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Technical boys and creative girls: the career aspirations of digitally skilled youths

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ABSTRACT

Digital technology is increasingly central to our lives, particularly among young people. However, there remains a concern from government and businesses of a digital skills gap because many youths, especially girls, tend to be consumers rather than creators of technology. Drawing on 32 semi-structured interviews with digitally skilled teenagers (aged 13–19), this article investigates their digital career aspirations and examines how identities and discourses of gender can interact with the type of digital careers that are of interest to these youths. While it was found that digitally skilled young people still articulate traditional gendered discourses of digital competence, especially around technical abilities, the growing importance of creativity as a career pathway into digital technology is highlighted. Implications of the findings are discussed in relation to the new computing curriculum in England, which prioritises technical computing skills, and the discontinuation of Information and Communications Technology (ICT), which facilitates a broader usage of software and digital productivity.

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Introduction

The importance of technology for digital literacy and the economy is internationally recognised, including in the UK (Bureau of Labor Statistics, 2015; Europa, 2015; House of Commons, 2016; Royal Society, 2012). The UK Government's *Digital Strategy* aims to make digital inclusion a part of wider public policies (Gov.uk, 2017). While debates around the digital divide, particularly in developed countries, have progressed from disparities in access to differences in digital skills (van Deursen & van Dijk, 2014), these inequalities continue to map onto social identities and differences, particularly gender. It is important to acknowledge that the use of digital technology is generally popular and widespread. In most western or developed countries girls do engage with technology, just as much as boys. Among today's young people there are negligible gender differences in terms of internet or social media usage, or the ownership of devices such as smartphones and tablets (Ofcom, 2015).

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However, while more youths may now be digitally skilled and connected, few opt to participate beyond the basic level of digital interaction or the passive consumption of digital content provided by others (Helsper & Eynon, 2010; Ofcom, 2015). There remains a particular concern that girls lack the aspirations to position themselves (and be positioned by others) as potential creators of digital technology, such as a career in computer programming. As such, digital technology, especially computer science, is often gendered as a male domain.

This paper explores the digital career aspirations of digitally skilled teenagers. We consider the type of careers that are of interest to them, especially those related to digital technology. More specifically, we explore the ways in which digital careers are considered as desirable (or not) for 'people like me', with a particular focus on gender identities and discourses. The findings then contribute to our discussions and thoughts on the new computing curriculum in England, as well as the discontinuation of the subject it replaces, Information and Communications Technology (ICT). In short, we argue that the renewed emphasis on technical computing could generate another level of the digital gender divide, even among those who are digitally skilled.

Gender differences in the digital domain

Concerns of the gender digital divide continue to plague the tech industry, despite conscious and continuous effort to promote girls in digital technology (e.g. code.org; ncwit.org; techfuturegirls.com, just to name a few). A plethora of research has explored the underrepresentation of women in computing. Unsurprisingly, the recurring themes revolve around gendered discourses of computing as a field typically 'for men'. As discussed below, girls and women can be subject to specific barriers and difficulties in their experiences of and encounter with computing and digital technologies.

In the UK, males are overrepresented in compulsory and post-compulsory computing education. In 2015, less than one in six (16%) GCSE[1] and less than one in ten (9%) A-level[2] computing students were girls, who actually outperform boys in proportional terms (JCQ, 2015a, 2015b; Kemp, Wong, & Berry, 2016). By comparison, ICT had three times as many students as computing at GCSE, with 42% being female (JCQ, 2015b), compared with 16% for computing. ICT focuses more on the knowledge and application of end-user and office productivity software, which is likely to have wider appeal as generic and transferable digital skills that are valued in many workplaces. Thus, ICT is often regarded by students as a skillset, rather than as a career pathway, which remains somewhat reserved for the tech savvy, typically male, candidates (Lasen, 2010).

At universities, girls represent less than one-fifth of all students in computer science (17.1%) or engineering and technology (16.1%) degrees (ECU, 2015). In employment, global technology companies, such as Google (January 2015), disclosed that women constitute only 18% of their 'tech' workforce, while their 'non-tech' workforce is more balanced at 47% female. Similarly, Twitter (July 2015) reported only 10% female in their 'tech' staff but 50% women in 'non-tech' areas. Available data indicate that women fare poorly in the computing and information technology (CIT) industry, despite comparable achievement to men in educational outcomes (ECU, 2015). Within the CIT industry, there is a clear gender divide between 'tech' and 'non-tech' staff. These patterns prompt us to question the appeal of digital careers for young females today, especially among the digitally skilled.

