Co-designing and Implementing Critical Computing Lesson Plans with K-12 Teachers

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Abstract

As demand for K-12 computer science (CS) education grows, we argue that most students would be best served by CS classes that not only teach computational thinking/programming, but also challenge them to critically analyze the role of technology in society. One of the main barriers to implementing this in K-12 classrooms is a lack of research on how in-service CS teachers can integrate critical pedagogy into their school context and existing curricula. This poster presents results from a study to co-design lessons with current K-12 CS teachers to integrate critical perspectives into their classrooms. Teacher participants participated in a synchronous professional learning series in which we taught them critical computing content drawn from relevant books and frameworks. Following this, we collaborated with the teacher participants to design or modify lessons that engage their students in critical analysis, which the participants then implemented in their classrooms. Teachers were encouraged to include content relevant to their students and the communities they are a part of. We conducted thematic analysis of transcripts from the interviews, professional learning series, and co-design sessions. The resulting eight (8) themes demonstrate the challenges and opportunities inherent in integrating critical perspectives into K-12 computing education. In the long term, results from this work will inform future sociocultural content integration into K-12 CS courses (e.g. "ethics content").

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1 Introduction

As computing wields increasing power in society, it has also caused greater harm and injustice at a greater scale than ever before possible. This reality has been recognized by a growing interdisciplinary community of scholars who use critical theory to analyze and critique the role of computing in society. Bias in algorithms has been shown to reproduce and reinforce racist and sexist discrimination [1, 11]. Privacy advocates have pointed to the growing surveillance state enabled by ubiquitous facial recognition systems [7]. Communities in the Global South have drawn comparisons to how digital technologies are extracting their labor and data are reproducing colonial power systems [6]. However, these critical perspectives are generally not reflected in the current curricula and pedagogy of computing education [9]. Instead, the field has rapidly expanded in both K-12 and higher education in reaction to an increase in demand for programming skills to fill jobs in the technology sector [12]. In higher education, computer science majors are among the least likely to be interested in justice [10]. In K-12 computing education, curricula have likewise focused on developing programming and computational thinking skills, in favor of engaging students in analyzing the role of computing in society [2, 3].

2 Study design

2.1 Co-design

This study addresses the gap in K-12 critical computing education lesson implementations by co-designing lesson plans with in-service K-12 computing teachers. In the context of design thinking, co-design is a process of collaborative design, involving a group of participants with different stakeholder identities [13]. For this study, we facilitated instructional co-design, which is a process in which research participants are actively engaged in designing and guiding the process for creating curriculum [5].

2.2 Research questions

The three research questions reflect the three stages of intervention and data collection. First, the group professional learning (PL) sessions serve both as a tool for capacity building and as a space for teacher participants to develop their identities as critical computing educators. Second, in the one-on-one co-design sessions, the teacher participants directly design and modify lesson plans for one of their courses, integrating the critical computing that they learned in the PL. Third, teachers implement their lesson plans and report the successes and challenges that they encountered.

(1) What kinds of identities as critical computing educators do K-12 computing teachers develop through a professional learning experience?
(2) How do K-12 computing teachers design and modify lesson plans to integrate critical computing?
(3) What successes and challenges do K-12 computing teachers encounter when implementing critical computing lessons in their classrooms?

To keep the scope of the study manageable and reduce barriers involved with collecting student data, we chose to focus on teachers'

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identity development and curriculum design practices, rather than student experiences.

3 Methods

3.1 Professional learning series

K-12 computing teachers were recruited for a professional learning (PL) series where they learned and discussed critical perspectives in computing. The professional development itself took place over three days. The first day focused on the role of computing in society and exploring examples of its benefits and harms. The second day defined critical theory and put it into context using critical race theory and critical pedagogy. The third day combined these topics by introducing critical computing education and providing examples of critical CS curriculum and lack thereof.

3.2 Individualized co-design sessions

Following the PL, we conducted co-design sessions with each of the teacher participants. These sessions were working meetings where we co-constructing lesson plans that integrate critical computing based on each teacher's individual teaching context (e.g. curriculum, student demographics).

Co-design methods have been used in education research for decades in various forms, including research-practice partnerships. They generally share several common characteristics: beginning the process with activities/lessons designed to build a common understanding of important concepts, designing based on teachers' specific teaching experience, and an open-ended design process that leaves room for revision [8]. The co-design process can at times be frustrating for teachers because it requires more exchange of ideas and has a murkier end state than a traditional PL where teachers are simply told to execute a concrete set of steps [4].

3.3 Data collection

Three different types of data were collected: interviews, audio/video recordings, and teacher artifacts. Interviews were conducted at three points: before the start of the PL, after the participants completed both the PL and their co-design session, and after implementing in their classroom. We have recordings of all synchronous sessions. Teacher artifacts include their responses to activities during the PL, drafts from the co-design session, and any updates they made to their lesson plan.

For RQ1, we seek to understand how teachers shape their identity as critical computing educators. Why do they think that it's important for their students to take on critical perspectives in the context of computing? We address RQ1 using data from the pre- and post-interviews as well as recordings of the PL sessions. The pre-interview orients us to the participant's teaching context and pedagogical philosophy, as well as collect formative data about their knowledge of computing in society and critical perspectives. The post-interview collected data about how their perspectives have changed over the PL sessions and about the co-design experience and generated artifact.

To answer RQ2, we collected data across the co-design process. This began with the recordings of the PL sessions. These were followed up with recordings of the individualized co-design sessions, where we led them in activities to design materials based on the ideas that they generated earlier, given their constraints and school environment. Additionally, their lesson plan design documents provide evidence of the ways in which participants design and modify lesson plans to integrate criticality.

Finally, we conducted interviews with each teacher just after they implemented their lesson plans. Our goal is to understand how their new lesson played out in reality, how the students reacted to it, what unforeseen challenges and successes happened, etc.

4 Results

The thematic analysis yielded the following themes, which will be defined in greater detail in the poster:

- Career preparation
- Innovating pedagogy to engage students
- Demonstrating the role of computing in society
- