ABSTRACT The declining number of women in computing is a cause for concern for those in education and the IT industry. A diverse workforce is necessary for there to be a creative balance in the IT industry. The reasons for this decline are varied and can be attributed to factors such as schooling, parental influences and the media. This article focuses on comparing the experiential differences between male and female students in GCSE ICT and A-level Computing and ICT lessons and their impact on students’ motivation. Questionnaires were used to provide statistical outcomes and interviews were conducted to probe more deeply into the thoughts and feelings of students. The results show that male and female students have very different experiences of computing at school, which inform their perceptions and influence educational decision making. This article focuses on qualitative findings.

The under-representation of women in computing has been a cause for concern in western countries for both social and economic reasons. A recent report published jointly by Intellect and the British Computer Society stated that women make up 45% of the UK workforce but that only 21% of the information technology (IT) workforce is female (BCS, e-skills UK and Intellect, 2009). The decline in the number of women entering the IT workforce is detrimental to the UK since the country is reliant upon a sufficient supply of scientists and technology specialists to boost its economy (Harding, 1997). The low number of women choosing to enter the IT workforce has contributed to a skills shortage within the industry, and it is therefore essential that the number of women in the industry be increased (BCS, e-skills UK and Intellect, 2009).

There are various reasons for the lack of women in the IT industry. Often cited is the perception that such jobs are geeky or just for men (Trauth, 2002). However, a high number of girls are choosing to take the GCSE Information and Communication Technology (ICT) Short Course, which is a half GCSE and requires the commitment of one lesson a week.

The numbers decrease at A-level and then again at university level. Camp (1997) described the problem as the ‘shrinking pipeline’, where the numbers of females decrease at each stage in the educational process. Camp’s study was conducted in the USA but the situation also occurs in the UK. Figure 1 shows that in the UK the drop in girls in particular is severe between GCSE level and A-level. The UK has long been concerned about the under-representation of women in computing.

Research design

A research study was designed to provide a picture of experiential differences among students taking GCSE ICT and A-level ICT and Computing in relation to gender and age. This article focuses on the qualitative results, looking at how IT...
experience in formal education shapes the way in which female students at different educational stages view the IT industry. Seventy interviews were conducted with five male and five female students taking each of the following courses:

- GCSE ICT Full Course;
- GCSE ICT Short Course;
- GCSE Business and Communication Systems;
- AS-level ICT;
- AS-level Computing;
- A-level ICT;

In the first phase of the study, 166 questionnaires were distributed to male and female students studying ICT and Business and Communication Systems at GCSE level, and Computing and ICT at A-level. This was conducted to provide a preliminary understanding of the main differences between males and females regarding the various experiences and perceptions that had influenced their attitudes to IT. The second phase of the study was to conduct in-depth interviews with 70 of these students, to understand the emotive reasons behind how the participants felt about computing and to what extent this influenced their eventual career aims.

Results

The study identified various factors within formal education that encourage or dissuade participants at GCSE and A-level. Summaries of case studies that illustrate the main points are presented here (pseudonyms are used throughout). We focus on two key outcomes of this study:

- the influence of previous courses on female participants;
- classroom atmosphere having an influence on female participants’ opinions of the IT industry, as well on as their levels of confidence.

The influence of previous courses on female participants

The findings show that the course the female participants took, at either GCSE or A-level, may have had an influence on whether they decided to continue studying ICT or computing at A-level or degree level. Those studying GCSE ICT felt that the course was not exciting. Case study 1 was typical of participants studying the GCSE ICT course, in that they found the modules on Microsoft Office boring. This was especially prominent within the interviews:

In today’s lesson, we have just got our Excel task and we have to do a spreadsheet system for a florist or sports shop. It’s just boring. I just don’t find that fun or I don’t know how it’s going to help me. I really hate it and it’s difficult. (GCSE ICT Full Course female participant)

The GCSE ICT female participants in this study found it hard to gauge how learning about Microsoft Office could be a sufficient foundation for a further course in ICT or Computing. They indicated that they found this ‘boring’ and ‘pointless’. This was reinforced by the interviews, which indicated that the female participants at GCSE level consider jobs in the IT industry to be either secretarial roles or ICT teaching roles:

I dunno … I just think that with what we are learning, it’s like we are learning how to be a secretary. I don’t want to be one of those. (GCSE ICT Full Course female participant)

This is in contrast with the findings of Ofsted (2009), which suggested that female students were more inclined to choose courses that focused on office skills.