While some studies suggest that the gender digital divide has narrowed (e.g. Vekiri, 2013), at least in terms of access or interest, others continue to report a gender difference in relation to frequency and types of computer use, as well as self-efficacy and aspirations in digital technology (e.g. Margolis & Fisher, 2002; Varma, 2010). For example, boys appear to use computers more regularly than girls, for education as well as for entertainment, especially gaming (Drabowicz, 2014). Girls, on the other hand, seem to use computers and the internet more specifically for communication and social networking (Ofcom, 2015). Studies have also found that girls are generally less interested in programming, even among undergraduate computer science students (Stoilescu & Egodawatte, 2010). Girls continue to self-report lower confidence in their digital abilities than boys and computing studies has been labelled by students, especially girls, as difficult, irrelevant and even boring (Lasen, 2010; Vekiri, 2013), especially during their junior years of digital engagement. This gender digital divide, at least in terms of aspiration, seems to reflect traditional gendered socialisation of boys and girls into masculinised and feminised beings (Butler, 1990).

According to Butler (1990), gender identity is constructed through a heterosexual matrix, where men are expected to exhibit masculine traits while women embody feminine characteristics. West and Zimmerman (1987, p. 135) explained that 'doing gender consists of managing … occasions so that … the outcome is seen and seeable in context as gender-appropriate'. In other words, masculinity and femininity are socially performed, controlled and disciplined (Butler, 1990). Although individuals are not compelled to perform gender through hetero-normative values, perceived inconsistency between the assigned physical body (e.g. as a man or a woman) and the performative gender can result in various social costs, such as discrimination and prejudice. In terms of digital career aspiration, the heterosexual matrix can shape the ways in which boys and girls consider (or not) particular digital careers as more suitable for their respective gender, which is governed and shaped by dominant gendered discourses as something men or women should 'do' rather than are born with/or as something 'natural'.

Existing research suggests that the gender digital divide was socialised from an early age, with different expectations and interests encouraged for boys and girls (Margolis & Fisher, 2002; Varma, 2010). Boys are typically expected to be more vocal, risky and adventurous than girls, who are socialised into roles that tend to be more obedient and caring, and make 'safer' choices (Francis & Skelton, 2005). The characteristics of CIT seem to align more with the attributes expected of boys. Stereotypical ideas around gender and digital technology may also be facilitated through gender-specific toys and leisure activities, such that computer games are often targeted at boys whereas more passive and caring toys (e.g. dolls) are typically focused on girls (Scantlebury & Baker, 2007). These stereotyped discourses can be reinforced by parents, teachers and the media.

At home, boys reportedly receive more support and encouragement from parents to use computers and technology products, while girls' engagement with technology tends to be more restrictive and less autonomous, which may also limit their opportunity to explore and develop curiosity with digital technology (Vekiri, 2013). At school, there are concerns that the learning environment in computing courses (especially at university) are so heavily male-dominated that it can generate a 'chilly climate' for girls, whose competence and suitability may be undermined by male colleagues (Varma, 2007). Worse still, teachers can also hold and reinforce gender stereotypes around digital proficiency, where boys are more often assumed to be the digital expert rather than girls (Abbiss, 2011). Boys are allegedly

given more opportunities by teachers in computer classrooms than girls (Cohoon & Aspray, 2006), while career advisers (and teachers) seem to display less enthusiasm towards girls who express an interest in computing-related careers (Adya & Kaiser, 2005). Furthermore, the field of CIT is popularly presented in the media as comprising men who are geeky and socially inept (Varma, 2007), which means that students without these advertised characteristics (e.g. girls) may experience more challenges in their bid to achieve such an (masculinised) identity (Sefton-Green & Brown, 2014). As such, a career in CIT might be undesirable for girls because CIT (and particularly computer science) is highly masculine and typically male-dominated, even in digital spaces such as online forums (Massanari, 2017).

While less common, some women reportedly challenge the male stereotype of CIT and negotiate a 'feminised' space within their study of undergraduate computing, although these females tend to be highly competent, with specialised digital skills and interests (Abbiss, 2011). These specific interests seem to revolve around creativity, albeit within the digital context. Within computer education, attention is often diverted to the use of computers and technology for creative learning, including computer-assisted learning and pedagogies (Buckingham, 2007). Fewer studies, by comparison, have explored creativity as a potential avenue for girls to develop aspirations in computing careers. The Department for Culture, Media & Sport (DCMS, 2016, p. 3) defined the creative industries as 'those industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property'. According to Sefton-Green and Brown (2014), within the realm of computing, digital arts is the most attractive to girls. No girls in their study mentioned programming or coding as a primary interest. Rather, girls with an appetite for digital technology tend to have aspirations in creative arts or designs. In other words, these girls appear to adopt and use digital technology as a part of (or within) their creative interests. Relatedly, Gee and Hayes (2010) argued that while female gamers are often undermined by male users, women appear to be adept digital creators, as demonstrated through their interactions and engagements with simulation video games. The infiltration of technology into traditional disciplines, especially those that are considered more 'female friendly', such as arts and design, seems to have opened up new spaces and opportunities for girls to engage in digital technology – a traditionally male-dominated domain – without the fear or pressure that are commonly associated with girls and technology.

