'I'm good, but not that good': digitally-skilled young people's identity in computing

Wong, B. ORCID: https://orcid.org/0000-0002-7310-6418 (2017) 'I'm good, but not that good': digitally-skilled young people's identity in computing. Computer Science Education, 26 (4). pp. 299-317. ISSN 0899-3408 doi: 10.1080/08993408.2017.1292604 Available at https://centaur.reading.ac.uk/69978/

Published version at: http://dx.doi.org/10.1080/08993408.2017.1292604
To link to this article DOI: http://dx.doi.org/10.1080/08993408.2017.1292604

Publisher: Taylor & Francis

Computer Science Education

ISSN: 0899-3408 (Print) 1744-5175 (Online) Journal homepage: http://www.tandfonline.com/loi/ncse20

'I'm good, but not that good': digitally-skilled young people's identity in computing

Billy Wong

To cite this article: Billy Wong (2016) 'I'm good, but not that good': digitally-skilled young people's identity in computing, Computer Science Education, 26:4, 299-317, DOI: 10.1080/08993408.2017.1292604

To link to this article: http://dx.doi.org/10.1080/08993408.2017.1292604

COMPUTER SCIENCE EDUCATION, 2017
VOL. 26, NO. 4, 299–317
http://dx.doi.org/10.1080/08993408.2017.1292604

Routledge
Taylor & Francis Group

'I'm good, but not that good': digitally-skilled young people's identity in computing

Billy Wong

Institute of Education, University of Reading, Reading, UK

ABSTRACT

Computers and information technology are fast becoming a part of young people's everyday life. However, there remains a difference between the majority who can use computers and the minority who are computer scientists or professionals. Drawing on 32 semi-structured interviews with digitally skilled young people (aged 13–19), we explore their views and aspirations in computing, with a focus on the identities and discourses that these youngsters articulate in relation to this field. Our findings suggest that, even among digitally skilled young people, traditional identities of computing as people who are clever but antisocial still prevail, which can be unattractive for youths, especially girls. Digitally skilled youths identify with computing in different ways and for different reasons. Most enjoy *doing* computing but few aspired to *being* a computer person. Implications of our findings for computing education are discussed especially the continued need to broaden identities in computing, even for the digitally skilled.

ARTICLE HISTORY
Received 21 June 2016
Accepted 24 January 2017

KEYWORDS
Geek; identity; STEM; aspiration; computer stereotype

Introduction

More and more young people today grow up with digital technology, especially those born after the third millennia. Digital users continue to increase as technology progressively colonise our everyday lives (Ofcom, 2015). However, there remains a key difference between the majority of us who consume technology and the minority who are able to produce or create digital artefacts, especially as specialists (Gardner & Davis, 2013). In language and literature, professionals are often positively constructed in public discourse such as being highly creative or articulate. With digital skills, however, the computer expert seems to attract more dubious imageries. Although concerns about the digital divide, particularly in developed countries, have progressed from inequalities of access to disparities in digital skills (House of Commons, 2016; Van Deursen & Van Dijk, 2014), perceptions

CONTACT Billy Wong billywong6385@gmail.com

of the typical computer person, or expert, continue to project onto specific social characteristics and identities. In this paper, we focus on youths who grew up with technology, who are digitally skilled and the different ways in which they identify with computing and computing careers.

As often reproduced in popular media (e.g. the rejuvenated character *Q* in recent *James Bond* movies), computer experts are typically constructed as men who are extremely intelligent and geeky, but also socially awkward and even obsessive (Francis, 1994; Koch, Müller, & Sieverding, 2008; Varma, 2007). With the continuous increase in computer users, the perseverance of such a stereotype merits an updated investigation as this raises concerns of social equity. While young people are growing up with more digital technologies, we might assume that our future digital workforce, especially in computing, will be plentiful and unproblematic. Yet, popular stereotypes and identities of the computer person could potentially dissuade a pool of talents to view computing careers as potential future pathways.

In this paper, we draw on sociological theories of identity as a lens to interpret how young people identify with computing. In particular, we focus on digitally skilled youths and the ways in which they construct, negotiate and aspire towards a future in computing. We argue that even among digitally skilled users, identities in computing are situated within complex social and personal interactions and self-presentations. A computing identity can be difficult even for today's youths, including those are digitally skilled. Most students seem to enjoy *doing* computing, but few aspired to *being* a computer person. Without proactive interventions, a career in the field of computing could remain exclusive to specific individuals and remain inaccessible and unthinkable for many others, even among the digitally skilled in technologically advanced societies.

Computing and identity

Competent people in digital technology are often imagined through stereotypes that include characteristics of being smart and committed, but also lonely, stubborn and antisocial (Cohoon & Aspray, 2006; Margolis & Fisher, 2002). In Mercier, Barron and O'Connor's (2006) draw-a-computer-user test, most children constructed the computer expert as someone who is knowledgeable, dedicated and intrinsically interested. However, these individuals are also likely to be men with glasses. These views are similar to wider stereotypes of mathematicians (Mendick & Moreau, 2013) and scientists (Losh, 2010), who are often constructed and reinforced in popular media as male geeks. McArthur (2009) defined geek as the "one who becomes an expert on a topic by will and determination" (p. 62), while Ward (2014) reminded us that geeks are also typified as being "shy, or unattractive social outcasts, who often shun other people who do not share their stigmatised status" (p. 713).

The word geek has historically been applied in a derogatory way to label (male) experts who lacked social skills. While the terms geek, nerd and even hacker are sometimes used interchangeably, Varma (2007) explains that "a nerd is fascinated

by theoretical scientific knowledge and learning whereas a geek is more computer specific" (p. 360). In other words, the notion of geek somewhat presupposes a relationship with computers or technology. According to Varma (2007), "a hacker is able to gain access or 'hack' into a system through high intelligence and unexpected skills not possessed by geeks. Because hacking involves unauthorised computer access to other systems, it is considered illegal" (p. 360). Hackers are, therefore, an extreme version of computing enthusiasts, who have the ability to challenge or infiltrate existing digital structures and organisations (Halbert, 1997). As such, it is no surprise that computer experts might be labelled as geeks or perceived as possible hackers, even though Skibell (2002) argues that in reality, few computer hackers would have the necessary skills or desires to actually commit serious crimes.

