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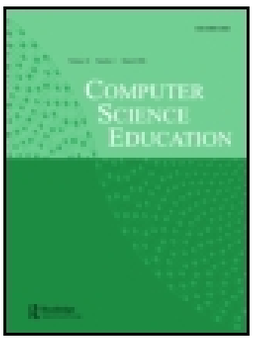

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What about the gatekeepers? School principals' and school guidance counsellors' attitudes towards computer science in secondary schools

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ABSTRACT

Background and Context: School principals and school guidance counsellors can be very influential in deciding what subjects are offered on the curriculum, how they are promoted and who they are targeted to. For that reason, exploring their views of Computer Science (CS) as a subject can help unearth potential barriers that may hinder the wider uptake of the subject in schools.

Objective: This study aimed to explore school principals and school guidance counsellors' views of CS as a subject at upper second level education in Ireland as part of the launch of a new subject.

Method: Using one-to-one semi-structured interviews, the study sought the views of a sample pf 10 school principals and 10 school guidance counsellors from secondary schools in Ireland that had recently introduced the subject of CS on the curriculum.

Findings: The study found contradictory views expressed, where the participants emphasised the value of the subject for all students, while at the same time presenting it as more suitable for certain types of students - highlight the tensions between the espoused values and the actual reality of practice.

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Computer science; computer science education in schools; school management; school principal; school guidance counsellor; secondary education

Introduction

There is growing recognition in education that the traditional scope of digital literacy is broadening (Røkenes & Krumsvik, 2014; Ferrari, 2012). Digital literacy for many schools was traditionally perceived as encompassing one's ability to use common application tools and have the ability to navigate the internet. As a result, schools have delivered ICT courses to students with this as the main focus (Bawden, 2001). These approaches have normally not included aspects such as coding or indeed an exploration of the ethical issues arising out of digital technology use. Yet as digital technologies play an ever-increasing role in our lives, what digital literacy now entails has broadened. Not only must students learn how to use digital technologies, but they must also have a strong foundation in cyber-ethics to safely and ethically utilise technologies and recognise both their positive and negative effects (Engen, 2019). Further still, as we live in a world where digital technologies play an increasingly important role in our lives, knowledge of aspects of

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coding and CS can no longer be seen as specialist areas of knowledge for a few but instead as important knowledge for all citizens.

Traditionally, coding and Computer Science (CS) have been seen as quite specialist areas of knowledge, and when implemented into schools as subjects, they have tended to be justified on the basis that they encourage students to consider undertaking further study in this area with a view to pursuing careers in the computer industry (Zimmerman, 2018). This rationale for their inclusion in schools has therefore been driven primarily by concerns about the economic competitiveness of countries and the need to supply the industry with an adequate supply of graduates to maintain growth in the sector (Tucker, 2003). Notwithstanding the importance of this rationale for the subject among those within the CS industry, such a narrow rationale, primarily based on human capital concerns, underestimates two important issues.

Firstly, justifying the subject on the grounds of its vocational relevance for attracting students to careers in the sector has not been very successful as the computer industry continues to experience a shortage of suitably qualified graduates (Ireland & Higher Education Authority, 2018).

Secondly, justifying the inclusion of CS on the curriculum based on the needs of the IT industry fails to recognise the growing need for all students to have a grounding in key concepts within CS and the wider educational value of studying the subject in terms of its ability to facilitate universal skills such as problem-solving and analytical skills. In order to move beyond this current emphasis towards greater uptake of the subject, there needs to be a reconceptualisation of the rationale for CS in schools. However, in order to pursue this, one firstly must explore how it is currently perceived, particularly by those outside of the traditional CS community.

On foot of this need, this study reports on a research study that interviewed both principals and school guidance counsellors (GCs) in schools where CS had been recently introduced as a subject on the school curriculum at upper secondary level. As a leader of a school, the school principal is highly influential in determining what subjects are offered in schools and as such it could be argued they act as the primary gatekeeper for subject access to schools. Therefore, their views of CS can be very influential in determining whether a school decides to offer the subject and why it is offered on the school's curriculum. The school GC is also very influential in relation to subject uptake as they are primarily responsible for providing career guidance to students and advising them on subjects they feel are suitable for students based on their career aspirations or interests. For that reason, the school GC can be very influential in directing students to study CS or indeed encouraging students not to opt for the subject (Smyth & Hannan, 2006). Given the critical role both of these "gatekeepers" play in the offering of the subject and its promotion within the school, this research therefore aimed to explore school principals' and school GCs' attitudes towards CS as a school subject and determine who they believe is suited to studying the subject.