In contrast, the male and female participants who took the Business and Communications Systems course with the aim of understanding the role of ICT in business felt the opposite. They experienced a different kind of curriculum that was more practical (Case study 2).
Participants studying for the GCSE Business and Communication Systems were more positive about their course. This could have been because they were in a school that had a focus on mathematics and computing, but also because by taking the course they were able to understand more about the practical application of computers:

*It’s not so bad. Like the teachers tell us about computers and at first I don’t see the point in it all. But when we learn about how real people in real businesses do what we are learning … I think it makes me feel like I am actually learning something relevant to my future.* (GCSE Business and Communications Systems course female participant)

Participants also felt that this course was creative and helped them to understand new aspects of the computer. However, some believed that working in computing was restrictive as it was perceived to be a monotonous process with no creativity. Participants enjoyed using PowerPoint as this was perceived to be creative and not ‘boring’:

*Student: PowerPoint, well anything that we can use graphics with. That’s why I enjoyed the website design. I liked doing the Publisher stuff so I could make posters and leaflets and that sort of stuff.*

*Researcher: Oh OK, cool. So what did you like about doing that?*

*Student: It was creative.*

*Researcher: Do you think working in computing is creative?*

*Student: Well, it’s just writing stuff down. So someone wants you to make a device or application, they design the spec, they do everything in computing you have to make something exact to what the other person has told you. It’s like where’s the room to breathe?* (GCSE Business and Communication Systems course female participant)

It was suggested that A-level ICT was enjoyable as it was a course that was related to real-life businesses (Case study 3).

Female A-level participants felt that the mix between practical and theory was enough to help them grasp important concepts such as ‘networking’ and ‘business’. This is surprising

---

**Case study 2 Charlie (aged 16), GCSE Business and Communications Systems**

Charlie is studying GCSE Business and Communication Systems. She attends a specialist mathematics and computing school. Charlie decided to take Business and Communication Systems at school because she wanted to combine learning about computers and business. She said that she was encouraged to do this by her dad who works at IBM. She was told that it would also be important for her future. The other courses she took were Art and Sociology. She said that she felt apprehensive about choosing Business and Communication Systems because she didn’t really know what to expect, because she hadn’t heard of some of the modules before, and it sounded difficult. But she was also excited that they got to use the better computers at school. Overall, Charlie was complimentary about the course, but she also said that there were ‘boring bits’ such as learning Microsoft Office. Charlie really enjoyed learning about website design and computer maintenance. She enjoyed the website design course because she was able to apply her new skills in her final art project, to make her art portfolio. She loved doing this as it was a really creative task.

---

**Case study 3 Sally (aged 17), A-level ICT**

Sally is studying ICT at A-level, which she took because she had really enjoyed the GCSE course. She wanted a similar but more advanced course at A-level, so she felt that ICT would be a good option to take. Sally is also studying Economics, Media Studies and Biology. She finds her ICT course interesting but would prefer to have more practical elements within the course. The course itself does have a range of modules from which the school can select. However, Sally said her school has selected modules that are not practical but are more business studies- and case study-based. Sally does enjoy learning about the business side and says she does not find it too difficult, but does not feel that this ‘unleashes’ her creative side. Sally would have liked to have learned far more about website design, multimedia and graphics, as well as computer security. Although the course does cover these, it is not in the depth that she would have preferred. Sally is unsure about what career she would like to go into, but the idea of website design and graphics sounds like something that would interest her.
as the contents of the A-level course relate to business studies, which Smyth and Darmody (2009) show as being more attractive to male students. Relating the course to business means that there is a direct link with the IT industry:

*I like that we do different things. We had to do a module on analysing the problem, so we had to create a list of requirements of what the business needed and wanted from a system. I never knew that actually happened. My teacher then said that there are people with jobs that do exactly that. I wouldn’t mind doing something like that.* (A-level IT course female participant)

This link provided participants with realistic ideas of future careers, which influenced them to continue with IT at degree level. This was similar for both male and female participants.

In contrast, female participants taking A-level Computing were not as satisfied with their experiences as female students taking A-level ICT (Case study 4).

Chloe’s experience was typical of other female participants studying computing at A-level. This was surprising, as previous studies have shown that if participants do have an exposure to computing concepts then they are less likely to be frightened of it. Holden and Weeden (2003) discussed the positive impact of holding computing camps for high school children and came to the conclusion that those who participated subsequently showed more of an interest in computing careers and courses.

**Classroom atmosphere has an influence on female participants’ opinions of the IT industry as well as on their levels of confidence**

The results of this research indicate that the atmosphere in the classroom or learning environment has an influence on female students’ opinions about the IT industry as well as on their levels of confidence.

Female participants who took Computing at A-level felt the subject was interesting as well as manageable. However, there were instances where they felt outnumbered by the male students in their class. This was more prominent in the interviews, which will be expanded on in the coming sections, and is also illustrated in Case study 5.