An identity in computing, alongside the geek or hacker identity can be difficult for women (Ensmenger, 2012). Girls do engage with computers, but few consider it as a potential career (Leech, 2007). While employment statistics remain patchy, available data in 2015 from major technology companies, such as Google (18%), Apple (22%) and Twitter (10%), confirmed the underrepresentation of women in their "tech" workforce. These representations mirror the female undergraduate computer science population in the UK (17%, ECU, 2015). At A-level examination (typically aged 18), less than one in ten (9%) computing students were girls (JCQ, 2015). Perhaps it is no surprise then that there are few female role models in computing and information technology. Most famous or successful personnel are (White and privileged) men, such as Bill Gates, Steven Jobs, Larry Page and Mark Zuckerberg. Stereotypes of geeks and nerds are often reproduced in public and media discourses (Mendick & Francis, 2012). For example, Kendall (2011) presented an interesting analysis into the appearance of the technical support team in a large electronics store, which corresponds to the archetypal nerd image. In the university context, Varma (2007) argued that the discourse of complete dedication may be a prerequisite for successful students in computer science degrees. This would literally demand students to be "unmarried, without boyfriends or girlfriends, no children, jobs or outside interests" (p. 371). Here, total commitment and devotion, including personal lifestyle, are sometimes expected of and projected as, the making of "true" computer experts-to-be. Such an identity may be undesirable not only for women but also for men.

For example, DiSalvo, Guzdial, Bruckman, and McKlin (2014) 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. According to the authors, these boys, who are mostly working class, downplayed the technical element of the experience and referred to it as "just a job" to their peers and families in an apparent attempt to avoid any identity stigmas or conflicts between their everyday identity and the identity discourses typically associated with computing enthusiasts. More concerning, Mendick and Francis (2012) asserted that the geek subject position "operates a racist positioning via which Black bodies are constructed as too 'cool' and/or too

resistant and/or insufficiently intelligent to fit the label" (p. 20). In short, a computing or geek identity may be racialised, gendered and/or classed (DiSalvo et al., 2014; Ward, 2014; Warschauer, Knobel, & Stone, 2004).

In the educational context, the prominence of programming can be a concern for prospective computing students, especially for those who are less confident in the technical aspects. Kinnunen et al. (2016) reported that many college students seem to construct programming not only as the dominant but also as the *only* activity within a computer science degree. Similarly, Peters (2014) argued that such a narrow construction and perception of computer science could deter individuals who might feel alienated by the technical emphasis on programming. These authors assert that computer science degrees are often broader and includes "other technical skills, soft skills and the ever expanding role of CS [computer science] in society" (Kinnunen et al., 2016, p. 13). In recent times, the meaning of geek may have garnered a broader appeal (Mendick & Francis, 2012; Tocci, 2009), as exemplified in CBS's sitcom *The Big Bang Theory* and the emergence of "geek chic", which is defined as "the dress, appearance, and culture associated with computing and technology enthusiasts, regarded as stylish or fashionable" (Oxford Dictionaries, 2010). Maybe this cultural shift will encourage more young people today to develop an identity in computing.

This study draws on sociological theories of identity to provide a conceptual lens for understanding digitally skilled young people's identifications with and aspirations towards, computing. Identity is conceptualised as fluid, relational, "always in process" and entangled within complex relations of power (Hall, 1990). Identity can be thought of as a continuous project of social constructions, constituting an ongoing process of negotiation within multifaceted structural and agentic relationships (Butler, 1990). In other words, young people's social identities are produced within or in negotiations with dominant identity discourses. Similarly, Goode (2010) considered how our individual experiences can lead to the formation of our "technology identity" and how holding or not holding, a technology identity *can impact* an individual's ongoing endeavours' (p. 501, *emphasis added*). In her case study of three university students, Goode documented the different pathways of these individuals in their development of an identity in technology. With an emphasis that our identities and experiences are culturally situated, Goode concluded that holding a particular technology identity can create both academic opportunities and obstacles for students. As such, if computing professionals are widely recognised and advertised as people who are innately clever, committed and analytical, then individuals without these characteristics (as perceived by self or by others) are likely to struggle or find it more difficult to adopt and pass off such an identity (Peters, 2014; Varma, 2007, 2010). Furthermore, the ways in which youngsters construct and identify with computing (and computing careers) are also be shaped by wider inequalities and expectations, such as gender, social class, "race"/ethnicity, family, peers, teachers and so on (Archer et al., 2010; Ashcraft & Ashcraft, 2015; Livingstone & Sefton-Green, 2016).

While interrelated, we consider digital/online identities (e.g. Buckingham, 2008; Windley, 2005; Zhao, Grasmuck, & Martin, 2008) to be qualitatively different from technology or computing identities. Our focus on computing identity is more specific to the field of computing, either in education or occupation. As such, our identity lens is interested in young people's experiences of computing in school, as well as their aspirations towards computing careers. In this paper, the focus is on digitally skilled youths and their views of the computer person. Our focus is in the UK and this generation of young people would have grown up in a digitally connected world. More specifically, we explore how these young people construct the computer expert and examine the extent to which these perceptions influence their own aspirations towards computing and information technology. In other words, how do digitally skilled young people identify with computing? Are computing enthusiasts Othered? Is computing still exclusive?

