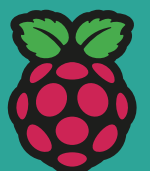


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Leonard, H. C., Kirby, D., Sentance, S., Chinaka, L., Deutsch, M., Dimitriadi, Y. and Goode, J. (2021). Localising culturally responsive computing teaching to an English context: developing teacher guidelines. In Understanding Computing Education (Vol 2): Equity, Diversity and Inclusion. Proceedings of the Raspberry Pi Foundation Research Seminars.

Available at: rpf.io/seminar-proceedings-vol-2



Localising culturally responsive computing teaching to an English context: developing teacher guidelines

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Abstract

This short report provides an overview of a project we undertook at the Raspberry Pi Foundation to develop a set of guidelines for computing teachers on culturally relevant and responsive computing teaching for an English context. We first provide an overview of the context and literature in the field, before describing the process of developing the guidelines with our working group. We then outline the next stages of development for this work.

Introduction

In England, there is a National Curriculum which ensures that all children have mandatory computing lessons between the ages of 5 and 16. Between 14 and 18, students can elect to take formal qualifications in computer science (CS). Despite all children having access to computing in school from an early age, those choosing to continue with formal qualifications in CS are mainly white and Chinese males, with other ethnic groups and

females underrepresented (Kemp et al., 2018). This is similar to patterns of participation in K-12 Computer Science in the United States (US; Gallup, 2020), where access to computing education is not mandatory and differs between states and local districts.

A lack of cultural relevance and responsiveness in the computing curriculum could contribute to the underrepresentation of young people from some minority ethnic backgrounds in formal computing qualifications in England, affecting the way that these young people engage with and learn the subject. Although the English population is majority White, there is a great deal of regional variation (Office for National Statistics, 2011). Ensuring that the curriculum is responsive to the diversity in the local community is therefore of great importance. This requires not only adapting the curriculum, teaching methods and materials to engage a broader range of students, but also developing teachers' understanding of the biases in current practices and helping them to work towards more equitable approaches to teaching computing (Goode et al., 2020a, 2020b). The next sections identify some of the theoretical frameworks

and research that form the basis of attempts to address these issues.

Theoretical frameworks

Cultural relevance and responsiveness in education are the focus of several key theoretical frameworks that have emerged in the US since the 1990s. Culturally Relevant Pedagogy (Ladson-Billings, 1995), Culturally Responsive Teaching (Gay, 2000), and Culturally Sustaining Pedagogy (Paris, 2012) all focus on the importance of allowing students from a range of backgrounds to express their cultures and identities through learning activities that are meaningful to them and that allow them to excel academically. They move away from “deficit thinking” (Yosso, 2005, p.75) in relation to students from minority groups, aiming to address the structural and personal biases in the education system that prevent these students from reaching their full potential.

Building on these frameworks, Scott and colleagues have developed Culturally Responsive Computing (CRC) to translate the tenets of these approaches into a computing-specific theory (Scott & White, 2013; Scott et al., 2015). CRC posits that technological and digital innovation is possible for all students and is in fact enhanced when students have opportunities to reflect on their own identities and cultures. Providing a learning context that supports this reflection encourages students to understand the current biases in technological development and to use technology in innovative ways to address issues that are meaningful to them and their communities (Scott et al., 2015). It promotes a critical engagement with technology and the digital world amongst all students, highlighting key issues of equity and social justice and identifying how digital innovation can help to address these issues (Madkins et al., 2020).

Implementing culturally responsive approaches in computing

Initiatives aiming to implement culturally responsive approaches have tended to focus on extracurricular activities (e.g. Scott & White, 2013; Scott et al., 2015), or have incorporated a short sequence of lessons into a formal education setting (e.g. Eglash et al., 2011; Babbit et al., 2015). It is often difficult to evaluate these interventions due to small sample sizes or because they are targeted at specific groups rather than being embedded within the wider curriculum for all students. The largest-scale development and implementation of a curriculum for formal K-12 education using culturally relevant and equity-focused approaches in the US is the Exploring Computer Science (ECS) course. It was initially developed for Los Angeles school districts and uses a student-centred and inquiry-led approach to computing topics that are relevant to the urban high school students for whom they are designed (Goode, 2010).