Uncovering these views can help to identify the prevailing attitudes towards CS among these school managers and in particular help to identify the misunderstandings and biases, whether conscious or unconscious, that may negatively impact on students taking on the subject. It is only by identifying these attitudes can work be put in place to address them.

Literature review

There is a significant body of literature that has examined attitudes towards CS both specifically within schools and in society in general. These studies have mainly been driven by concerns about uptake of the subject and the subsequent impact on the supply of suitable applicants to university-level CS-related programmes.

Back in the mid-2000s, computing was declared to be in crisis and economic security was deemed to be under threat in many countries due to the shortfall of CS graduates compared to the number of job opportunities requiring high-level computing skills (Cassel et al., 2007). In their research, the authors outlined a number of factors attributed to the decline in student interest in CS. During this period, there was a call within the community to address this crisis by encouraging ICT companies to adopt media campaigns to change the image of the computing profession (Klawe, 2005). A number of non-industry initiatives emerged such as the promotion of computing education in high schools by the CS Teachers Association (CSTA), development of informational brochures by the ACM Education board and development of Java introduction course teaching materials by the Java Task Force. However, despite these and initiatives pioneered within institutions, the problems still persisted mid-2000. At the beginning of the 2000s, industry was still concerned about the lack of availability of STEM workers (Langdon et al., 2011). This has led to significant research efforts around the perceptions of CS.

As well as the concerns about the general uptake of CS, there has also been a concern about the under-representation of particular student groups and the area of CS has proved to be a one of the most trying areas in terms of expanding student diversity. Many of the initiatives that have attempted to widen the participation and provide greater access to STEM areas have largely failed. As CS is still a very new and a novel subject area in the secondary school domain, much of the related research relates to CS courses at third-level, but some early international statistics suggest that similar pictures are beginning to emerge in the secondary school education sector in relation to uptake. For example, the American "Program Participation and Performance Data statistics" showed that in 2014, of the CS test takers, only 3.9% were African-American and 8.8% were Hispanic, with dramatically lower pass rates for both African-American (33.4%) and Hispanic (39.2%) students when compared to the overall pass rate of 70.3% (College Board 2014). This is mirrored at third-level in the US where only 11.4% of CS degrees were awarded to African-American students and 8.5% awarded to Hispanic students in 2012 (NCES 2012). This is in spite of research that shows that innovative organizations, such as the digital technology sector, that employ a racially diverse workforce, tend to perform better when compared to other companies (Richard et al., 2003). This discrepancy does not reflect an issue of ability. Instead, as Carter (2006) points out, it reflects the fact that students do not choose CS because of an incorrect perception of the field of CS.

The relatively low level of female[1] participation in the subject is another very active area of research and concern. The significant body of research in this area reflects the wider concerns about the lack of female participation in STEM subjects in general (Krieger et al., 2015). A study conducted by Moorman and Johnson (2003) concluded that despite a strong aptitude for studying CS and mathematics, female students undervalued their skills compared to their male counterparts. The authors recommended the use of female role models and single gender classes to address the perceptions of CS as a male field.

Other studies (Hur et al., 2017) have recommended providing CS programming experiences in K-12 classrooms with the goal of boosting girls' confidence and interest in CS. Fisher and Margolis (2002) conducted a study to understand experiences of women and men enrolled in CS undergraduate programs in Carnegie Mellon University in the US with the goal of increasing female representation. Their study made a number of recommendations including the adjustment of curriculum to meet the needs of inexperienced students, the need to appreciate motivational differences, the importance of making an effort in all areas of teaching to include "outsiders" and the need to be persistent in attempts to make systematic changes.

Some of the research exploring the issue of female participation considers biological differences and preferences that are associated with gender preferences and is speculative in nature suggesting that female students would do better with less of a focus on "gadgetry" and more of a focus on "mathematics" (Palma, 2001). Krieger et al. (2015) suggest that female students "tinker less, and do not consider themselves tinkerers" and as a result a redesigning of course materials for "tinkering" and "nontinkering" types is required. Whilst others exploring female participation place greater focus on environmental influences and suggest that social norms are a major contributing factor and that the "approach to engaging young women to take computing" is to provide and promote examples of successful female computer scientists (Black et al., 2011). The influence of social norms is supported by international evidence where data indicates that interest in CS by female students varies greatly depending between countries and their associated cultures. Through an analysis of international statistics of female participation in computing Galpin (2002) reported that there was a wide range in participation in computing by women, and that this was regardless of the geographical proximity of the countries as there was considerable variation in many countries in relative close proximity such as the members of the European Union. Accepting that social norms is a major factor leads to the question of how these are formed and what are the contributing factors that might be addressed to correct this social perception.