The study

This paper draws on a qualitative study which explored the views and identities of 32 teenagers (aged 13–19) in relation to computing and digital technology. These young people are relatively diverse in terms of gender (18 boys and 14 girls), although the majority self-identified as being White British ($n = 22$) and were considered as "working class" ($n = 28$) according to parental education and occupation. While this data-set has limited some aspects of our discussions, especially by ethnic and social class differences, the dominance of White working class students in our study can also shed light on the experiences of this socially disadvantaged group (see Implications section). More importantly, these students are of particular interest because they are already digitally skilled and would be considered as high achievers based on their school grades, which include the study of computing or Information and Communications Technology (ICT). This study contributes to the computer education literature through a study of the computing aspirations of young people who are digitally skilled. Computing study tends to be more technical, especially the emphasis on programming skills, whereas ICT focuses more on the application of generic and transferable digital and software skills (DfE, 2015)

Participants were attendees of a fully funded computing summer school, which ran across two sites in England, UK. The summer school aims to provide young people with a platform to work digitally and creatively through the design and production of a computer animation clip. As such, the summer school supports students who are already interested (and most often, skilled) in digital media creation. It is important to take note that their views and aspirations towards computing and computing career are likely to be more positive than the average school student, which is a site for future research. Yet, as discussed later, the computing trajectories and identities of digitally skilled youths are not necessarily straightforward.

At the time of our data collection, the summer school received a large grant which covered students' cost of travel, accommodation and catering. This windfall

has enabled the summer school to run twice across two English cities; "Site A" has a very high population and is very cosmopolitan, while "Site B" has a medium population and is less culturally diverse. Although the summer school is free-of-charge at the point of delivery, the summer school was able to attract more students who would otherwise be reluctant to even apply due to the other costs such as transport and accommodation. All participants in both summer school sites were invited to take part in our research. The majority of students agreed to be interviewed (67% for Site A, $n = 22$; and 56% for Site B, $n = 10$), which resulted in 32 semi-structured interviews that averaged 45 min. Interviews were mostly conducted by the author, with support from another colleague (Peter Kemp); these were audio recorded and later transcribed verbatim, with student names anonymised. Participants were asked to talk about their views and experiences of computing in and out of school, including the role of peers, teachers and family members. Their views and aspirations in computing and technology were then probed in relation to identity discourses and stereotypes of the computer expert. For the presentation of data, ellipses were used for omitted text.

Data analysis is informed by a social constructionist perspective which understands social phenomena as socially constructed and discursively produced. Interview data were organised using *NVivo* and preliminary coded by emerging concepts as we move "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 concepts were mostly derived from the interview schedule, but additional themes also emerged, as discussed below, in relation to young people's self-identifications with computing. These themes were then conceptually analysed through identity discourses of computing, with the focus on the ways in which students' articulate viewpoints and aspirations that might reinforce and/or challenge their own identifications with computing. An analysis of the identity discourses can yield deeper understandings into the ways in which digitally skilled youths come to envision computing careers as typical for "people like me" (or not) and how students might be positioned (by themselves and by their perceptions of others) in relation to these popular stereotypes of computing. The findings below will first unveil the ways in which digitally skilled youths construct the computer person before we examine if and how these youths identify with computing.

Construction of the computer person

Despite the popularity of digital technology, our findings suggest that the computer person is still conceived as being different to the typical digital user, who might engage in internet browsing, social media, email and/or office productivity software. As discussed below, even among our digitally skilled youths, many are actively *doing* computing, but few appear to have aspirations about *being* a computer person. The computer person is constructed by digitally skilled young

people themselves through characteristics that seem to reflect popular stereotypes. Similar to Cohoon and Aspray (2006), when prompted to describe people with an interest in computing, most youths in our study articulated them as committed, analytical, clever but antisocial individuals. Beyond these popular attributes, some youngsters have also enunciated curiosity and creativity as important features of a computer person.

Commitment

Many students, such as Indy (15, girl), spoke of resilience as a key characteristic of their idealised computer enthusiast. She explained that "you have to be very perseverant because often stuff like … programming, when stuff doesn't work … you have to keep trying until you get it right … you have to be determined to finish your job and do it to a high standard'. Similarly, Jessica (18, girl) commented that "you can be the worst programmer but if you're dedicated, you learn from your mistake". According to David (18, boy),

> computers are notorious for going wrong. That happens a lot more, a lot of the time, and it depends on how willing, I think people are to take risks … I guess people who think more logically, tend to be able to help.

For students such as Indy, Jessica and David, a computer person is viewed as someone who is determined, logical and perhaps more risky or adventurous, characteristics which seem to align with traditional masculinity (Francis & Skelton, 2005).

Perhaps coincidental, it is only the boys in our study who have talked about the extra time they are prepared to commit in solving computing-related issues. Nick (16, boy) revealed that "when I was doing my *python* course work [in school] … I would go home … and just try to solve it". He said that "I would still be doing the same thing until I solved the problem", which reflects the trait of resilience commonly associated with a computing identity. By contrast, while Andrea (17, girl) described computing enthusiasts as "hard working and willing to work through the night", she admitted that "personally I can't work through the night … there's got to be a point where I stop and do something else". As such, an identity in computing appears to be beyond the presumed commitment she (and students like her) is prepared to allocate. That is, as Nick said, until the problem is solved.

Cleverness and geeky

Another key but expected characteristic articulated by young people is intelligence. Hector (15, boy) described computing enthusiasts as typically "quiet, analytical, thinking … really smart, generally wear glasses and are quite geeky". Similarly, Michelle (14, girl) reckoned that "they're all quite intelligent. I've never really met an unintelligent person that's into computers … they're like really clever, but geeky". When asked to explain what is meant by geeky, Miranda offered a

positive interpretation. She claimed that "I always thought of it as a good thing that meant you were really intelligent", although, as reported in existing literature (e.g. Varma, 2007), she also imagined that "people who work on computers have no social skills that they sit there in silence all day". Another student, David (18, boy) defined geek as "someone who is naturally more gifted and able to understand things better than others", even though he also included "people who have no life, sit behind a computer all day, probably wear glasses, probably don't sleep much, don't see daylight much". As such, despite widely considered as digitally talented, geeks are also tainted with specific, presumably undesirable, personalities.