In this paper, we wish to explore this proposition further. We focus on a cohort of digitally skilled youths and their aspirations towards computing and technology careers. Enquiries into young people's aspirations can offer valuable insights into the educational and career routes students intend to pursue (Croll, 2008). Our aspirations can be shaped by the home, school and personal factors (e.g. hobbies, interests or experiences), although these influences are also located within structural and demographic variables, such as gender, social class and ethnicity (Archer, DeWitt, & Wong, 2014). The OECD (2012) reported that, on average, four times as many boys as girls aspired to work in the fields of engineering and computing across 55 countries. If we anticipate a similar pattern (as suggested by Croll, 2008) between career aspirations and eventual employment, then a focus on young people's digital career aspirations could potentially shed light onto our future digital workforce, which is projected to expand despite the current economic downturn (Bureau of Labor Statistics, 2015; Europa, 2015). More specifically, we investigate the careers that are of interest to digitally skilled boys

and girls as we also examine the influences of gender identities and discourses in relation to their digital career aspirations. Our study contributes to the gender digital divide literature, with our focus on digitally skilled youths and, as explained below, in the context of a computing summer school that aims to bring together technical skills and creative minds.

The study

Few studies of a qualitative nature have explored young people's digital career aspirations, especially those who are digitally skilled. This paper draws on an exploratory study that examined the views and aspirations of 32 young people (aged 13–19) in relation to digital technology. Participants were attendees of a fully funded computing summer school, which ran across two sites in England, UK. The students were relatively diverse in terms of gender (18 boys and 14 girls), although the majority self-identified as being White British ($n = 22$), followed by Asian ($n = 4$), Black ($n = 3$), White Other ($n = 2$) and Middle Eastern ($n = 1$), which is comparable to the diversity of the UK population) and were considered as 'working class' ($n = 28$) according to parental education and occupation. These students are of particular interest because they are all digitally skilled. Our participants are considered to be high achievers, especially in ICT[3] or computing studies, based on their self-reported examination results and predictions (e.g. at GCSE and/or A-level). As such, their intentions to pursue (or not) digital careers are unlikely to be determined by low attainment, which continues to be a key concern in the leaky pipeline argument within science, technology, engineering and mathematics (STEM) education (Royal Society, 2012).

The computing summer school is based in a UK university computer lab. The aim is to provide young people with a platform to work digitally and creatively through the design and production of a 3D animation clip. Participation is self-selected, although students must submit a portfolio to demonstrate their existing digital skills in the open-source 3D graphics and animation software, *Blender* (e.g. an existing video clip or digital art). As such, the summer school supports students who are already interested (and also digitally skilled) in digital media creation. At the time of our data collection the summer school received a large grant, which covered students' cost of travel, accommodation and catering. Although the summer school had always been free of charge at the point of delivery, this funding attracted students who would otherwise be reluctant to even apply due to the other costs. All participants in the summer school were invited to take part and the majority of students (63%, 32 of 51) agreed to be interviewed, which averaged 45 min each. The interviews were conducted on site in a quiet room and were audio recorded and later transcribed verbatim, with student names anonymised. Participants were asked to talk about their interests and experiences of computing and digital technology in and outside of school, including the role of peers, teachers and family members. Their digital career aspirations were then probed, with a focus on wider STEM education discourses, including gendered stereotypes of CIT (e.g. as typically 'for men').

Our data analysis is informed by the social constructionist perspective, which interprets social phenomena as socially constructed and discursively produced (Burr, 2003). Interview transcripts were managed using NVivo® (QSR International (UK), Daresbury, UK) and initially coded by emerging concepts and themes (e.g. *reasons for attending the summer school*; *range and experiences of digital skills*; *hobbies and activities*; *career and educational aspirations*; *views of computing stereotypes*) as the lead author moved 'back and forth' between the

data and analyses in an iterative process through which the dimensions of concepts (and themes) are refined and/or expanded through the comparison of data (Miles & Huberman, 1994). These themes were then conceptually analysed through gendered discourses of CIT, with the focus on the ways in which students articulate viewpoints and aspirations that might reinforce and/or challenge traditional gender ideologies (Butler, 1990). An analysis of gendered discourses can yield deeper understandings of the ways in which boys and girls come to envision CIT careers as typical for 'people like me' (or not) and how students might be positioned (by themselves and by their perceptions of others, such as parents and teachers) in relation to gendered stereotypes of computing. It is important to note that there can be different (and competing) discourses (and understandings) embedded within the same issue (e.g. construction of CIT careers) and the discourses young people were able to produce through their talks can appear multiple and even contradictory. In fact, such apparent contradictions (e.g. discourses of CIT as 'for men' and 'for anyone') also illustrate the complexity within young people's constructions and interpretations of computing.

