Pre-Service Teachers' Perspectives on Computer Science Education Within an Equity-Oriented Teacher Education Program

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Abstract: This is a small-scale case study of pre-service teachers' perspectives on teaching and learning computer science (CS) after they participated in an equity-oriented teacher education program. We found that this program appeared to support pre-service teachers (PTs) in developing more expansive views on CS teaching and learning.

Introduction

In this paper, we consider pre-service teachers' views on computer science education in an after-school program for elementary students. As this was the first time incorporating new CS education tools into our program, we conducted an initial case study in order to understand: What were pre-service teachers' perspectives on teaching and learning CS after participating in this teacher education program? Our club, called EPIC, is focused on equity-oriented teacher education and providing culturally sustaining and disciplinarily-rich learning for elementary school children. The design of EPIC emphasizes working with children as partners and supports adults and children in working collaboratively on interest-driven and academically rigorous projects. We report findings from a small-scale case study, in which we analyzed interviews with participating pre-service teachers (PTs), focusing on their experiences teaching and learning CS and their ideas about CS education. Our analysis showed that PTs developed more expansive views on children's capabilities in CS and that their experience sparked new possibilities for CS pedagogies that can be more empowering for learners than approaches to CS education that are more often afforded to students from nondominant communities (Margolis et al., 2008).

Background

Researchers have made great strides in developing approaches to teaching CS through constructionist practices (Papert, 1980), including developing more interest-driven learning experiences that have the opportunity to better support culturally sustaining learning experiences for students from nondominant communities (e.g., Pinkard et al., 2017). Expansive learning opportunities around CS are not often afforded to students in equitable ways. In the US, white and/or wealthy students are more likely to be in schools that offer CS classes, even while students of color are more likely to be interested in learning CS (Google & Gallup, 2015). Even in schools that do offer CS, women and students of color are less likely to be perceived as capable in computing, and learning opportunities around CS education are often limited to "drill and kill" computing experiences (Margolis et al., 2008) or "Unplugged" experiences that do not involve actually programming computational technologies (Bell et al., 2009). Additionally, the question remains as to how computing can be integrated into elementary pre-service programs in line with practices that can advance equity.

Methods

This case study draws on interviews with four PTs who participated in EPIC. Of the fourteen university students who attended the club, we interviewed these four students because they intended to become teachers and were available for interviews. We understand that the small-scale nature of this research is a limitation, however in line with our social design experiment (Guitierrez & Jurow, 2016), we sought to understand PTs' experiences in our program as part of ongoing iterations of our program design to align with goals for more equitable and expansive learning. We analyzed data using an inductive approach (Strauss & Corbin, 1994).

Design and context

We incorporated CS education into an after-school club experience for pre-service elementary teachers and elementary students. Many of our university student participants intend to become teachers and generally tend to be white; the majority identify as women, coming from middle income backgrounds and being monolingual English speakers. Many elementary students (ages 8 to 11) who participate in the club identify as Mexican and speak varying levels of Spanish and English and many students come from families living in poverty. Our aims were to provide CS learning opportunities for children from historically underserved communities and to support PTs in approaching computing education with a focus on interest-driven learning and equity. We made

use of a new programmable technology called BBC micro:bit, a small programmable computer designed for young students with a block-based programming environment. The micro:bit is small, relatively inexpensive (USD $12), easy to integrate with the craft materials (e.g., paper, fabric, glue) that we already used at EPIC, and includes a variety of built-in sensors, a 5x5 pixel LED screen, and a built-in wireless (Bluetooth) radio.

Pre-service teacher perspectives on teaching and learning computing

Finding One. Pre-service teachers thought the children they engaged with at the club were capable, creative and talented in CS. Pre-service teachers made comments about their partners, such as: "they learned it pretty quickly," "they were so creative with their projects" and "they excelled at it." In the interviews, several of the PTs said they felt their elementary student partners often were the ones teaching them CS.

Finding Two. Pre-service teachers indicated that they felt the CS should be approached in a way that supports interest-driven and open-ended learning, and supports elementary students in participating in multiple, varied ways. For instance, one PT shared that she wanted her elementary partners to have creative freedom in their final CS project and her role was to support them in that endeavor. Another PT said that she wanted to keep the CS projects open-ended because students have different interests than one another and it is more meaningful for students to work on something that matters to them personally. One PT also commented, however, that she would have preferred more structure up front before diving into the open-ended projects.

Finding Three. Pre-service teachers had varying perspectives about the primary CS tool used at the club, the micro:bit. All of the PTs indicated that the micro:bit integrated well with the crafting and story-telling practices at the club, as with the goals of the club, including purpose-driven projects and relationship building. However, some PTs also shared that, by the end of the semester, some students lost interest in the micro:bit and that there was too much emphasis on this particular technology.

Discussion and tensions

Based on our small case study, we found that the PTs developed ideas for fostering more expansive CS learning opportunities with elementary students. Our data suggest that the PTs' asset-based views of children supported a move away from more hierarchical teacher-student relationships. PTs were grappling with the role of expertise in teaching CS, some simultaneously discussed a lack of expertise as an affordance for challenging such hierarchies *and* as a significant challenge for supporting their elementary partners in CS work. In future iterations, we have sought to help PTs develop greater expertise in CS while continuing to support them in seeing children as capable and creative with CS. Our interviews also helped us appreciate how these PTs were thinking about the potential educative value of children's ideas and experiences in relation to the disciplinary practices of CS. This perspective was in line with the design of our learning environment and our goals for supporting collaborative, interest-driven work. However, one PT's comment about wanting more structure early on raised a tension regarding what constitutes foundational CS learning for PTs, when to provide it and how. Relatedly, in regards to the use of the micro:bit, our intention was to support children and PTs in integrating the tool into their repertoire of tools for thinking and making. We did not want the tool to become the focal point of the program. As part of subsequent iterations of EPIC, we are working to offer a greater variety of tools to support CS work and position the micro:bit as one tool for supporting creative endeavors. As in any design work, we continue to reflect and revise our program to best meet our goals of supporting learning and equity.

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