While Megan (15, girl) agreed that "a geek is maybe someone that has is clever, that has a passion with something to do with technology", she also said that "they focus solely on that and they maybe don't have any other interests". In other words, geeks are viewed as committed individuals, but perhaps excessively. Indeed, Jet (14, boy) believes that the word geek is "negative and it's because people are trying to make fun of everyone". As such, a geek identity can also be experienced in a derogatory way. Furthermore, young people's construction of the computer person as being clever may also be gendered, as exemplified by Indy (15, girl), who claimed that computing enthusiasts "are men and that they're nerds". The conflation of men and nerds suggests that these characteristics are more typical and expected of boys than it is for girls.

Individualistic and antisocial

The characteristics of being individualistic and antisocial are also mentioned by our digitally skilled youths in their constructions of the computer person, which aligns with popular media stereotypes. According to Abdullah (18, boy), computing enthusiasts "tend to be more antisocial to be honest … they don't talk to anyone, they just sit there". Similarly, Adam (18, boy) believes that computing professionals may be "isolated and being your own team to a project might lead to some social skills being not in use". Some students, such as Hayley (15, girl), also acknowledge that the characteristic of antisocial is also replicated "in all the movies, they'll be like the nerds and the geeks … they portray them as people with no social life, no friends". In a similar vein, Cindy (15, girl) recalled a personal experience when a film crew visited her school to record young people working in a computer lab. She noted that "they were only interested in the people that looked smart and had glasses … they didn't even ask if they were interested in computing, they were just like right you and you and you. There's a group who looked like real nerds in a way". From this example, we can see that stereotypes of the computer person are actively being reproduced and reinforced by the media.

Although Andrea (17, girl) is also familiar with media stereotypes of the computer person, where "the popular characters are always social and partying, and the nerds just sit there on their computers all day doing their own private thing", she defended that computing enthusiasts can also be sociable people who like

"talking to friends and doing anything any other normal person would do". Her deliberate reference to "normal person" is interesting here as she appears to recognise, acknowledge but also reject the dominant discourse of the computer person as antisocial. While the extent to which her views are widely shared by other digitally skilled young people is unclear, the availability of such identity discourse is noteworthy if we aspire to broaden the identity discourses in computing.

Curious and creative

Within digitally skilled young people's construction of the computer person, we also found evidence that being curious and creative are considered as key qualities of a computing enthusiast. For instance, Cindy (15, girl) describes the computer person as someone who always "want to find out more, like they'll ask a question and they'll just ask why", while Robert (18, boy) said that they tend to be "a bit more eager to try and tackle a thing, problem". Robert offered an example, of a doorbell and described how a computing person will "want to know how that doorbell works [and] want to try and see if I can make that doorbell", whereas "ordinary people would just look at a doorbell … press the doorbell and … [go] through the door". For students such as Cindy and Robert, curious people may be more adept in computing, which demands users "to really push themselves and see what they can create and what they can do" (Andrea 15, girl). According to Adam (18, boy), computer enthusiasts, such as himself, would be excited when they are "able to create something out of your own ability and seeing it work". As such, a computer person is viewed by some digitally skilled youths, as individuals who are inquisitive and imaginative. These views appear to offer a different perspective of computing enthusiasts, beyond the popular (and gendered) perceptions which tend to revolve around technical ability and personality traits.

Is computing for me?

Digitally skilled young people seem to construct people in computing as a "step up" from the casual everyday user as advanced digital users are expected to command significant knowledge skills and expertise. Our focus now is on the ways in which digitally skilled youth identify with computing. We begin, briefly, with the reasons young people have articulated in relation to why some people may be indifferent towards computing.

Perception of computing as difficult and "not for me"

A number of youngsters suggested that computing is difficult, at least the perception of it, to be the main reason for disengagement and/or non-participation. Hayley (15, girl) believes that "the people who are not interested in it don't understand it". Indy (15, girl) elaborates that it may be a confidence issue as computing is

"often viewed as straight hard because it's lots of unconventional naming systems and maths and things". Indeed, Klopp (15, boy) admitted that he did not choose to study computing for GCSE because "at the time, I thought it was kind of too complicated, because when I heard … computer science, I instantly thought of binary … and thought that that would be really, really hard. So I didn't choose that". Klopp ended up studying ICT, which tends to focus more on the use of application and productivity software (DfE, 2015). While Megan (15, girl) persevered with computing studies, she recalled that "everyone did say before I chose my option and after I chose my option, that computer science is really hard because you have to learn so much in a limited time". While difficulty is subjectively interpreted, it seems that the discourse of computing as a difficult subject is a widely shared discourse. According to Bob (15, boy), "some people are just afraid of the look of programming codes". He said that people can often "find it too complicated and really too afraid of the complexity of an end result over the simplicity of the processes". He disclosed that he could "write a script … make it twenty lines long and [people] would look at it and they would see complexity", but "if they actually looked into it, then they would know it's really simple to build".

For some students, the wider perception of computing as difficult can actually inspire them to thrive in this field. We mentioned earlier that a computing identity is often associated with intelligence, especially with reference to geeks. Keith (15, boy) said he is happy that his friends "describe me as a computer geek [and that] I kind of was [seen as] a genius at times because I sometimes take the extra step of learning". Bob (15, boy) said his nickname in school is "Hackaban" because he "got told off multiple times because the teachers are scared I'm hacking the computers because of that nickname". It is noted that the nickname "Hackerban" is a merger of the word hacker and a phonic reference to the participant's name. As far as we can tell, Bob's digital engagement is legitimate but what is more interesting is the imagined capabilities that others might perceive of him, due to his stated quicker understanding and navigation of how different software works, when compared to his peers or even teacher. Although some students, particularly boys, appear to thrive on such recognition, others were less optimistic about being labelled as a computing enthusiast (see Jet earlier).