Although it is fair to say that the formation of a particular social norm is complex, there has been some research that points to some of the major contributing factors other than simply role models. De Lara and Liu (2016) research into identifying the key factors that affect women's interest in CS highlighted that the "parallel participation between home and schools is dramatically important for the reinforcement of self-confidence, which reflects on the women's self-efficacy" (p.15) and as a result is a major factor in adjusting the social norm.

Returning to the poor levels of uptake among students in general, many CS studies around perceptions of CS have found that despite the digital saturation of today's youth across nearly all demographic groups, students of color and females remain severely underrepresented in CS and the broader STEM domain, where large cohorts of the U.S. population, "including women and minorities such as African-Americans and Hispanic/Latinx, are under-represented in computationally-intensive STEM professions and in the higher education degree programs that train them" (Cao et al., 2020, p. 999). Therefore, as the review highlights, CS continues to carry stereotypical views and this is reflected in who is deemed suitable for the subject. For example, work by Wang et al. (2016) found 'narrow and stereotypical' perceptions of the subject amongst students, parents, principals and superintendents in a large survey study across the united states.

Therefore the "White, male, smart" stereotype appears to remain deeply embedded despite decades of attempts to address it.

This evidence indicates there needs to be a significant change in current approaches to address the poor uptake of the subject. Guzdial (2020) is proposing such a change. He admits that the goal of his research in the past, broadening participation in CS, was to get more women and underrepresented minorities into CS, but he is now learning that "our goal should be to change CS Education so that everyone is welcome and supported". We would agree with this sentiment and have found little evidence in the literature related to perceptions of CS of studies exploring the role of gatekeepers or school management within the high school/second-level educational system and the role it plays in influencing the perceptions of CS. While there is a body of research that indicates that school leadership is important in student learning (Fullan, 2007; Leithwood et al., 2004) and that career guidance counsellors can act as gatekeepers to different subjects, these studies have tended to explore the issue from the perspective of meritocratic versus egalitarian values and criteria (Stone, 1998; Yogev & Roditi, 1987). There is a dearth of research that explores this issue from the perspective of one's perceptions of a subject, particularly in the area of CS. Perceptions of subjects, and why they exist on the curriculum, among those in school management is however important. Fancsali et al. (2018), for example, found that among the schools in New York City's 32 community school districts there were diverse motives expressed for the introduction of CS into the schools. Similarly, research by Parker (2019) into supports and barriers to CS uptake in high schools in the state of Georgia in the US identified perceptions among students that CS was a difficult subject to learn. These perceptions of why the subject exists, and who it is suitable for, effect its uptake in schools. For example, Larke's (2019) research into the roll-out of CS in England found that existing teachers of digital skills acted as gatekeepers to block a CS curriculum that conflicted with their beliefs and values. Among those in influential positions in schools, such as the school principal and school guidance counsellor who frequently determine subject offerings in schools and determine the criteria for access to these subjects, such perceptions are even more important, particularly in widening participation and challenging existing stereotypes of the subject of CS. Despite their importance, there is limited research exploring school principals and career guidance counsellors' views of CS as a school subject and their roles as gatekeepers to subjects. It is with this in mind that this study is undertaken.

Context of the study

In 2017 the Department of Education and Skills in Ireland announced the introduction of a CS subject at upper secondary school level. Despite calls in Ireland for the introduction of CS as a subject in second-level education since the 1970s (see McGarr, 2009), there were no formal opportunities for students to engage in the study of CS up to that point. While earlier studies had been undertaken by the National Council for Curriculum and Assessment (NCCA) into the feasibility of introducing a subject over 20 years ago (O'Doherty et al., 2004), little progress was made in the intervening period as attention focused on efforts to integrate digital technologies as teaching and learning tools across the curriculum (McGarr & Johnston, 2019). During these years, exposure to CS-related activities were largely dependent on the interest and enthusiasm of teachers within

schools that offered optional experiences for interested students, either as part of introductory ICT classes or as extra-curricular activities outside the formal timetable. The first formal footing of a computer-science-based subject on the curriculum was the introduction of a short course in coding, introduced as part of reforms to the lower-secondary level curriculum. This initiative has been very successful with over 100 schools (of some 750 schools in total in the state) offering the subject since its initial launch in 2017.