The educational and career aspirations of competent digital youths

A digital technology career is difficult to define because technology continues to redefine itself in light of progress and new developments. According to the US Bureau of Labor Statistics (2015), a career in computer and information technology (CIT) can be grouped under the following types of occupations: Computer and Information Research Scientists; Computer Network Architects; Computer Programmers; Computer Systems Analysts; Database Administrators; Information Security Analysts; Network and Computer Systems Administrators; Software Developers; Web Developers; and Computer Support Specialists. While these categories are useful to categorise professionals, it is perhaps too specific for most young people in terms of their career aspirations.

Among our digitally skilled youths, the vast majority (28 out of 32) had expressed aspirations for university education (in fact, three of our older participants are already in higher education). Two students were unsure, due to the cost, while another two students mentioned apprenticeships, both related to CIT. The most popular field of studies was in computer animation (n = 12, six boys, six girls), followed by computer science (n = 9, six boys, three girls), game design (n = 7, three boys, four girls), art (n = 7, four boys, three girls), engineering (n = 2, both boys), English (n = 1, girl) and language (n = 1, girl). Only a few students mentioned more than one field of potential study. Unsurprisingly, these educational aspirations also mirrored their career aspirations, even though a broader range of professions were mentioned[4]. It is worth reiterating that our students were attendees at a specialised computing summer school, designed to attract and support the interest of those in digital creation. As such, it is perhaps not a surprise to find computer animation and computer science to be the most popular educational and career choices.

Yet, these two career pathways are quite different, even though the use of digital technology is prominent in their respective works. As discussed below, we found it fruitful to tentatively separate CIT careers into two broad types: those that are predominantly technical and those driven by creative thinking and design. Here, we noted gendered discourses of, and aspirations in, CIT.

A gendered pathway into digital careers

As mentioned earlier, 'tech' professionals in major technology companies are overwhelmingly male and we find indications of such a pattern among our digitally skilled youths. Only two girls (of 14) mentioned an interest in computer science degrees. Indy (15-year-old girl) and Cindy (15-year-old girl) were both motivated by the high salary they anticipated in this field. By comparison, six boys (of 18) mentioned computer science degrees as a potential university route. In addition to high wages, these boys seem intrinsically interested in CIT. Below, we describe the gendered discourses of CIT as articulated by digitally skilled youths and we explore why some CIT careers, especially those that appear to be technically oriented, seem less attractive to girls.

Computing and information technology as 'for men'

It is concerning to report that gendered views of computing were still expressed by the majority of our digital youths, even though the use of digital technology is almost an everyday norm for most of these youngsters. When asked to comment on their views about computing stereotypes, most students (28 of 32) articulated gendered discourses of CIT as typically 'for men', which positions men as the rightful occupants in computing while women are considered less comfortable or interested in technology. For instance, Hayley (15-year-old girl) suggested that 'girls are worried about taking IT because it's considered a more manly subject'. According to Declan (16-year-old boy), 'when you think of people who do computing you always think of boys, and all the boys they like technology so you're always going to be around technology as a boy'. Girls, on the other hand, might 'go for something that's more girly, I don't know, a beautician or stuff like that' (Declan). As such, students such as Hayley and Declan view the dominance of men in CIT as normal or even natural, as computing and technology are considered to be more masculine.

Despite contemporary expectations and assumptions of better gender equality, many students, especially girls, accepted that the traditional role of girls continues to be a barrier for women, even in digital technology. Indy (15-year-old girl) acknowledged but questioned the view that 'girls should stay at home and cook, and be able to look after children, and stuff and boys go out and swing on trees and get maths jobs or accountants and do everything'. The masculinisation of computing as typically 'for men' appeared widespread as these gendered views seem to have been instilled since childhood, even though this generation of youths supposedly grew up with digital technology and a better awareness of gender equality. For girls to succeed, Crystal (17-year-old girl) was convinced that they 'need to work harder' than boys in male-dominated fields, such as in CIT. According to Jade (19-year-old girl), some girls avoided computing because 'they feel embarrassed to show other people that they're into it'. David (18-year-old boy) speculated that girls may be 'more conscious of their personas to the other people and want to be seen as feminine'. In other words, girls might find it more difficult to identify with computing because an identity in computing might challenge or be inconsistent with a female identity and what girls are typically expected to 'do' (West & Zimmerman, 1987). As such, gendered discourses could negatively influence girls' digital career aspirations, particularly those widely associated with masculine traits.

