

Building Identity in Computer Science Education: A Research-Practice Partnership Approach to Empowering Appalachian Educators

Objectives/Purposes

Rapid technological advances, such as the increased integration of generative artificial intelligence, underscore the importance of computer science (CS) education. It is projected that by 2026 over 3.5 million jobs will be computing related in the United States (Computer Science Professional Development Guide, 2018, p. 3). Additionally, as of 2018, 58 percent of all new jobs in STEM were computing (Computer Science Professional Development Guide, 2018). Because of the growth of technological advances, it is not enough for students to simply be consumers of technology; they must understand how it works (Computer Science Professional Development Guide, 2018; State of CS Education Report, 2023).

Despite increased access to and discourse surrounding CS, disparities in participation still exist (Computer Science Professional Development Guide, 2018). Across the 35 states, only 5.8 percent of high school students are enrolled in a foundational CS course, while opportunities to quality CS are largely divided (Larsen et al., 2023; State of CS Education Report, 2023). These statistics demonstrate that disparities and underrepresentation in CS are influenced by more than access. Scott et al. (2015), asserted that disparities exist due to biases about who creates and who endures socially and culturally irrelevant curriculum. This assertion highlights the importance of early exposure to CS to counteract stereotypes about who can succeed in CS. When students are introduced to CS early on, it increases representation of diverse communities and contributes to a more equitable opportunity for access (State of CS Education Report, 2023).

Culturally Relevant and Responsive CS Education in Appalachia

Appalachian communities have historically lacked access to institutional safety nets and investment (Magill et al., 2021). Yet, the funds of knowledge (Moll et al., 1992) and rich cultural

practices shared with students by educators serve as “doors” that open up opportunities for students to acquire new understandings. Funds of knowledge found within Appalachian communities are not only beneficial when considering the new skills that accompany CS standards, they are crucial for supporting students’ understanding of their identities within CS. Therefore, it is necessary that educators are afforded the resources needed to advance meaningful and culturally relevant CS instruction.

Through community-engaged partnership we engage educators in Appalachian communities in building knowledge needed to implement culturally relevant CS practices. Educators' voices are elevated through engaged professional development (PD) and an expanding network of educators from across Appalachia that uses interdisciplinary and intersectional approaches to foster educator comfort and identity within CS. Additionally, Culturally Responsive Pedagogy (CRP) is utilized to address issues of practice for this region through means of storytelling (Lalik et al., 2003; Penuel et al., 2013). This approach empowers educators to enhance STEM access by providing opportunities that equip their community with skills to address locally relevant issues (Arnold et al., 2005; Harper et al., 2024).

The purpose of this study is to explore educator identity in the context of CS and will address two research questions:

1. How do educators view themselves in the context of computer science and STEM?
2. How do educators perceive and describe the relationship between computer science and STEM education in relation to their school, students, and local community, and what factors are identified as relevant to integrate CS into their pedagogy?

These questions will be answered through a qualitative thematic analysis of interviews and open-ended survey questions centered around teacher identity and CS learning. The educators engaged in a PD spanning across multiple months that implements a collaborative, educator-researcher-developed curriculum that focuses on integrating CS and literacy through storytelling. The PD seeks to center community knowledge and cultural practices while actively working towards solving problems of practice and addressing approaches of STEM and CS integration that have affected historically marginalized communities.

Perspectives/Framework

This project draws on principles of CRP, applying to this project through a multipronged approach that centers the cultural knowledge and practices of individuals and communities. This framework considers lived experiences and individual frames of reference in addition to cultural and community knowledge, thereby contributing to the cultural responsiveness needed to engage both students and educators in ongoing CS and STEM learning (Gay, 2010). CS learning becomes engaging to (and more representative of) all when it is presented in ways that make it relevant and applicable. When conducting research with teachers and their students from historically underrepresented communities, Ryoo (2019) found that “...key pedagogical practices that had [the] greatest impact on youth’s interest and engagement with [CS] included:

1. Demystifying CS by showing its connection to everyday life;
2. Addressing social issues impacting both CS and students’ communities’; and
3. Valuing students’ voices and perspectives” (p. 36).

These are all practices aligned with CRP's aim of critically analyzing and addressing the ways in which dominant knowledge systems have real-life consequences for communities that have been marginalized. To this end, the CRP framework is appropriate as this project builds on sociocultural perspectives and the cultural practice of voice and storytelling in Appalachia (Gutierrez & Rogoff, 2003; Nasir, 2012). Centering voice is epistemologically positioned within each phase of the project and reflected through educator, student, and researcher reflections. Further, Lalik et al. (2003) and Barajas-Lopez & Bang (2018) share that storytelling and centering voice and lived experiences of educators and their communities' positions individuals to produce collaboratively. The partnership honors the shifting voice of individuals and communities in relation to CS and STEM knowledge, to promote educators' identity and sense of belonging in CS.

Methods/Data Sources

Participants

This study included ($n=22$) K-12 educators across six large school districts. Participants enrolled in the professional learning sessions as part of the partnership. The participants taught varying subjects in urban, rural, and suburban communities. Pre-interview participants included nine educators, all but one participant completed a survey. Six participants self-identified as women, and two identified as men. All eight participants identified as White and native English-speaking individuals.