Megan (15, girl) appears unsure about an identity in computing as she feels "I don't really fit that stereotype very much". She seems adamant that her engagement with computers is different from the stereotypical committed computer enthusiast and asserted that "I have a life … outside of computers". Similarly, Michelle (14, girl) said she "don't really want to be labelled" as a computer person because she could not identify herself with the dominant stereotype. Instead, both Megan and Michelle preferred the creative aspects of digital technology, such as the use of software to design and innovate.

Declan (16, boy) represents an interesting case as he admitted that "most people [in school] don't even know I'm really that into computers' because I don't really tell people that I'm into it". Perhaps Declan prefers to keep his interests to himself

but the denial of such interest in school to others might also suggest that a computing identity in school might be precarious. Indeed, some digitally skilled youths considered themselves as unusual when compared to their peers. For example, Nick (16, boy) believes he is "a little strange … a bit weird" because he has "been interested in computers for a long time". Likewise, Claire (17, girl) thinks that she has a "weird sense of humour" because her jokes are mostly "a mix of between talk and a bit of internet". In other words, an identity in computing seems to imply that individuals are somewhat different to the norm. If that is the case, do young people still want a career in computing?

Computing is masculine

Within the wider gendered discourses of computing (Varma, 2010), it is interesting to note that ongoing efforts to promote girls in science, technology, engineering and mathematics (STEM) may have enhanced the digital experiences of at least one of our female participants. Cindy (15, girl) recalled that her ICT teacher once said to her that "you're so lucky being a woman" as "people [and employers now] look for women, because they can bring to the table what men can't". While such views are probably well intended, the emphasis here on women can also infer that women's involvement only offer something that men cannot, but not necessarily the view that women can also contribute in the same way as men do (Mendick & Moreau, 2013). Further research is merited. In practice, Cindy said she was fully supported by her school as she managed to secure multiple and extended work placements around digital technology, perhaps easier and quicker than her boy counterparts. With a supportive school and teacher, girls such as Cindy appear to be in a stronger position to develop and consolidate an identity in computing.

Yet, the current landscape of the computing and technology industry is still heavily dominated by men. Andrea (17-year-old girl) stressed that "a lot of leaders of technology, the big voices, are males … that might take females away from it thinking that this is a thing that males should do. Maybe I shouldn't do it". Akin to a catch-22 situation, Andrea explained that "most people feel comfortable around their own gender" and "if more females were to do [computing], then a lot of other females would realise that both genders can do it". Until then, an identity in computing appears to be more difficult for girls.

Indecisive about computing careers

When asked if a computing career is desirable, many of our digitally skilled youths were unsure. Owen (19, boy) said "maybe. I can't say that yes or no", as with the many others who responded either "don't know" or "not sure". Some students reiterated that a computing career, such as a programmer, is hard. Claire (17, girl), for instance, said that "I don't think I'd be very good" working in computing because "I'm very clumsy". Likewise, Jade (19, girl) conceded that the job of a programmer,

for instance, would "put me off because I know I would get so frustrated", presumably in reference to tasks such as code testing and debugging. Just under a third of our students seemed optimistic about a computing career. Micky (16, boy) said that a programmer "is not my dream job but it's something that is very interesting". Another student, Declan (16, boy), said that a career in computing "would appeal to me but I wouldn't be able to just sit there programming all day. I'd need something on the side to do something". Here, the perception of non-stop programming may be off-putting for some of our digitally skilled youngsters. While a career *in* computing seem less attractive for most students, such as Owen (19, boy), who confirmed that "I don't want to be a programmer, but I want to be able to use code", it appears that careers *from* computing may have a broader appeal (see Wong, 2015). As such, a computing-related identity may be more intelligible for our digitally skilled youths than an identity in computing, which seems to be regarded as more restrictive. As discussed below, most of our youths enjoy *doing* computing, but few aspired to *being* a computer person.

"Doing" computing and "being" a computer person

We asked digitally skilled youths to describe their understanding of a computer person and we explored the ways in which young people negotiated and developed their identities in relation to computing. While we found that popular stereotypes of computing enthusiasts still persist, even among today's youths, we also unveiled that few youngsters, even if digitally skilled, felt competent enough to assume a computing identity and aspired to the identities of a computer person. In other words, we note a distinction between *doing* computing and *being* a computer person. In this section, we revisit the importance of social identity as a lens to understand young people's participation in computing, before we offer our recommendations in light of the findings.

We found evidence of a potential mismatch between the computing identities of digitally skilled youths and the assumed identities of computing professional. Young people, including the digitally skilled, seem to construct computing enthusiasts as people who are different from normal people and "not like us". Our youngsters typically fashioned the computer person as those who go beyond what is usually offered or available in school and who go on and advance their digital skills in their own time. For instance, individuals such as Klopp (15, boy) can self-exclude from the study of computing (e.g. at GCSE or A-level) due to perceptions that the subject might be too hard and difficult for them (see DeWitt, Archer, & Osborne, 2013 in the science education context). While in hindsight Klopp said he felt he could have excelled in computing with relative ease, the fact that he (and others like him who were interested in computing) initially doubted his ability suggests that an identity in computing may not be as widely available as we might expect, even though we are supposedly surrounded by digital technology, especially young people of today's generation.

This apparent lack of self-efficacy might also reflect the social locations of our students, who are mostly White working class. Unlike their middle-class counterparts, our students, while digitally skilled, are likely to have fewer resources or support to facilitate their learning or sense of entitlements (Lareau, 2003; Tondeur, Sinnaeve, van Houtte, & van Braak, 2010; Wainer, Vieira, & Melguizo, 2015). For instance, working-class students, such as those on "pupil premium" (an indicator of low family income), are proportionally underrepresented in the study of GCSE computing (in England, typically aged 16), as well as attaining lower grades than "non-pupil premium" students (Kemp, Wong, & Berry, 2016). While further research is merited, we speculate that an identity in computing might be perceived and even experienced as "out of reach" and not for "people like me", especially among White working-class girls when we consider the intersections of social class, ethnicity and gender together. Equally concerning, even competence in computing may not be sufficient enough for young people to pursue an identity in computing.

