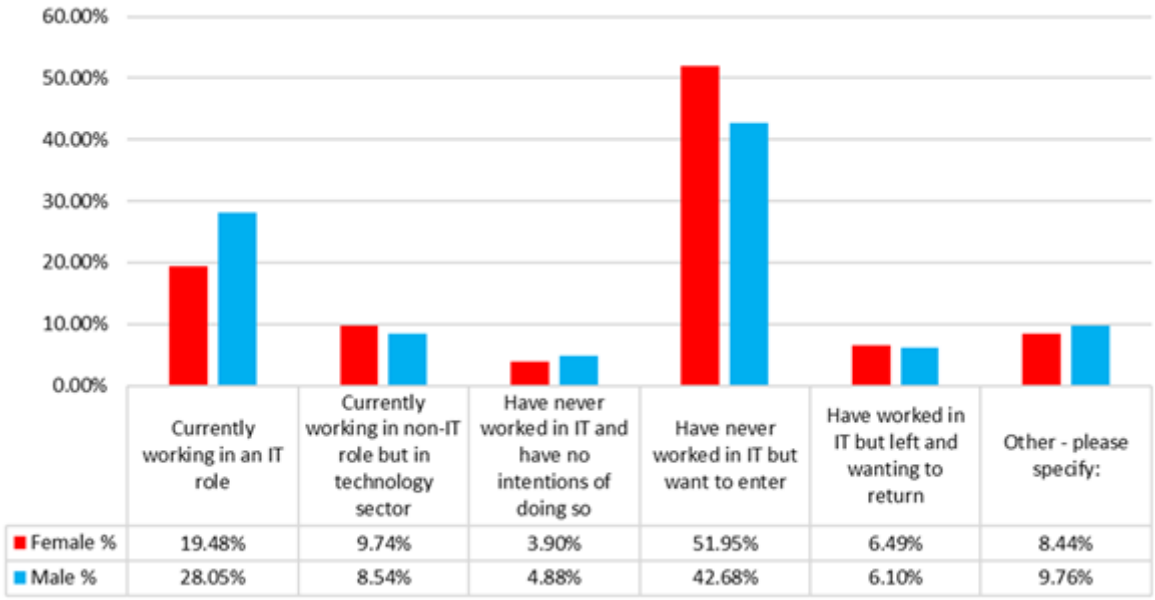


Figure 2: Proportion of women and men enrolled on joint honours Q67

	BSc Computing & IT (Q62)	**BSc Computing & IT & another subject (Q67)**	**Total**
Women (n)	36.3% (n=66)	22.6% (n=38)	**168**
Men (n)	69.4% (n=59)	8.2% (n=7)	**85**
Total (n)	49.4% (n=125)	17.8% (n=45)	**253**

Table 1 Proportion of participants with different degree intentions by gender



	Currently working in an IT role	Currently working in non-IT role but in technology sector	Have never worked in IT and have no intentions of doing so	Have never worked in IT but want to enter	Have worked in IT but left and wanting to return	Other - please specify:
Female %	19.48%	9.74%	3.90%	51.95%	6.49%	8.44%
Male %	28.05%	8.54%	4.88%	42.68%	6.10%	9.76%