Some students also noted that peers and teachers can reinforce, or even govern, the type of activities in which different genders were expected to engage or develop an interest.

Jade (19-year-old girl) recalled that her interest in video games was ridiculed by her male friends, who claimed that 'girls can't be game designers … girls don't play video games'. Likewise, Owen (19-year-old boy) said that 'even at my school, one of the girls took computing and was really into gaming, and all the boys taunted the piss out of her'. In school, Jade remembered the dismissive attitude of her teacher, who 'just laughed at me' when 'I told her that I wanted to do computing'. Jade said that her teacher did not believe she could 'even lasted a week doing computing' but claimed that the subject was widely considered as 'difficult'. However, the perception of computing as difficult may also be gendered. Donna (17-year-old girl) felt that girls in computing can be undermined as they are perceived to be 'less skilful' by boys or even teachers. These views suggest that the experiences of girls in CIT can be unpleasant and undermined. Girls who participate in computing can be met with resistance, typically by males but also by females, following the heterosexual matrix and gender expectations (Butler, 1990). In other words, the social construction of CIT as a masculine field has caused the participation of girls in computing to be seen as a challenge to established gender roles (and possibly cultures/traditions), which, for some, are fiercely defended. As such, girls may be considered as less capable and suitable in CIT than boys.

Is the digital future looking better for girls?

Just under half of our students (14 out of 32) expressed egalitarian views of CIT. That is, views of computing through the lens of meritocracy and equal opportunity. Yet, many of these students (12 out of 14) also expressed gendered views as discussed above. In other words, 12 students articulated competing discourses of CIT. On the one hand, they recognise differences and inequalities between the computing experiences of boys and girls. On the other hand, they also believed that success is possible for anyone who is intelligent or hard working. For instance, Hector (15-year-old boy) assumed that women were less interested in computing than men, due to traditional gender roles. However, he also stated that success in CIT 'just depends on ability. If a girl had a better ability than a guy, they're going to get more recognition and it doesn't really matter on gender.' While Hector appeared sympathetic and understanding about gendered barriers, he maintained that success in CIT is still dependent on ability and attitude, irrespective of gender.

Only two students, Jet (14-year-old boy) and Megan (15-year-old girl), expressed gender-equal views of computing without any acknowledgement, or acceptance, of inequalities between boys and girls. Jet drew on his own experiences, where 'I have a lot of friends that are girls and are … into computing'. He did not believe that gender 'really matters because I think anyone who's interested in [CIT] can work what they want'. For Jet, the balance of girls with a computing interest in his immediate environment might have offered him a different, albeit naive, view of CIT, where everyone is equal and unrestricted by social identities and embodiments. Megan, who aspired to work in digital translation, recalled that 'we've had lots of speakers come into our school, male and female, who work in technology'. Megan attends a girls-only school and a career or identity in CIT may be more intelligible for girls like her because her school seems to support and facilitate a learning environment where girls are encouraged to thrive in computing. Further research is merited.

A creative route into digital careers

As the influence of CIT continues to fuse into more professions, we might have reasons to be positive about the gender digital divide. As discussed below, digitally skilled youths, especially girls, were able to identify with CIT careers that are more oriented towards creativity. We suggest that these careers, which seem to prioritise creative minds as much as technical skills, offer digitally skilled youths a creative route into digital careers. Among our youths, we found that just over two-thirds (23 out of 32) had an interest in CIT careers that might be recognised as creatively oriented, namely in computer animation, game design and web design (see DCMS, 2016). While we acknowledge that these creative-oriented computing careers will demand certain technical know-how (i.e. they are not mutually exclusive), it is encouraging to note that students' views of these creative-oriented computing careers appear to attract little, if any, gendered views and discourses. We speculate that wider discourses and identities around creativity are less bounded by traditional gender stereotypes.

A curious and imaginative mind

Many digital youths reflected that their interests in computing may have developed from their other hobbies and pastimes, often through curiosity and a desire to reproduce or modify particular artefacts. Hayley (15-year-old girl) recollected that her interest in computer animation really started when 'I was watching a documentary once about the makings of *Monster, Inc*. It was really interesting and ever since then I was keen to learn about animation and computing and stuff like that.' For students such as Hayley, engagements in CIT can be bolstered by an interest or aspiration in computer animation.