Young people's construction of a computing person seems to demand more than just digital skills. A computing identity seems to infer that individuals also possess a particular mindset and characteristics (e.g. being different, strange and antisocial). As such, an identity in computing may be infused with particular (but highly stereotyped) attributes and expectations. Thus, many of our young people foresee little similarities between themselves and the computer person they have articulated. Most students (e.g. Andrea) reckoned that, when compared to the archetypal computing enthusiast, they considered themselves as less extreme in terms of dedication and/or less knowledgeable in terms of digital skills (Margolis & Fisher, 2002). While we recognised our youths are digitally skilled, based on their school attainments or existing digital skills at least, we found that most of our youngsters do not actually consider themselves as "that good" in computing. These students seem to have avoided, whether by self or by others, an "authentic" identity in computing. Perhaps an "amateur" computing identity is more intelligible for most of our digital youths at this stage of their digital participation. As such, digitally skilled youths are generally happy to *do* computing, even though few appeared affirmative about *becoming* a computer person. In science and mathematics education research, a similar distinction has been made between young people who enjoy *doing* the subject (i.e. science and maths) but have little if any aspirations about *being* a scientist or mathematician (Archer et al., 2010; Mendick, 2005). Like our study, these researchers recognise the importance of social identity in young people's identifications with and aspirations towards STEM disciplines (Carlone & Johnson, 2007; Hatmaker, 2013; Mendick, 2005; Wong, 2016).

Some of our students (e.g. Declan, Megan and Michelle) appeared reluctant to be recognised as a computer person, which might be linked to the geek identity that is also typically embodied with computing (Varma, 2007). We speculate that some students may be conscious about the presentation of their selves to people around them and are concerned (or find it undesirable) that they may be associated with the stereotypical identities of a computer person or a geek. As such,

a computing identity is unintelligible for these students. While a clever or geek identity can actually be the reason for doing particular activities (e.g. a motivation to study advanced science, see Wong, 2012), we suspect it is the less desirable attributes (e.g. socially inept, stubbornness, attachment to the computer screen) that are often associated with computer enthusiasts that these youngsters are keen to avoid (Cohoon & Aspray, 2006).

Although the identity discourses of a computing person can be unattractive for some people, especially girls, it can also be seductive for a few others (e.g. Bob and Keith). These individuals seem to take pride in (and even feed off) the recognitions approved by others, such as peers and teachers, which is heightened by perceptions of their ability to engage in digital activities that are beyond the typical person, such as the "dark web" or "legally controversial"/illegal activities (Halbert, 1997). Such a deviant form of computing identity, especially as a hacker, may be reserved for specific individuals, particularly boys, as these values typically align with hegemonic masculinity (Connell, 1995). In other words, the prospect of breaking rules and being "bad" can be an attractive identity, especially for some boys. Furthermore, as hinted already, the surrounding environment (e.g. family, school and media) can also play a key role in the development of young people's identity in computing (Goode, 2010). We believe future research can explore the roles played by significant others in relation to the computing identities of contemporary youths (see Archer et al., 2012 in the science education context). Below, we focus on the practical implications of our findings.

Implications

The focus on identity has enabled us to affirm that little has changed in terms of the computing stereotype, which can perpetuate a form of social inequality in terms of computing identifications. Young people today, including the digitally skilled, continue to articulate a rather narrowed view of the computer person. There were, however, indications that computer enthusiasts are being thought of in broader (and less masculine) terms, especially through the attributes of creativity and curiosity. Although we discuss the importance of creative computing elsewhere, especially for girls (Wong & Kemp, under review), we believe educators and policy-makers could capitalise on young people's widening views and experiences of computing and the computer person.

In the classroom context, Mercier et al. (2006) suggested that students could be given "multiple, varied experiences with technology", which include the opportunity to be "both the teacher and the learner" (p. 344). By adopting different roles, youngsters could be an expert in one instance but a novice in another. Referring to the self-consciousness of some of our digitally skilled youths in relation to their digital ability, perhaps this role shifting approach could open up more perspectives around computing learning, especially in that a computing identity does not necessary mean that an individual has to understand and "know it all". In a

related vein, DiSalvo et al. (2014) advised that computing learning could be more flexible in terms of delivery and more receptive to outside or alternative cultures and identities. For instance, rather than to govern the rules of participations and interactions between students and computers, the computer classroom could operate in a more liberal way that respects students' own practices and engagement with digital technology. Here, the authors believed that by allowing young people to shape the design and ethos of their computing learning environment, students are more likely to be motivated and more open towards a computing identity. However, given boys are typically the dominant gender in computing studies (JCQ, 2015), if the computing learning environment is solely shaped by the participants (i.e. mostly boys), then this environment might be gendered and represent a "chilly climate" for many girls (Varma, 2007).