Figure 3 Experience of working in the IT/Tech sector by gender

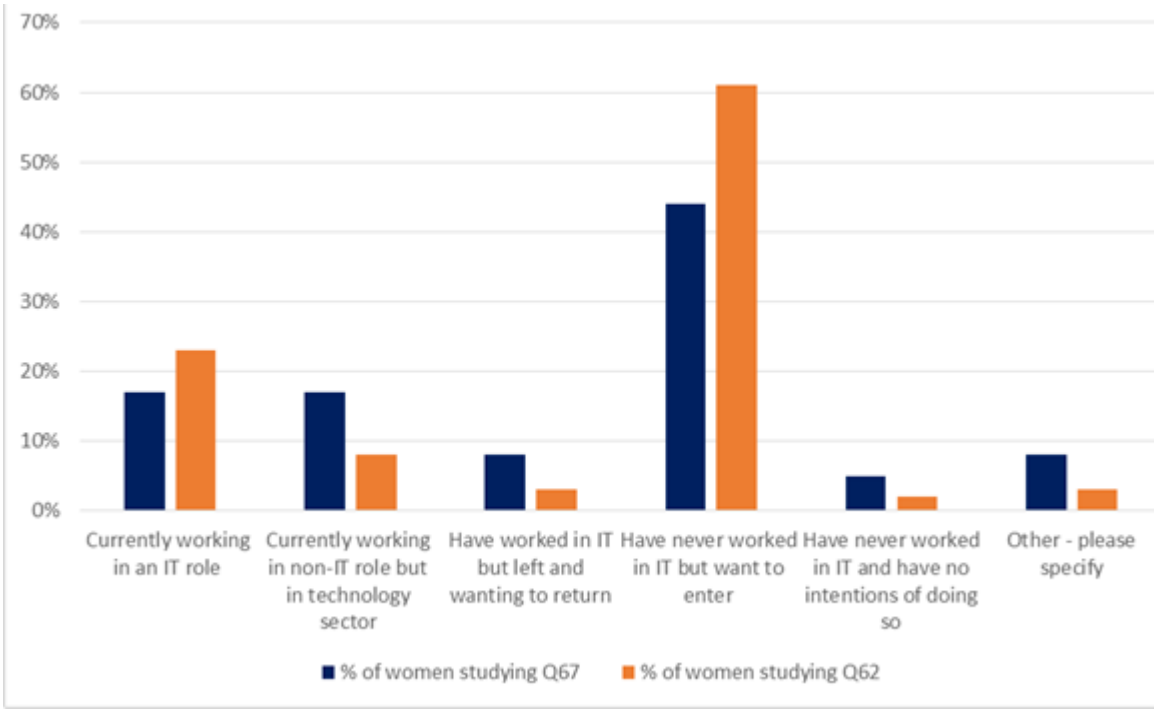


Figure 4 Experience of working in the IT/Tech sector for women by degree intention