Another popular field where students seem to be fascinated by the creative elements of computing is in game design, especially story development or character creation (Gee & Hayes, 2010). Like several other boys, Steven's (13-year-old boy) interest in game design emerged through his regular engagement with computer games. He explained that 'I got interested in computing whilst I was playing a lot of games … I just wanted to start making games, and that's how I got interested in computing'. A few girls, such as Andrea (17-year-old girl), were also interested in game design. She decided that 'wouldn't it be fun to make something that other people can enjoy' and began her journey in game design a year ago with an older male friend. Perhaps a coincidence (or not), two other girls with an explicit interest in gaming also made some references to male influences (Adya & Kaiser, 2005). Both Jade (19-year-old girl) and Jessica (18-year-old girl) cited their older brothers as the key personnel who introduced gaming into their lives. Without any sisters, Jade felt that she 'had to join in their kind of fun'. Nonetheless, the creative aspects of game design continue to fascinate these girls. Jessica 'love[s] how they can bring a story into a game and make you feel immersed in it and interacting … especially the games where you can change the ending'. While the role of gender influences in gaming may merit further investigation, it seems clear that many of our digitally skilled youths are mesmerised by digital careers that would allow them to unleash their creative thinking and ideas.

Creative first, technical second

As such, young people might be attracted to computing because of the possibilities that digital technology and software can add to their creative insights and outputs. In particular, the extensive (and sometimes exclusive) use of software in particular arts or design sub-disciplines may encourage a cohort of creative-oriented youths to master digital technology, develop digital creativity and produce digital creations. In other words, these students may be digitally skilled, but their priorities may not necessarily be about improving their technical abilities, but rather about applying their acquired digital skills and knowledge (e.g. of using specialised software or digital technologies) to be creative and productive.

For example, Claire (17-year-old girl) said that she 'like[s] fine art' and initially used 'traditional stuff', although now she 'mainly use[s] digital stuff because it's just easier and [requires] less resources'. While Claire acknowledged that 'computing is more technical', she believed that 'with things like [computer] animation it's really creative technology. It's quite attractive to people who do art mainly.' Likewise, Jade (19-year-old girl) clarified that 'I think because you're using the computers to do your work, that's a part of computing, but then what you're actually doing is [creative] animation'. For girls such as Claire and Jade, CIT appeared to have opened up new windows of opportunities for them to develop their creative interests in the digital realm (Sefton-Green & Brown, 2014). The emphasis on creativity before technicality appears to attract few, if any, of the gendered barriers as mentioned earlier for girls to participate in CIT. Being digitally creative is more accessible to girls than being digitally technical, which can attract traditional gender discourses. While the creative pathway into CIT could potentially address concerns regarding the gender digital divide, a second layer of gender divide within CIT might consequentially emerge (i.e. between technical and creative computing). For instance, Donna (17-year-old girl) confessed that she chose to study ICT rather than computing at A-level because the former 'were covering much more of my interest'. For youths such as Donna, especially girls, the subject ICT would offer students the opportunity to learn and master the functions of existing software, rather than the focus being on technical computing (e.g. programming).

It is important to stress that an interest in digital creativity is not limited to girls. A number of boys were also keen to focus on and develop their creative sides. Klopp (15-year-old boy) said that 'I am pretty much very interested in computing and such. Not so much in computer science; you could say more design bit, not the actual scripting and stuff.' Here, Klopp's computing interest seems to revolve around what he could potentially do with a particular software product. In other words, students are learning core technical skills through the pursuit of creative outputs.

Discussion and conclusion

While digitally skilled youths have expressed educational and career aspirations in computing and information technology, we found that few girls are interested in technical-oriented computing, which continues to attract gendered discourses of computing as 'for men'. By contrast, creative-oriented computing careers appeared popular for both girls and boys, which seem to attract few, if any, gender stereotypes. Indeed, many of our youths may have become digitally skilled as a result of their creative interest and determination, and may have mastered digital technologies and software in order to advance their digital creations. As

such, a creative route into computing may be a more viable option for those less interested in technical computing, especially girls (Doubé & Lang, 2012). Yet, it would be dangerous to assume that a focus on creative computing would eradicate concerns of digital gender inequality. If girls are only encouraged to pursue computing-related careers that prioritise creativity, we are at risk of reproducing a gender digital divide within CIT, as currently seen in major technology companies (e.g. Google and Twitter). As such, we revisit the emphasis of the new computing curriculum in England on technical abilities as well as the importance of more generic digital and software skills, which were part of the soon-to-be discontinued subject, ICT.