On the subject of gender, Leech (2007) spoke of the importance of female role models as a way for girls to have a visual presence in computing (see Andrea), even though such an effort must be complemented with classroom and pedagogical changes. To break down gendered identities of computing, Cheryan, Plaut, Davies and Steele (2009) reported that minor changes to the computer lab can potentially influence gender stereotyped views. For example, the removal of objects that may be considered stereotypical (but also masculine) of computer science, such as a *Star Trek* poster and videos games, seemingly resulted in girls to report a higher level of computing interest. As such, a positive and gender-neutral learning environment is important for girls to feel more at ease in computing. For educators, this could also infer more attention to be devoted to the social elements of computing, beyond the transmission of technical skills that are normally expected. For instance, in an action research, Margolis and Fisher (2002) introduced a preparatory course for a computer science programme and the aim was to give students, particularly girls, a broader view of (and a wider range of identities in) computing, such as its real-life applications and its interdisciplinarity. The authors explained that, in normal circumstances, students would instead be frontloaded with programming oriented contents, which might put off some students (Stoilescu & Egodawatte, 2010), including digitally skilled youths such as Declan and Jade in our own study. In these interventions, for instance, students are encouraged to focus beyond the speed of writing computer programs but to also appreciate the wider aspects of software design more generally (Klawe & Shneiderman, 2005). Similarly, Kinnunen et al. (2016) also suggested that in order to broaden the computing identities available to prospective students, computing courses could be more diverse in terms of content, such as a focus on business skills and acumen, rather than just technical programming. Furthermore, while we acknowledge and fully appreciate the good intentions of many individuals and organisations to promote coding for the general public, such as through *Code Week* and *Hour of Code*, we must be careful not to reinforce the dominant stereotype that computing is only about programming (Peters, 2014). Only then, we might expect students to articulate a broader range and understanding of computing identities.

To conclude, our study focused on digitally skilled youths and while we may have expected this cohort to identify with computing, what we found was a more complex relationship between *doing* computing and *being* a computing person. Only a few of our students, mostly boys, aspired to the narrow constructions of computer enthusiasts, while many others appeared troubled by the identity stereotypes that are still reproduced in popular culture. In particular, many felt that they are good with computers, but not good enough to be a computer person. Assumptions must not be made that our digital technology workforce is in plentiful supply just because more people are now digitally socialised and connected. The apparent exclusiveness of computing professionals begs the question of social equity and as such, more work is still needed to broaden and diversify the identities available to young people in computing, especially those who are digitally skilled.

Disclosure statement

No potential conflict of interest was reported by the author.

Notes on contributor

Billy Wong is a lecturer in widening participation at the University of Reading. His areas of research are educational identities and inequalities. He has published in sociology of education and science education journals. He is the author of Science education, career aspirations and minority ethnic students, a book published by Palgrave.

ORCID

Billy Wong http://orcid.org/0000-0002-7310-6418

References

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2010). "Doing" science versus "being" a scientist: Examining 10/11-year-old schoolchildren's constructions of science through the lens of identity. *Science Education, 94*, 617–639. doi:10.1002/sce.20399

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). Science aspirations and family habitus: How families shape children's engagement and identification with science. *American Educational Research Journal, 49*, 881–908. doi:10.3102/0002831211433290

Ashcraft, K. L., & Ashcraft, C. (2015). Breaking the "glass slipper": What diversity interventions can learn from the historical evolution of occupational identity in ICT and commercial aviation. In V. Schafer & B.G. Thierry (Eds.), *Connecting women* (pp. 137–155). Switzerland: Springer International Publishing.

Buckingham, D. (2008). *Youth, identity and digital media*. Cambridge, MA: MIT Press.

Butler, J. (1990). *Gender trouble*. New York, NY: Routledge.

Carlone, H. B., & Johnson, A. C. (2007). Understanding the science experiences of women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching, 44*, 1187–1218. doi:10.1002/tea.20237

Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: How stereotypical cues impact gender participation in computer science. *Journal of Personality and Social Psychology, 97*, 1045–1060. doi:10.1037/a0016239

Cohoon, J. M., & Aspray, W. (2006). *Women and information technology: Research on under representation*. Cambridge, MA: MIT Press.

Connell, R. W. (1995). *Masculinities*. Berkeley, CA: University of California Press.

DeWitt, J., Archer, L., & Osborne, J. (2013). Nerdy, brainy and normal: Children's and parents' constructions of those who are highly engaged with science. *Research in Science Education, 43*, 1455–1476. doi:10.1007/s11165-012-9315-0

DfE. (2015). *Further additional GCSE and A-level subject content consultation*. London: Department for Education.

Dictionaries, O. (2010). *Oxford dictionary of English*. Oxford: Oxford University Press.

DiSalvo, B., Guzdial, M., Bruckman, A., & McKlin, T. (2014). Saving face while geeking out: Video game testing as a justification for learning computer science. *Journal of the Learning, Sciences, 23*, 272–315. doi:10.1080/10508406.2014.893434

ECU. (2015). *Equality in higher education: Statistical report 2015 Part 2: Students*. London: Equality Challenge Unit.

Ensmenger, N. L. (2012). *The computer boys take over: Computers, programmers, and the politics of technical expertise*. Cambridge, MA: MIT Press.

Francis, F. J. (1994). The relationship between computer related attitudes and gender stereotyping of computer use. *Computers and Education, 22*, 283–289. doi:10.1016/0360-1315(94)90050-7

Francis, B., & Skelton, C. (2005). *Reassessing gender and achievement: Questioning contemporary key debates*. London: Routledge.

Gardner, H., & Davis, K. (2013). *The app generation: How today's youth navigate identity, intimacy, and imagination in a digital world*. New Haven, CT: Yale University Press.

Goode, J. (2010). The digital identity divide: How technology knowledge impacts college students. *New Media and Society, 12*, 497–513. doi:10.1177/1461444809343560

Halbert, D. (1997). Discourses of danger and the computer hacker. *The Information Society, 13*, 361–374. doi:10.1080/019722497129061

Hall, S. (1990). Cultural identity and diaspora. In J. Rutherford (Ed.), *Identity: Community, Culture, Difference* (pp. 222–237). London: Lawrence and Wishart.

Hatmaker, D. M. (2013). Engineering identity: Gender and professional identity negotiation among women engineers. *Gender, Work and Organization, 20*, 382–396. doi:10.1111/j.1468-0432.2012.00589.x

House of Commons. (2016). *Digital skills crisis*. London: House of Commons Science and Technology Committee.

JCQ. (2015). *Entry trends, gender and regional charts GCE 2015*. London: Joint Councils for Qualifications.

Kemp, P., Wong, B., & Berry, M. (2016). *The Roehampton computing education report: Data from 2015*. London: University of Roehampton.

