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Accessible Computational Thinking in Elementary Science

Jeremy Bernier, Francheska Figueroa, Jesse Ha, Janice Mak, Man Su, Lin Yan, Brian Nelson
Arizona State University
jeremy.bernier@asu.edu, francheska.k.figueroa@asu.edu, jesseha@asu.edu, jmak4@asu.edu, mansu@asu.edu, lyan27@asu.edu, brian.nelson@asu.edu

Lautaro Cabrera, Kristina Kramarczuk, Yue Xin, Diane Jass Ketelhut, Ebony Terrell Shockley
University of Maryland
cabrera1@terpmail.umd.edu, kkramarc@umd.edu, yxin21@umd.edu, djk@umd.edu, eterrell@umd.edu

Abstract: Computational thinking (CT) is ubiquitous in modern science, yet rarely integrated at the elementary school level. Moreover, access to computer science education at the PK-12 level is inequitably distributed. We believe that access to CT must be available earlier and implemented with the support of an equitable pedagogical framework. Our poster will describe our Accessible Computational Thinking (ACT) research project exploring professional development with elementary teachers on integrating computational thinking with Culturally Responsive Teaching practices.

Computational thinking (CT) is ubiquitous in modern science, as scientists work with ever larger and more complicated data sets and turn to algorithms and computer programming to sort and analyze data more effectively (Restuccia et al., 2017). Despite its importance, the explicit teaching of CT and computer science concepts in PK-12 schools is typically only accessible through foundational computer programming classes that are not offered until high school and are offered in schools that primarily serve affluent students (Code.org et al., 2021). Meanwhile, research suggests that computing should be integrated into curricula earlier and more widely: elementary schools serve all students and so can be important spaces to increase student interest, identity, and capacity in computer science (Code.org et al., 2021). Given this and how integral CT is to modern science, we argue that CT should be integrated into elementary science education.

We believe that integrating CT into elementary science education requires attending to equity. White men are significantly overrepresented in most STEM fields, especially in computer science, engineering, and the natural sciences (Fry et al., 2021). This lack of diversity has consequences for scientific and societal progress; for example, the underrepresentation of women and Black, Latino/a/x, and Native American (BLNA) people in computing leads to the development of biased algorithms that reproduce societal inequities (Noble, 2018). Moreover, access to computer science education at the PK-12 level is inequitably distributed, with BLNA students and students who are eligible for the National School Lunch program having the lowest access to computer science courses (Simoni, et al., 2016).

Therefore, we believe that access to CT in science education must be available earlier, more broadly, and implemented with the support of a pedagogical framework specifically targeted towards equity. Various frameworks—such as Culturally Relevant Pedagogy (Ladson-Billings, 1995), Culturally Responsive Teaching (Gay, 2002), Culturally Sustaining Pedagogy (Alim et al., 2020), and Culturally Responsive Computing (Madkins et al., 2020)—can inform equity efforts in computer science education (Madkins et al., 2020). For our work, we are adopting the framework of Culturally Responsive Teaching (CRT) as articulated by Gay (2002). In brief, this approach involves teachers being involved in their student's communities and cultures, designing lessons that reflect diverse cultures, and valuing their different ways of knowing and being (Gay 2002).

For our NSF-funded Accessible Computational Thinking (ACT) project, we are designing and implementing a professional development (PD) program to support elementary educators in integrating CT into science lessons using CRT practices. We will be working with elementary teachers from schools in both the southwest and northeast of the United States which have significant populations of BLNA students. These teachers will participate in summer PD workshops on CT and CRT, during which they will adapt existing science lessons to integrate CT with CRT practices. Over the subsequent school year, we will support teachers in implementing CT-integrated science lessons with CRT practices. We will provide ongoing PD meetings and collect data through classroom observations, teacher interviews, and assessments.

The below two figures represent visuals presented on our poster. Figure 1 provides a conceptual depiction and Figure 2 provides a timeline of our project's first two years.

Figure 1
A Conceptual Diagram Relating Science, CT, and CRT for our project

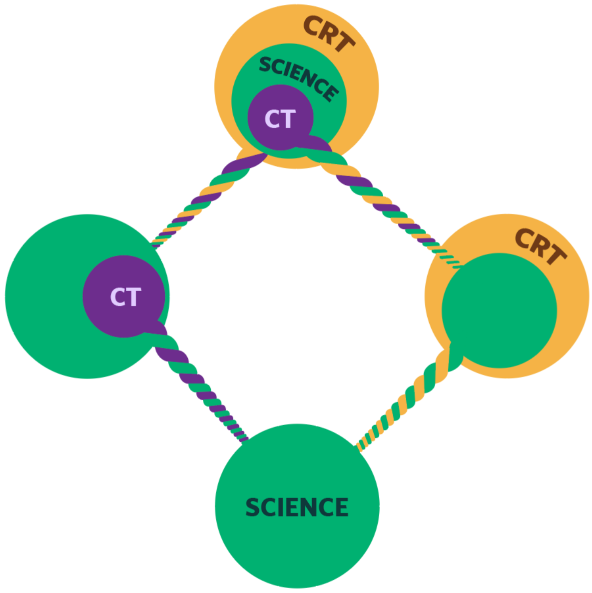
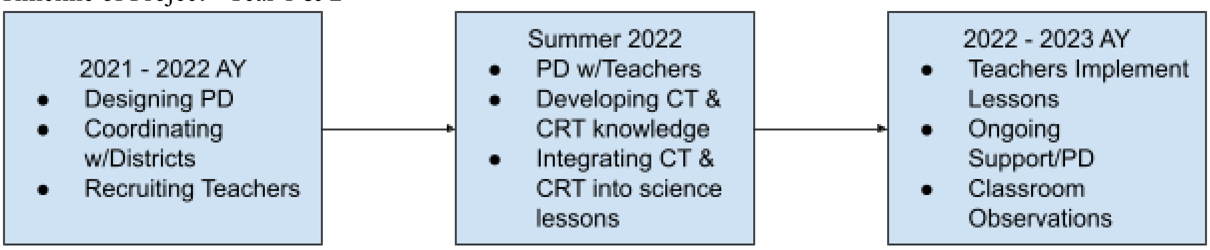


Figure 2
Timeline of Project - Year 1 & 2



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Acknowledgments

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