The launch of a formal upper secondary level subject in CS came as part of the government's digital strategy for schools 2015–2020, where it committed to introducing a CS subject at upper secondary level in response to calls from the IT industry and third-level institutions. A scoping review was undertaken to explore the nature of provision of CS in other countries in advance of the establishment of the subject development group that oversaw the design of the syllabus. In Ireland, the NCCA, a statutory body charged with developing new curricula, commenced its work in early 2017. Curriculum development in Ireland is based on a partnership model where the NCCA establishes a subject design team consisting of representatives of the various stakeholder groups reflecting the make-up of the NCCA. These groups include representatives from business and industry, teacher unions, school management associations, representatives from the national parents' council as well as members from the Department of Education and Skills. Following the work of the subject development group, a new subject was introduced into schools in September 2018. In the initial 2 years, a group of 40 schools, representative of the range of schools in Ireland (including rural, urban, single sex and mixed, disadvantaged, management type and size) was selected to offer the programme. Since this initial roll-out in 2018 a further 52 schools have since joined the second phase of implementation representing over 10% of the total number of post-primary schools in the republic of Ireland. As part of the roll-out of the new subject, a comprehensive programme was established to provide professional development for the teachers. These teachers ranged in experience of teaching CS in schools but were mainly selected on the basis that they have previous experience of CS and had related qualifications.

Materials and methods

The data reported on here formed part of a wider 2-year study funded by Science Foundation Ireland (SFI) that tracked the implementation of the new subject in the 40 pilot schools. This larger study undertook a survey of all teachers in year one of the subject roll-out and in year two engaged in more in-depth qualitative case studies of a representative sample of 10 of the schools (25%). The school-based element of the study reported on here adopted a subjectivist epistemological stance located in the interpretivist paradigm with the goal of capturing the experience of the participants. As a result, the data collection was primarily focused on capturing the expressed views of the teachers, school principals and GCs through one-to-one semi-structured interviews which, while providing set guiding questions, also provided scope for the researcher to explore issues that arose in the interview. In each school the cooperating teacher, school principal and school GC were each interviewed separately. In addition, lessons were also observed and a sample of students also participated in group interviews. As this paper specifically examines the school managements' perspectives on the initiative, details of these specific interviews are the focus of this paper.

To achieve the representative sample of schools, the various defining characteristics of the 40 schools were firstly established and a purposeful sample of 10 schools was then selected to capture the various school types. This included schools with different management and patronage, schools of different enrollment numbers, single-sex and mixed schools, schools designated as economically disadvantaged and both rural and urban schools. This sample was drawn from a pool of 25 schools that had indicated a willingness to participate in the second stage of the study. The selected sample was then checked against the overall population of schools to ensure that all relevant dimensions were captured. In compliance with the ethical approval granted by the institution, each school was written to and provided with a detailed research information sheet and consent forms.

Once consent was granted, schools were contacted to arrange a suitable date to visit the site. The data collection normally took one school day, but in some cases a second visit was required to complete an interview or lesson observation that could not take place on the scheduled day. The first school visit was attended by the full research team of four members so that the interview protocols could be piloted and discussed before any subsequent visits were made to other schools. The other nine school visits (and all associated data collection) was undertaken by a full-time researcher employed on the project that had no connection to any of the schools.

The interviews with the school principals and GCs were conducted face-to-face with the researcher on the school site, normally in their offices. Prior to commencement of these interviews the purpose of the study was reiterated and the participants were invited to sign a form indicating their consent to participate and for the interview to be audio recorded. Interviews ranged in length from approximately 20 minutes to longer interviews of under one-hour. Questions to the principals included why their school became involved in the initiative and what type of student did they feel were attracted to the subject as well as questions related to how the subject was arranged in the school timetable and what subjects it competed against. The GCs questions sought their views of CS on the curriculum, the value the subject had for students, what type of student would they encourage to take on this subject and why and what was being done at a school level to encourage uptake.

On completion of the interviews, the audio recordings were analysed by the four members of the research team. A thematic analysis, guided by Braun and Clarke (2013) stages of thematic analysis, was employed to identify common themes emerging from the interviews. Identifying these themes was an iterative process involving the team members analysing the interviews, drawing out tentative themes before then discussing them with the wider research group. Through this iterative process, the key themes from the interviews were identified and these form the main headings of the subsequent findings section. While the research adopted an exploratory approach, at the latter stages of this process where the main themes were defined, the key issues that emerged resonated strongly with the issues identified in the existing literature. Many of the key opinions expressed aligned with what had been previously reported in studies dealing with existing perceptions of the subject.

Before presenting the findings, it is important to highlight the limitations of the study. Firstly, as with the roll-out of any new initiatives, there is the likelihood that schools will aim to present themselves in as good a light as possible, hence interpretations of

responses from the participants need to be cognisant of this. In addition, given the positivity surrounding the launch of the subject, the schools (and specifically management) may have been eager to parrot this positive discourse and not raise concerns or hesitations. That being said, the multiple data collection tools provided a level of triangulation in the study through the capturing of different perspectives from multiple actors in each site. Also, the number of schools participating in the study provided a range of different sites that enables the research team to examine the common issues emerging from quite different sites. This alleviated the potential of our interpretation to be influenced by any one or a small number of sites.