Broader gender discourses of computing

Computer scientists, and those who are tech savvy and competent, are often portrayed in the media as geeks (and typically male) who embody specific characteristics, such as cleverness and logical minds, but also stubbornness and even social ineptitude (e.g. Varma, 2007, 2010). These images help to reproduce computing as a predominantly male domain and reinforce the dominant gender paradigm (West & Zimmerman, 1987). Girls, as well as some boys, may experience more challenges, or find it less desirable, to identify or associate with CIT.

Yet, as technology continues to grow and immerse our everyday lives, perhaps the gendered discourses around technical computing, in particular, might eventually disappear. For instance, we have witnessed international efforts to promote coding for the general public. Backed by the tech industry, initiatives such as *Code Week* and *Hour of Code* now involve thousands of people across the world each year. In the US, a range of informal education programmes has also been set up with the aim to increase girls' interest in computing, from half-day workshops to summer camps (Ashcraft, Eger, & Friend, 2012). Christensen, Knezek, and Tyler-Wood (2014) found that the earlier young people, especially girls, participate in these intervention programmes, the more positive they are likely to be towards STEM. Similarly, the availability of role models, even in the form of online mentoring (Stoeger, Duan, Schirner, Greindl, & Ziegler, 2013), might help girls to build alternative or counter discourses around computing as typically 'for men'. In our study, girls such as Andrea, Jade and Jessica recalled that their particular interests in CIT (especially gaming) were initiated and encouraged by someone they personally knew, even though they happen to be male. Nonetheless, such forms of direct social capital (see Wong, 2016) could be a positive influence to support girls' engagement and identities in computing. However, it is important to note that while these additional supports can certainly improve the views and experiences of young people in computing, these activities and support are often self-selected and participants tend to be from more affluent backgrounds (Archer, Dawson, DeWitt, Seakins, & Wong, 2015). In other words, these opportunities may not be available, or constructed as possible or doable, for everyone.

Robertson (2013) reported, from an intervention which focuses on gaming as a way to facilitate computing interest, that this seems to work better for boys than for girls, even though Howland and Good (2015) found evidence that girls can write more complex programming scripts than boys when it comes to making computer games. DiSalvo, Guzdial, Bruckman, and McKlin (2014) also found that African-American boys who participated in a computing-related work placement often play down their participation in the presence of others, in order to 'save face' and to maintain a 'cool' identity in an apparent attempt

to avoid any identity stigmas or conflicts between their everyday identity and the identity discourses typically associated with computing enthusiasts. Furthermore, some girls (and boys) may be digitally skilled, but that does not mean they have career or educational aspirations towards CIT, as traditional gendered (as well as classed or racialised) discourses and identities could shape perceptions of the field as interesting but not for 'people like me'. It is important to emphasise that while our focus is on gender differences, digital experiences can also differ by other social variables, especially social class and ethnicity, and these variables can interact with gender in specific ways to generate unique (and often even more disadvantaged) experiences (Hill Collins, 2000). As discussed elsewhere (Wong, 2017), an identity in computing is highly exclusive, so much so that even digitally skilled youths may not consider themselves to be 'good enough' as a future CIT professional.

It has been suggested that girls tend to favour disciplines that appear more social or relevant in our everyday lives, even in the context of digital technology (Vekiri, 2013). Koppi, Sheard, Naghdy, Edwards, and Brookes (2010) found that female computing graduates were more concerned than their male counterparts about the development of interpersonal and people skills (see also Gee & Hayes, 2010). As such, an exclusive focus on technical contents may dissuade some girls from taking computing courses (perhaps even in compulsory schooling). For educators, this could imply that more attention should be devoted to the social elements of computing, beyond the transmission of technical skills that are normally expected. To break down gendered discourses of computing, Cheryan, Plaut, Davies, and Steele (2009) found that minor changes to the computer classroom can potentially reduce gender-stereotyped views. In their controlled study, the removal of objects that may be considered stereotypical of computer science (but also masculine), such as a *Star Trek* poster and video games, seemingly resulted in girls reporting a higher level of computing interest. Furthermore, it was suggested that the teaching strategy of paired programming (Liebenberg, Mentz, & Breed, 2012) can also function to support and improve the social skills of young people in computing studies. Same-sex pairs might also strengthen the identities of girls in computing through collaborative learning and peer support. A positive environment is, therefore, necessary as a means to promote a broader range of discourses of computing, beyond the heterosexual matrix of traditional gendered roles and expectations (Butler, 1990). As witnessed in Megan's interview, her attendance at a girls' only school seems to have supported her articulation of gender-neutral discourses of CIT. We call for more research into the role of single-sex schools in shaping young people's digital education and aspirations.