Data Sources

The primary data source utilized in this study were interviews, which were designed to gather detailed information about educators' identities and perceptions of their students and communities in relation to CS and computational thinking (CT). The educators were asked to

share their personal values and current understandings of CS and about their views on the relevance of CS to the lives of their students. The objective of the interviews was to obtain educators' perspectives on integrating CS into their teaching practices.

The surveys were employed as supplementary data sources, providing additional insights into the educators' perceptions regarding their own CS understanding and instruction. The survey questions sought to ascertain the educators' definitions of and confidence in teaching CS and CT concepts and how they wove them into literacy and other subject areas. Furthermore, the surveys gathered insight into educators' attitudes toward CS education, thereby providing a complementary qualitative data set alongside the findings from the interviews.

Procedures

Data collection is ongoing as part of a multi-month PL and community partnership. More specifically, qualitative thematic analysis (Neuendorf, 2018) was applied to two data sources: pre-PL interviews and open-ended survey data. Surveys were sent out to participants prior to the PL sessions in addition to the pre-interviews which were conducted over Zoom two weeks before the in-person PD sessions. Qualitative thematic analysis was conducted holistically by the research team using a data analysis application for coding, member checks occurred to ensure participants' validation of the collected data.

Data Analysis

Thematic analysis was applied to both data sources using a priori coding based on our research questions (Neuendorf, 2018; Saldaña, 2013). Through these analyses, we explored educators' perspectives on the value and importance of CS. This entailed gaining insight into their perceptions of the role of CS in the broader educational context and its potential impact on students' future prospects. Our analysis concentrated on educators' perceptions of integrated

teaching approaches, with a particular emphasis on the integration of CS concepts into other subject areas. In addition, we examined student and community interests that educators believe are relevant to CS instruction to ensure that CS education remains relevant and meaningful. This involved understanding the cultural, social, and economic contexts of the Appalachian communities and the influence of these factors on student engagement with CS. This multifaceted exploration was designed to understand the factors that influence educators' engagement in CS education in Appalachian communities.

A priori codes were utilized and modified throughout the coding process (Saldaña, 2013). After coding the data, the findings were grouped into categories to facilitate a deeper understanding and highlight the diverse perspectives and experiences of educators, contributing to an understanding of the challenges and opportunities facing CS education in Appalachian communities.

Findings

Preliminary findings from interviews and survey responses suggested several themes aligning with our inquiries examining educator identities. Themes were grouped into categories related to educators' understandings and valuations of CS, perceptions of themselves in the context of CS teaching and learning, as well as views of their students and communities in relation to CS. They included: value and importance of CS, teachers' roles in students' learning of CS, the relevance of CS, and CS as a vehicle for future success.

Participants' views of themselves in relation to CS and their competence in teaching CS concepts varied widely amongst the group, with some indicating high levels of confidence in teaching CS concepts, while others reported very little confidence. There were also varied perceptions of teachers' views of competencies in making CS learning meaningful based on

students' cultural backgrounds and identities. Nonetheless, many educators expressed a desire to learn more about CS and understand more about CT and interdisciplinary approaches to integrating CS. In particular, they spoke of their roles in students' learning of CS, describing their roles as helping and equipping students, "facilitat[ing] the learning," and "provid[ing] students with the access that they would not possibly have at their homes". Some also spoke of their roles as helping to "break barriers" that contribute to students believing they cannot be a CS person. In this way, participants expressed general interest in learning CS instructional strategies that they could use to enhance their instruction and increase their student's access to CS.

Participants' ideas of CS and CT varied; however, there was an overall understanding that CS involved using technology and computational processes. Participants viewed CS as important to their students and communities, describing it as a "needed and necessary" part of students' learning. Findings suggested that teachers held a shared view of CS in the context of their students' communities as a means of upward mobility, as there was overwhelming agreement amongst participants perceiving CS as a means of introducing students to new opportunities. Teachers also spoke of CS "as a way of the future" and as a vehicle for exposing students to different career options. Some also viewed CS as having the potential to alter students' futures in a positive way and provide them with a means of going beyond what might be expected of them career-wise within their communities. With analyses forthcoming, we seek to explore these and other themes more in-depth.

Significance

The scholarly significance of this work is understood through the perspectives of the community of educators engaging in CS PD and the potential to transform how we support teacher identity and self-comfort as they build implementation knowledge in CS. Traditionally,

CS education has been perceived as requiring specialized knowledge and skills, which often creates a barrier for educators who do not see themselves as "computer science person." This partnership fosters teacher identity in CS by providing ongoing PD and collaboration opportunities to help educators see themselves as capable CS instructors.

Additionally, teacher identity and knowledge of CS engages educators in CS and STEM work, expanding opportunities for their learning communities. Educators who are confident in their CS abilities are more likely to experiment with new teaching methods, integrate CS across the curriculum, and create engaging, real-world learning experiences for students. This shift in pedagogy is critical for preparing students to thrive in a technology-driven world and addressing the digital divide in marginalized communities.

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