Results

Views of the school principal teachers

CS for a specific group

Subjects often exist on the curriculum to serve specific purposes. Some subjects are seen as critical in contributing to students' personal and social development whereas others are seen as important for career preparation. For that reason, subjects are often perceived as being in related clusters. How CS is perceived vis a vis other subjects can therefore significantly influence what "type" of subject it is, why it exists and what "type" of student it best serves. The analysis of the principal interviews indicated that it was perceived in different ways. Four of the principals associated it within the broader context of STEM subjects. When asked, for example, why it was introduced into the school, one principal commented that it was brought in to promote the STEM provision in the schools and specifically to encourage female students to take on STEM a subject. The subject's association with mathematics was the most dominant association in the interviews with six of the principals associating it with mathematics. The following justification from a principal in a small urban all-male school highlights the general cluster of subjects that it was associated with;

> We decided to take on the computer science due to our long tradition with the young scientist competition. Those students who enter that [the competition] usually have a strong focus on the Maths, Physics area. So we felt computer science would be very complimentary to that. (P7)

One principal justified this association by drawing on anecdotal evidence from the CS teacher in relation to the students "mathematical talent", while at the same time emphasising that it was available to all students;

> . . . from what I'm hearing . . . I suppose there seems to be students who have a mathematical talent, . . . from [the teacher's] experience talking to me now. It's open to everybody, you know, we haven't restricted anybody . . . (P4)

This quote highlights the implicit association with mathematical ability set within a wider rhetorical discourse that emphasises its offering to all students.

Two of the principals also associated the subject with traditional "practical" subjects. Within the Irish post-primary school context, there are a number of subjects that have their origins in the historical vocational school and traditionally existed to prepare students for craft and trade areas of employment. These subjects of Technology, Engineering and Architectural Technology (formerly known as Woodwork and

Metalwork) are workshop-based and involve a significant level of design and make activities. Because of their traditions, these subjects continue to be male dominated and also tend to be seen as subjects suited for less "academically able" students. For that reason, they have tended to attract students from more working-class backgrounds and lack the prestige and status of other subjects in schools. Associating the subjects with these types of subjects, can therefore have implications in relation to how they are seen and what students decide to opt for CS. The following quote from one principal highlights this "practical" association and its association as one suitable for boys;

> So, you know, so we've always had a strong emphasis on those practical subjects. And then I suppose maybe being a boys school, we found that the boys do very well in those kind of practical hands-on subjects, so that's why we would have been quite interested when the new computer science subject came on board, we were very happy to come into it [adopt it] (P3)

Another way in which the principals' views of the subject were evident was in how they justified it on the school curriculum, five of the principals saw the subject as being provided to help them transition to CS courses in third-level education and to help students progress to careers within the CS area, as the following quotes highlight;

> Computer science, we felt [it] was very beneficial towards third-level. (P9)

> You're not going to get all the kids [students]. Like all the kids aren't going to be computer scientists (P5)

> . . . we're very happy to have it in school. I think for girls, it's a huge opportunity for employment, going into college and that, you know, and there's so many opportunities with it, (P4)

CS for everyone

While the subject was associated with STEM, Mathematics and "practical subjects", the analysis of the interview transcripts indicated that five of the school principals mentioned the value of all students studying CS. One noted that it was part of being literate in a technological world, while others noted how the value of CS for all students was emphasised to all principals as part of the information sessions offered to the participating schools as part of the subject roll-out. While it is commendable and welcome that such views were expressed, only half of the principals expressed these views (and it may well be that some were simply repeating what they had heard in the information sessions provided to them). In addition, their comments suggested that, while they believed it should be offered to all students, they nonetheless also believed it was suited to particular students. The two interview excerpts below highlight this issue. In the first, the school principal suggests that the subject is more suited to more "academically capable" students, but the "weaker" students would get "something out of it". Similarly, in the second excerpt, while providing a very strong justification for the subject for all students, the principal nonetheless re-iterates negative stereotypes of "computer nerds" and "high-flying maths kids" suggesting that these views remain prominent;

> . . . I went to the in-service and the message was very clear to us as principals, that it [the CS subject] was for every type of student . . . that the weaker students could get something out of

> this as well as the very good student and I came back with that message to people, but I suppose there is just a nervousness until you work through it once. (P2)

> I was really clear about that from the very start that it's not about the geek. . . . this isn't about being exclusive because we're inclusive. That was important. Like I was really clear about that from the very start. This is not for the computer nerd or, pardon my language, but it's really for everyone, you know. . . . If you're the student who likes to work things out, solve problems, engage in problem solving, this program could be really for you, you know and wasn't kind of for the high-flying math kids or whatever they might be, really we wanted to open, we want to open it up to anybody really who's expressing an interest in it. (P6)