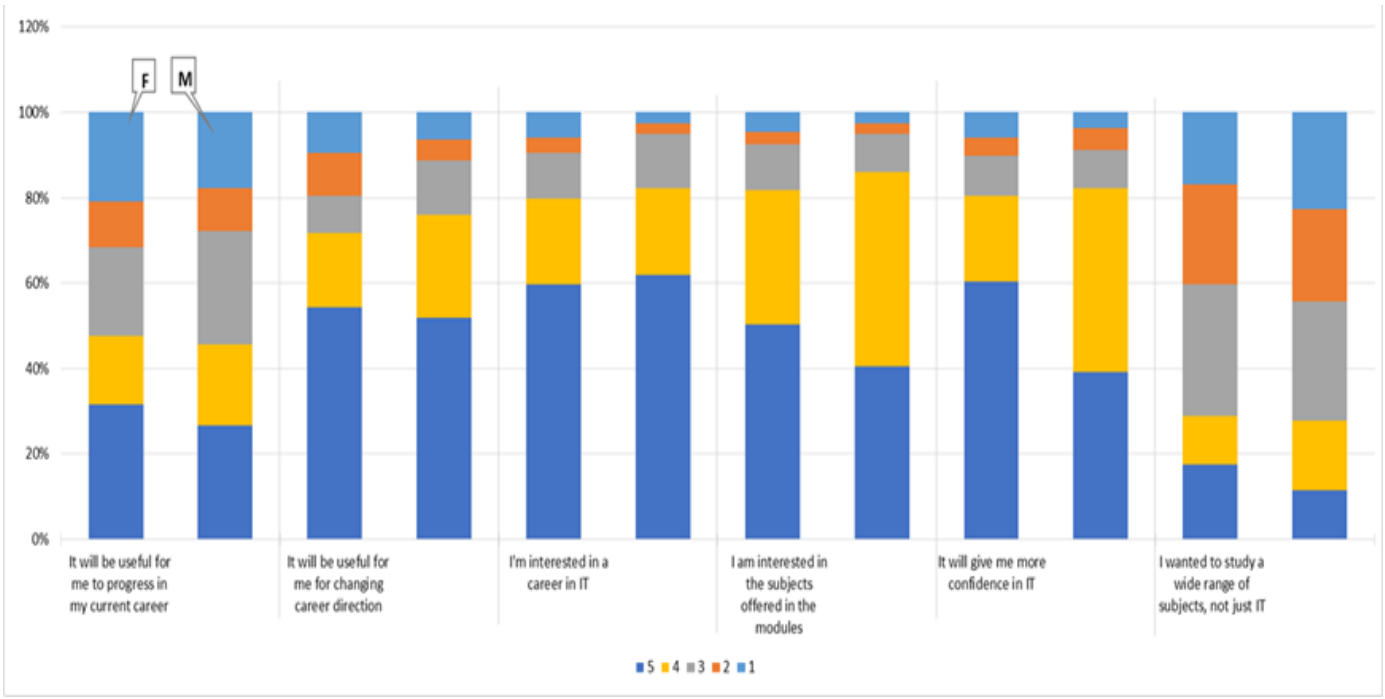


Figure 5 Reasons for choosing the degree registered on

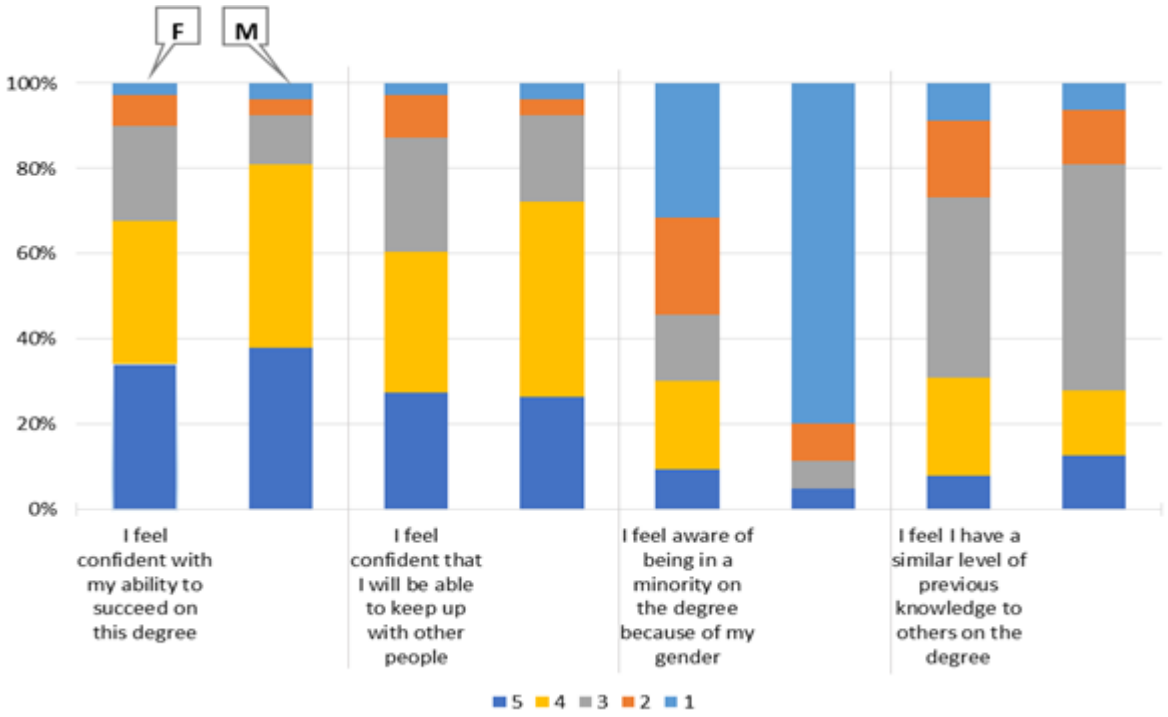


Figure 6 Feelings about studying the degree registered on

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University approval processes

SRPP/SSPP – Approval from the Student Research Project Panel/Staff Survey Project Panel was obtained according to the Open University's code of practice and procedures before embarking on this project. Application number 2017/094