Throughout the interviews, it was clear that the feeling of loneliness and isolation was a contributing factor to them not wanting to carry on with computing at university. The majority of female A-level Computing students said that they were put off the subject through their classroom experience – they felt isolated and did not feel capable of doing the degree course. The following interview extract bears similarities to Chloe’s experience:

*Going to class can be a chore, ‘cos it’s a difficult course and I don’t feel like I have many friends. There is one other girl in my class and if she is away...* (Case study 4 Chloe (aged 16), AS-level Computing)

**Case study 5 Chloe (aged 16), AS-level Computing**

Chloe feels more behind than others in her class since, when she looks at her classmates’ computer screens, they are sometimes doing things on the computer that she had never seen before. There is one other female student in her class with whom she works closely. Chloe said that they were discussing trying to integrate more with the male students in their class, so they can learn what their classmates are doing. She also feels that the teacher pays more attention to the male students, and that she and her friend are left to get on with the tasks on their own. They do ask the teacher for help, but she feels that the teacher patronises them, as do the male students.
then I am on my own. The guys in the class are just so clever. I am too scared to ask them for help. (A-level Computing course female participant)

This has been an ongoing concern in the women in computing domain as highlighted by Moorman and Johnson (2003) and Cottrell (1992) who reported that feelings of isolation in computing lessons were a factor in females feeling discouraged from computing as a career. In the studies conducted by Clarke and Teague (1996) and by Margolis and Fisher (2003), there were recurring themes where female students had indicated that they felt isolated.

There were small numbers of female participants in the Computing A-level classes in comparison with the numbers of males. Female students said that they felt they could only approach other female students for help. They were too embarrassed to ask the male students in their class because they felt that they were asking ‘stupid questions’.

This was consistent with previous studies, such as those by Teague (1998) and Sharp et al. (2006), which found that female students felt anxious about asking for help. The participants in this study said that they often spent lessons not achieving anything before plucking up the courage to ask a male student or the teacher for help.

Lack of confidence is well documented as a reason why female students are dissuaded from IT courses. Beyer et al. (2003) found that those on computer science courses in the USA felt that they had lower confidence levels than that of their male peers. The findings from our study reinforce this and also indicate that programming and networking modules were a factor in the decreasing confidence levels of female A-level Computing participants:

It’s difficult because I don’t understand what the teacher is on about. The module on networking is difficult and the business module is something that I find difficult. I am also not good at exams. (A-level Computing course female participant)

Female A-level Computing participants felt that they were not competent with the ‘coding’ aspect of the course. It was thus not surprising that, out of all the A-level Computing modules participants had been taught, it was the coding modules and programming assignments that had caused participants the most difficulty. The following interview extract is in relation to programming languages and other aspects of the course that the interviewee did not understand in the undergraduate prospectuses:

Reseacher: So how did you decide not to take computing at degree level?

Student: Well ‘cos, I dunno, I didn’t really know much about what was in the computing prospectuses from the universities. So I asked the [computing] teacher for a meeting to see if I could discuss some of the prospectuses.

Reseacher: That’s a really good idea.

Student: That’s what I thought! But I went to see her and she didn’t really know much. She just said: “Oh my god, it just looks so difficult.”

Reseacher: Couldn’t you ask anyone else?

Student: I don’t really know anyone else to ask. My teacher is the only person I know and I am too embarrassed to ask anyone else.

Reseacher: Why are you embarrassed?

Student: Because when I went to see my teacher to make an appointment, a guy in my class was there [and] he started laughing. (A-level Computing course female participant)

Female A-level computing participants said that they did not feel that the course was ‘too bad’ until they started the coding element. They felt that this had diminished their confidence because of the lack of support they felt they had received.

Conclusions and recommendations for schools and policy makers

This account has presented the current factors at significant decision-making points (GCSE and A-level) that dissuade or encourage female students to pursue a degree in IT or computing. Existing studies in this area primarily focus on a specific age group, such as that by Mitchell, Purchase and Hamer (2009), which mainly considered the GCSE age group, or that by Carter and Jenkins (2001), which considered the degree-level group. Fewer studies in the UK seem to have been focused on A-level students. This research found that positive experiences of computers are needed to make girls more enthusiastic about careers in IT and, if girls have these positive experiences, they are more likely to imagine themselves working in the IT industry. The IT industry and computing is perceived by society to be ‘geeky’ and researchers posit that this dissuades female students from pursuing IT studies (Helmsley-Brown and Foskett, 2001; Colley and Comber, 2003; Margolis and Fisher, 2003).
On the basis of these findings, we would recommend the following for schools and universities to encourage women to continue with their IT education:

- Provide a real-life context so that female students are able to see the relevance of what they are learning and how they can contribute to the IT industry.
- Provide A-level Computing students with more information about the IT industry and demonstrate how programming fits in with what goes on in real IT organisations. Again, this will allow female students to understand the relevance of what they are learning.
- Provide A-level Computing students with more support. This could be in the form of single-sex classes where they are not afraid to ask for help, or internal school ‘women in computing’ groups.
- Provide ICT and computing teachers with a more in-depth understanding of the IT industry and computing concepts.

References


Website
UCAS Statistical Enquiry Tool: www.ucas.com/about_us/stat_services/stats_online/.

Reena Pau is a postdoctoral researcher in the School of Education, University of Southampton.
Email: reenapau@gmail.com
Wendy Hall is dean of the Faculty of Physical and Applied Sciences, University of Southampton.
Marcus Grace is the deputy head of the School of Education, University of Southampton.