The beliefs that the subject should be offered to all, but was perhaps suitable to particular students, was perhaps the dominant opinion across the interviews. There was one school however that adopted a much more restrictive policy in their school. The school in question required all students to undertake an aptitude test to determine suitability for enrollment in the subject. This approach was defended by the principal who justified its use based on the CS teachers' views. That being said, they questioned this approach, highlighting the precedence set in this regard as such an approach was not used for other subject areas;

> all of the new Leaving Cert [upper secondary] computer science teachers believe that there should be an ability in this direction and kind of mandatory for them to get into a class. And of course, all principals are saying, well, we don't hold that kind of theory for any other subjects so we can't be that black and white (P8)

Therefore in general, the principals primarily associated the subject with existing STEM subjects, and while half expressed the view that it should be offered to all students, they nonetheless drew on common discourses associated with the subject being more suitable for more academically able students with mathematical aptitudes and that it was primarily justified in terms of the career opportunities it would open up for students. That being said, during the interviews two the principals commented that some students that they believed didn't necessarily fit the mold of a typically suitable student for the subject, were performing quite well in the subject, thus raising questions about the validity of the claims made by the principals during the interviews. In the two excerpts below the first principal's views of academic ability is challenged and in the second, while they expressed their surprise of some students that were performing well in the subject despite not fitting the "typical" CS student profile;

> I suppose, we'd be very conscious of who's going into the class . . . looking at their academic ability and that . . . [to] make sure, cause there's two students now who really floundered, you know, when they went in there first, but they said they seem to be getting grips of it. (P4)

> Some of the kids that have been involved [they] have discovered . . . it's not what they thought it was. And actually they're, they're quite good at it. So, there's those kids who I couldn't have said [would be good at it] . . . And then there's the ones you'd expect . . . [they] are slightly quirky . . . [they] have different ways of thinking . . . maybe sometimes quite introverted in a way or they're people who operate within the school and they're never going to be looking for too much attention or anything . . . (P5)

Views of the guidance counsellors

The views of the GCs reflected the opinions expressed by the principals in that there was a strong association of CS with existing technology subjects and with mathematics. Three GCs associated it with the existing technology and Engineering subjects with one teacher noting how it added another "layer" to this suite of subjects and another claimed that as a subject, "it actually goes on the same sort of lines" (GC02) as Engineering and Technology. Another GC reported that when giving a careers presentation to the students every year the subject "sits in with the technology subjects" (GC01).

One noted, when the subject of female participation was raised in the interview, how the subject could be used to promote greater female participation but it had not been attempted yet, as the following quote indicates;

> Yeah, we probably should look at that as well, just to promote some more promotion of girls in the STEM areas. I think that's an area that we could improve on, definitely, you know, just for the girls, in conjunction with like the, you know, the engineering department and the maths, just promote that like it is, it is something that maybe we should. (GC09)

In addition to its association with Technology subjects, it was also associated with Mathematics, again mirroring the views of the school principals. Three of the GCs made reference to having to be "strong" at mathematics to succeed in the subject. In the following interview excerpt, the GC tells about how their concern about a student's mathematical ability led them to contact the student's parents to get them to reconsider whether they should take on the CS subject. This highlights the very influential role of the GC in students' subject selection and the need to target this level of school management;

> There was one student that I was concerned about, I had looked through his report and his maths was a concern, but I rang [his mother] and just said, not that it's mathematically based, but just in terms of how that might [effect] him . . . (GC03)

There was one GC however that recognised that the association with Mathematics was inhibiting student update, noting that;

> . . . sometimes that can be kind of a fear for some of our students, you know, that they feel 'oh do I have to be a really strong honours math student to do computer science?'. (GC06)

In line with the principals' comments there was also evidence from three GCs interviews that CS was seen as a subject suited to specific students, particularly those that were more academically successful in schools. The following two interview excerpts highlight this leaning. In the first example, the GC reports that the 'traditional sort of Maths, Physics applied Maths' students (subjects that are held in high esteem and considered academically challenging subjects) were attracted to the subject. Similarly, in the second quote the GC, when explaining who is most suited to the subject, notes that it is "not for every student";

> . . . at the moment I'm seeing sort of a range of students who are applying for it, like the ones who are the traditional sort of maths, physics, applied maths, and then just people who are interested in computing and hardware and software generally . . . so a range I think. (GC09)

> . . . I do think it's not for every student. I would be concerned about some of the ones [students] who are actually taking it up who will struggle.Do you know that sort of way? (GC02)