The curriculum has been evaluated in recent years across five different states (McGee et al., 2018; Ryoo, 2019; Qazi et al., 2020). These studies have reported improvements in student engagement with the computing curriculum and both their perceived and objective learning gains over the course. Importantly, a key predictor in these learning gains was teachers’ years of teaching the ECS curriculum (McGee et al., 2018). This may be due to increasing familiarity with the content, but is also likely to be related to the teachers developing understanding of the equity-focused principles underlying the curriculum and their ease in discussing complex and sensitive issues around race, bias and systemic barriers (Goode et al., 2020a, 2020b). The authors report changes in teachers’ attitudes and openness to discussion during professional development courses before and after teaching ECS for one year. This highlights the importance of supporting teachers in implementing culturally

responsive approaches in computing, which is central to the current experience report.

Supporting computing teachers

While the computing education community in the US has begun to focus efforts on developing culturally relevant, responsive and sustaining curricula for computing, the curriculum in England has not been derived from these principles. Across K-12 education, Newly Qualified Teachers (NQTs) consistently reveal relatively low confidence in teaching diverse groups of learners: in response to the question *“How good was your training in preparing you to teach learners from minority ethnic backgrounds?”* 51% of NQTs trained for primary and 56% trained for secondary teaching answered ‘good’ or ‘very good’ (Ginnis et al., 2018). In the Teachers’ Standards for England, language specifically related to ethnicity and race are not evident, referring instead to *“pupils of all backgrounds”* (p.10) and *“tolerance of those with different faiths and beliefs”* (p.14, Department for Education, 2011).

In this context, we aimed to develop guidelines for computing teachers in England that introduced culturally relevant and responsive theory and practice, and provided practical examples from local curricula that they could use in their own teaching. The intention was to draw attention to systemic injustices and biases in the ways that technology is designed and used, and also to encourage students to use technology to address issues that are meaningful and important to them and their communities. To achieve this aim, we put together a working group of computing education researchers from the US, Canada and the UK, along with UK-based computing teachers. The next sections outline the process and outcome of the work of this group to produce the final guidelines.

The working group

A mixed group of practising computing teachers, academics, and practitioners in the field of computing education was established. This included two academics working in primary and secondary computing education respectively, and two invited academics from the US and Canada bringing international experience. Seven teachers were recruited to the study through an open call on local teacher networks and social media. An honorarium was offered to all members of the working group to facilitate their participation.

Two meetings were convened for all working group members. Prior to the first meeting, all participants were given reading material and resources to inform the initial discussions. The first meeting focused on the development of an initial idea of criteria that would support teachers in evaluating learning materials to ensure that lessons took account of culturally relevant pedagogy. A series of whiteboard activities, and small and whole group discussions was planned to engage all teachers, with a variety of prompts and mechanisms for detailed and accurate capture of contributions (see Figure 1).

Between the two meetings, three of the authors revised the criteria to develop a broader set of guidelines, drawing in the perspectives presented in the meeting. These were iterated and circulated again for comment, and then iterated again. In the second meeting, the invited academics led group discussions around the iterations of the guidelines. Participants collectively revised the third version of the guidelines and also considered the ways in which we could understand and develop our notions of ‘culture’. All input was carefully captured in detail and represented in a fourth version of the guidelines. After the second meeting, these were again re-circulated and the final version developed.