An inclusive curriculum: for everyone and for the specialist

While access to digital technology is increasingly driven at home, schools continue to provide a structured learning mechanism through the curriculum. If the government wishes to promote digital competency, perhaps we first need to clarify the purpose of the new computing curriculum. Are we trying to promote digitally literate citizens or are we trying to nurture the next generation of computer scientists, programmers or technology entrepreneurs? The aims of the new computing curriculum seem to satisfy the latter, with a heavy emphasis on technical skills, particularly coding (DfE, 2013).

In England, the provision of CIT was previously delegated to the subject ICT, where students learn and practise generic and transferable digital and software skills. By contrast,

the subject computing (e.g. at GCSE, which was reintroduced in 2012) was not considered to be widely offered by secondary schools, as qualified staff remain scarce (Royal Society, 2012) and the core subjects (i.e. science, mathematics and English) were often prioritised within limited resources. The overhaul of the national curriculum in 2014 has positioned computing as a replacement for ICT, with new computer science qualifications introduced whilst ICT qualifications will be phased out (DfE, 2015).

However, our findings lead us to assert that there is immense value in retaining (or even re-establishing) a less technical-oriented subject related to CIT, namely the soon-to-be decommissioned ICT, which supports broader digital and software skills that could encourage young people to use and excel for digital creative purposes. We are concerned that the new computing curriculum does not necessarily cater for those with an interest to learn about digital software (but not technical computing, such as programming), and who only wish to express, apply and demonstrate their creativity in the digital context. Indeed, there are wider concerns (see Creative Industries Federation, 2016) that changes in the English school league tables (i.e. EBacc[5]) have effectively reduced the value of subjects that actively promote art and creativity (which, as we have argued, includes ICT), whilst more technical subjects, such as computing, are being prioritised (Gibb, 2015). While the use of digital skills is expected to increase and advance in the foreseeable future, not everyone, even among the digitally skilled, would desire a career *in* CIT (Wong, 2017). Rather, as many students in our study suggest, these individuals might have career aspirations *from* CIT (see Wong, 2015). In other words, the mass appeal of specialised CIT careers is likely to be lower than the wider range of careers that make use of digital skills (Lasen, 2010), which might be a career *from* CIT. As such, we believe that the complete abolishment of ICT might deprive a cohort of youths who wish to develop their creativity using digital technology, but would probably avoid studying computing as a subject due to wider perceptions of it being a difficult (and highly masculinise) subject. Perhaps a reintroduction of a reformed version of ICT, which focuses on contemporary digital skills and software, might alleviate such a potential outcome.

An alternative proposition would be to ensure that the provision of digital application skills is shared across other established subjects (e.g. art, English, mathematics, music, science and so on). In this way, students are still given the opportunity to develop and be accustomed to a range of software and digital skills to contribute to their basket of transferable digital skills. In this scenario, it would be essential for key topics in computing studies, such as programming, to be firmly enforced and supported so that they become a normative and expected learning outcome for all students (across the different age groups) in a range of subjects (akin to the use of grammar rules in History; the application of mathematics in Geography; or a skill with sketching that could be used to illustrate a poem in English). If digital technology is increasingly central to our lives, then we should ensure that all young people and future citizens are equipped with the necessary digital skills to succeed (Ardies, De Maeyer, Gijbels, & Van Keulen, 2014). Perhaps a bolder suggestion would be to ensure that the study of computing is compulsory across all schools. Whilst this interpretation of the English computing curriculum is possible, it remains to be seen whether this becomes standard practice in schools that do not have to adhere to the national curriculum, such as academies and free schools.

In summary, the gender digital divide, even in aspirational terms, is a genuine concern as the career trajectories envisioned by our digitally skilled youths continue to reflect wider patterns of gender inequality.

Notes

1. General Certificate of Secondary Education (GCSE) is an academic qualification generally taken by students aged 14–16 in England.
2. A-level is an academic qualification typically taken by students aged 16–18 in England.
3. Not all students were offered computing at GCSE or A-level in their respective schools. We noted that 17 students (11 boys, 6 girls) have studied/are studying computing. The other 15 students (7 boys, 8 girls) did/are doing ICT.
4. These careers were mentioned 55 times by our 32 students, with computer animation (n = 15), programming (n = 7), art and design (n = 6), game design (n = 6), engineering (n = 4), film production (n = 4) and web design (n = 4) the most popular.
5. The Department for Education stated 'the English Baccalaureate (EBacc) is a school performance measure [on] how many pupils get a grade C or above in the core academic subjects [English, mathematics, history/geography, the sciences and a language] at key stage 4'.

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