Kendall, L. (2011). "White and nerdy": Computers, race, and the nerd stereotype. *The Journal of Popular Culture, 44*, 505–524. doi:10.1111/j.1540-5931.2011.00846.x

Kinnunen, P., Butler, M., Morgan, M., Nylen, A., Peters, A., Sinclair, J., … Pesonen, E. (2016). Understanding initial undergraduate expectations and identity in computing studies. *European Journal of Engineering Education*. Epub ahead of print 24 Feb 2016. doi: 10.1080/03043797.2016.1146233

Klawe, M., & Shneiderman, B. (2005). Crisis and opportunity in computer science. *Communications of the ACM, 48*, 27–28. doi:10.1145/1096000.1096024

Koch, S. C., Müller, S. M., & Sieverding, M. (2008). Women and computers. Effects of stereotype threat on attribution of failure. *Computers and Education, 51*, 1795–1803. doi:10.1016/j.compedu.2008.05.007

Lareau, A. (2003). *Unequal childhood*. Berkeley, CA: University of California Press.

Leech, R. (2007). Geek chic: Getting girls into it. *Teacher: The National Education Magazine*, 4–6, 8–10. URL: http://search.informit.com.au/documentSummary;dn=351119117602686;res=IELHSS

Livingstone, S., & Sefton-Green, J. (2016). *The class: Living and learning in the digital age*. New York, NY: New York University Press.

Losh, S. C. (2010). Stereotypes about scientists over time among US adults: 1983 and 2001. *Public Understanding of Science, 19*, 372–382. doi:10.1177/0963662508098576

Margolis, J., & Fisher, A. (2002). *Unlocking the clubhouse: Women in computing*. Cambridge, MA: MIT Press.

McArthur, J. A. (2009). Digital subculture: A geek meaning of style. *Journal of Communication Inquiry, 33*, 58–70. doi:10.1177/0196859908325676

Mendick, H. (2005). A beautiful myth? The gendering of being/doing "good at maths". *Gender and Education, 17*, 203–219. doi:10.1080/0954025042000301465

Mendick, H., & Francis, B. (2012). Boffin and geek identities: Abject or privileged? *Gender and Education, 24*, 15–24. doi:10.1080/09540253.2011.564575

Mendick, H., & Moreau, M. P. (2013). New media, old images: Constructing online representations of women and men in science, engineering and technology. *Gender and Education, 25*, 325–339. doi:10.1080/09540253.2012.740447

Mercier, E. M., Barron, B., & O'Connor, K. M. (2006). Images of self and others as computer users: The role of gender and experience. *Journal of Computer Assisted Learning, 22*, 335–348. doi:10.1111/j.1365-2729.2006.00182.x

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis*. Thousand Oaks, CA: Sage.

Ofcom. (2015). *Adults' media use and attitudes: Report 2015*. London: Office of Communication.

Peters, A. (2014). *The role of students' identity development in higher education in computing* (Licentiate thesis). Uppsala University, Uppsala.

Skibell, R. (2002). The myth of the computer hacker. *Information, Communication and Society, 5*, 336–356. doi:10.1080/13691180210159292a

Stoilescu, D., & Egodawatte, G. (2010). Gender differences in the use of computers, programming, and peer interactions in computer science classrooms. *Computer Science Education, 20*, 283–300. doi:10.1080/08993408.2010.527691

Tocci, J. (2009). *Geek cultures: Media and identity in the digital age* (Unpublished PhD thesis). Philadelphia: University of Pennsylvania.

Tondeur, J., Sinnaeve, I., van Houtte, M., & van Braak, J. (2010). ICT as cultural capital: The relationship between socioeconomic status and the computer-use profile of young people. *New Media & Society, 13*, 151–168. doi:10.1177/1461444810369245

Van Deursen, A. J. A. M. & Van Dijk, J. A. G. M. (2014). The digital divide shifts to differences in usage. *New Media and Society, 16*, 507–526. doi:10.1177/1461444813487959

Varma, R. (2007). Women in computing: The role of geek culture. *Science as Culture, 16*, 359–376. doi:10.1080/09505430701706707

Varma, R. (2010). Why so few women enroll in computing? Gender and ethnic differences in students' perception. *Computer Science Education, 20*, 301–316. doi:10.1080/08993408.2010.527697

Wainer, J., Vieira, P., & Melguizo, T. (2015). The association between having access to computers and Internet and educational achievement for primary students in Brazil. *Computers & Education, 80*, 68–76. doi:10.1016/j.compedu.2014.08.007

Ward, M. R. M. (2014). 'I'm a geek I am': Academic achievement and the performance of a studious working-class masculinity. *Gender and Education, 26*, 709–725. doi:10.1080/09540253.2014.953918.

Warschauer, M., Knobel, M., & Stone, L. (2004). Technology and equity in schooling: Deconstructing the digital divide. *Educational Policy, 18*, 562–588. doi:10.1177/0895904804266469

Windley, P. J. (2005). *Digital identity*. Sebastopol, CA: O'Reilly Media Inc.

Wong, B. (2012). Identifying with science: A case study of two 13 year-old British Asian "high achieving working class" schoolgirls. *International Journal of Science Education, 34*, 43–65. doi:10.1080/09500693.2010.551671

Wong, B. (2015). Careers "From" but not "in" science: Why are aspirations to be a scientist challenging for minority ethnic students? *Journal of Research in Science Teaching, 52*, 979–1002. doi:10.1002/tea.21231

Wong, B. (2016). *Science education, career aspirations and minority ethnic students*. Basingstoke: Palgrave MacMillan.

Wong, B., & Kemp, P. (under review). Technical boys and creative girls: The career aspirations of digitally-competent youths.

Zhao, S., Grasmuck, S., & Martin, J. (2008). Identity construction on Facebook: Digital empowerment in anchored relationships. *Computers in Human Behavior, 24*, 1816–1836. doi:10.1016/j.chb.2008.02.012