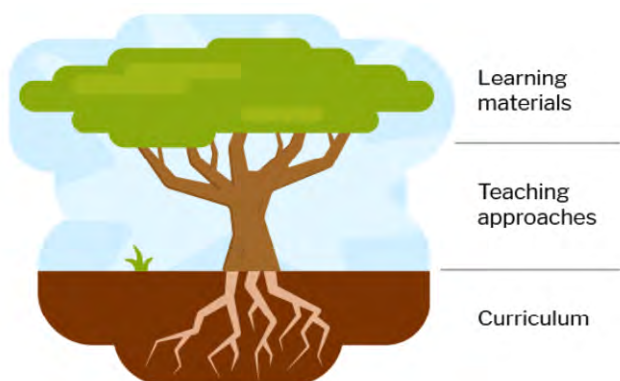


Figure 2. Teaching and curriculum design at three levels: curriculum (the roots), teaching approaches (the branches), and learning materials (the leaves).

The guidelines

The guidelines include a section on definitions (Table 1), followed by guidance under the three headings of curriculum, teaching approaches, and learning materials (Figure 2). The guidance also includes a discussion about issues facing computing teachers beyond their actual classroom practice and a set of resources for further reading. The resource can be [downloaded as a PDF](#)¹¹.

Curriculum

This includes the contexts in which computing concepts are taught, and how connections are made with issues that are meaningful to learners. The guidelines cover contextualisation and making connections. Examples of some of the prompts within this section are:

- How are computing topics discussed in relation to their social/historical/political context? For example, can you link the topic to pioneers of computing who have contributed to its development, or to current

social justice issues?

- To what extent are there any specific issues in your local community that you could use to give real-world context to classroom computing concepts?

Teaching approaches

Equitable teaching approaches such as open-ended, inquiry-led activities and discussion-based collaborative tasks are key to providing opportunities for all learners to express their ideas and their identities through computing. Here the guidelines focus on making content accessible and relevant to all learners and to help them to express their own cultures and identities, providing opportunities for open-ended or inquiry-led activities, and promoting collaborative and structured group discussion. Examples of some of the suggestions within this section are:

- Have you considered industry perspectives and provided opportunities to hear from a variety of people working in industry or a variety of other careers?
- How have you encouraged learners to consider multiple perspectives when solving a problem? This can be achieved by sharing their code or projects with the class to show alternative methods for achieving the same end point.

Learning materials

In terms of learning materials, the guidance focuses on inclusive representations of a range of cultures and ensuring the accessibility of the learning materials to ensure that all learners feel that computing is relevant to them. Here the guidelines focus on representation and accessibility in terms of the language, images, videos and examples being used. Examples of some of the prompts within this section are:

- Are the names of the people/places in

¹¹ <https://www.raspberrypi.org/blog/culturally-relevant-computing-curriculum-guidelines-for-teachers/>

examples representative of a range of ethnicities, genders, cultures, and countries?

- Do the videos or images have captions that could be translated into multiple languages, and are transcripts available for the videos?

context-specific elements developed in collaboration with teachers themselves.

Next steps

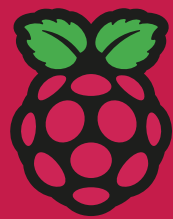
This report has described a small-scale project made possible by the SIGCSE Special Projects scheme¹². As well as providing a set of localised guidelines for a computing teaching community in an important area that has not previously been explored, we believe it will be useful for researchers and practitioners in other contexts to adapt this work for their own communities. We plan to engage with both teachers and learners to better understand how to implement culturally responsive computing teaching in the classroom, and to continue to develop the guidelines in line with our findings from this engagement.

A key component of successful implementation of culturally relevant pedagogy is raising teacher awareness and providing appropriate professional development to support teachers in understanding and delivering the approach in the classroom (Goode et al., 2020a, 2020b). Teachers need to be prepared to have complex and sensitive conversations with both colleagues and learners, and to acknowledge their own unconscious biases. This can be a difficult process, and is likely to require longer-term professional development: "A single 'equity' discussion is insufficient to surface more sophisticated and complex discussions." (Goode et al., 2000b, p.365). Teachers will need support in auditing their current teaching and identifying opportunities for incorporating culturally relevant pedagogy into their classrooms. Again, teachers' level of comfort in discussing and addressing issues is likely to differ between countries, and so we recommend that professional development and training should incorporate

¹² <https://sigcse.org/programs/special/2020.html>

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