While these views above indicate that the subject was seen as what could be argued as an intellectually challenging subject that was suited to more higher performing students that excelled in mathematics, when speaking about the value of the subject, seven of the GCs noted how it had universal benefits for students beyond careers specifically in the CS industry. Two GCs saw its function as providing students with an insight into CS so that they were better informed to make career decisions. One noted for example how it addressed the problem of students taking a "leap of faith" in selecting university courses;

> [the CS subject] bridges that gap for them. Rather than just going taking a bit of a leap of faith and doing a computer science course and they're not really too sure about what the content of it is so . . . I think it's great. (GC09)

Yet these views of the narrow vocational rationale for the subject were in the minority as the remaining GCs argued that its study had universal benefits. There were three main reasons put forward in their comments, the first was an acknowledgement that students were living in an increasingly technological world and that knowledge of CS would be of benefit. The second related to the increasing application of CS in all career areas, thus knowledge of CS would be beneficial regardless of one's specific career choice. Thirdly, the analytical and problem-solving skills acquired through their engagement with the subject were seen as important skills for all. The three quotes below reflect these three areas;

> Well, number one, they enjoy it. And number two, I suppose they are future-proofing themselves. You know, they have skills for the future. (GC02)

> . . . I think the skills that they're learning in computer science kind of gives them a really great platform for any career they are going to go into because of the way it's been delivered, you know (GC03)

> I think the skills acquired in any subject are translatable to lots of careers. . . . I think the skills, you know independent learning, critical thinking, problem solving, I think those are skills that come into every career. (GC10)

As the findings have highlighted, there was a high level of similarity between the two groups in terms of how they saw CS. In addition, while different views existed, the most notable feature of the interviews was the contradictory views expressed where the participants would emphasise the value of the subject for all students while at the same time presenting it as more suitable for certain types of students. This contradictory discourse may highlight the tensions between the espoused values and the actual reality of practice.

Discussion

As the findings have shown, there was a desire to categorise the subject in some way whether as a STEM subject, a mathematical-type subject or a "practical" subject. This desire to categorise could be seen as a natural human tendency to organise and position something new into existing taxonomies and understandings. Therefore, the identity of all subjects is not only shaped by what they are and what they contain, they are also shaped by the subjects that already exist. They may be seen as similar to existing subjects or quite different. To some extent, how the subject is seen in comparison to other subjects

can have a significant effect on how it is perceived. For example, being seen "like" other subjects may immediately associate it with prevailing stereotypes of these existing subjects. On the other hand, if it is seen as unlike existing subjects it provides an opportunity for the new subject to carve out its own identity free from prevailing stereotypes that may hinder uptake of the subject.

In Ireland, where CS has not existed as a subject up to this point, and therefore had no patterns of enrollment or perceptions in schools, it could be argued that there was an opportunity to reconceptualise what the subject was. The comments of the principals and GCs however appear to show that the wider societal perceptions of CS are already present. Further still, their comments highlight that it is being associated with particular subjects such as STEM, Mathematics and "Practical subjects" (which in Ireland has traditionally been vocationally orientated craft subjects). As a result, being associated with these existing subjects, they also inherit the gender stereotypes that exist within these subjects and, in the case of association with mathematics, inherit the perception that it is a "difficult" and intellectually challenging subject suitable for a niche cohort of students.

While the findings have shown that there was a view expressed by many of the participants that it should be seen as a subject suitable for all students, implicit beliefs shaped by prevailing norms can act as powerful influences that steer certain students to the subject whilst discouraging others. It begs the question as to how authentic is the discourse in relation to "CS for every student" that was expressed by some of the participants, particularly in light of the evidence that the overall uptake of the subject amongst girls (as one example) has been very low. The variety, and sometimes contradictory, views expressed by the participants largely reflects the many views that exist in relation to CS that dominate the wider societal discourse and hence these principals and GCs are parroting these views. For that reason, the views expressed in this study largely reflect the competing discourses in relation to CS in schools that are played out in the media. Concerns about adequate supply or graduates for the CS and wider STEM industries have driven much of the discourse in relation to justifying the inclusion of CS in schools. In contrast to these concerns about human capital, other discourses also exist that justify the study of CS in schools for social reasons (to ensure all students understanding the increasing power and influence of computer technology in our day-to-day lives), for educational reasons (to use CS as a vehicle to develop students logical thinking, analytical skills and problem-solving abilities) and for equality reasons (to ensure all students, particularly those from minority groups and female students that are underrepresented in CS, have access to the subject). This tangled ball of agendas is therefore reflected in the participants' views too.

As a newly established subject on the Irish second-level curriculum there is a commitment from the ministry to ensure that the launch of the subject is a success. This is evident in the funding and resources allocated to its roll-out in recent years, Further still, through the engagement of a wider group of stakeholders including subject associations, the CS industry and higher education, there is a concerted effort to increase uptake of the subject and ensure that it is successfully established as a subject in the coming years. However, if Ireland is to avoid the types of enrollment and uptake patterns evident in other countries, it will be important that perceptions and attitudes towards the subject that potentially inhibit uptake of it, not only among the general school-going population, but also within traditionally under-represented groups, are challenged.

To explore possible ways forward, we argue that the theory of social identity, a psychological theory linked to identity (Tajfel et al., 1971), can help raise awareness of different possible approaches to take to address the problem. According to the theory, identity is not just what one is but also what one is not. Therefore in describing who we are, we often also describe who we are not, thus distancing ourselves from some groups whilst aligning ourselves with others. Work by Tajfel and colleagues in this area also identified different ways in which people can address the issue of being associated with low-status groups (Turner et al., 1979). They argued that there are three approaches one can take. The first is *social mobility*, where one can leave the group they belong to and aspire to join (or be associated with) a higher status group. This form of social mobility can only be achieved however if one has the ability to achieve this. For example, one cannot change one's skin colour but could change their economic circumstances. The second approach is *social competition* where an individual or group will attempt to elevate the status of their own group by creating comparisons to other groups so as to reflect their group in a more positive light. The third approach is *social creativity*. This is where the individual or group members change or adapt particular negative attributes of their group and replace them with alternative attributes that are more favourable. This can also involve changing negative perceptions of some group attributes by reconceptualising the attribute in an alternative more positive way. Social Identity Theory has already been used by other researchers exploring female participation in STEM (see: Kelly et al., 2020; Kim et al., 2018).

While recognising that this is a theory within psychology, it nonetheless has value in looking at the challenge of promoting CS in schools as there is much in the theory of Social Identity that can help us to look at how to change the status of the subject and therefore increase potential student engagement. It could be argued that previous approaches to promoting CS have tended to focus on social mobility and social competition. For example, in relation to social mobility, it has been positioned in schools over several decades as being an academically demanding subject therefore positioned amongst more prestigious subjects on the curriculum as opposed to lower-status vocational and practical subjects (McGarr & Lynch, 2017). This however has had little benefits in uptake and has, arguably, alienated a significant proportion of the school-going population from considering it. There is also evidence that social competition has been employed where there has been attempts to compare it more favourably to other subjects, frequently on the basis that it leads to better career opportunities and salaries. Again, however, this does not appear to have had a significant effect. We argue that a social creativity approach, where the subject is reconceptualized in alternative ways that purposefully distances itself from its historical associations is the best way to address issues of perception. There are examples internationally where alternative approaches to the marketing and delivery of CS for students have achieved this. For example the Beauty and Joy of Computing[2] is designed to attract new students, particularly students underrepresented in computing "to the joys and life opportunities that come with programming and CS and to make rigorous CS accessible and enjoyable". The program authors (Harvey, 2012) attribute its success in attracting and retaining students to the social context that is included in the curriculum. Reconceptualising what CS is and associating it with previously unconsidered areas appears to have contributed to the success of the programme. Therefore, to address the negative stereotypes associated with the subject and to increase participation, the promotion of the subject needs to move away from the traditional approaches in the past and

reconceptualise what CS can be. Indeed, perhaps as the example from Harvey (2012) above highlights, even the use of the name is something that should be critically questioned.

Conclusions

This study explored principals' and GCs' views of CS in their schools as part of the roll-out of the subject. While all were committed to its successful roll-out in schools and made efforts to promote it, they nonetheless drew on traditional views of the subject that have not helped the wider uptake of the subject in other countries. CS is a new subject in Irish schools with no previous history, but despite this, traditional stereotypes of who is best suited to the subject were present. There are two main conclusions that can be drawn from this study, the first relates to the importance of school management in the promotion of the subject in schools and the need for future work to target this specific group of professionals as they can act as gatekeepers determining whether the subject is offered in the school and who it is offered to. Therefore, understanding their views of the subject is critical. The second main conclusion from this study relates to the need to radically change the way in which CS is being promoted in schools and employ more creative techniques to conceptualise how the subject is perceived, that everyone is welcomed and supported in CS, and ensuring that traditional perspectives are avoided. Without such attention it is likely that there will remain a "typical CS" cohort of students that will opt for the subject thus restricting a wider cohort of the school-going population benefitting from the opportunity of studying the subject.

Notes

1. We acknowledge the non-binary aspect of gender, the term "female" used throughout this paper refers to those assigned female at birth.
2. https://bjc.edc.org/

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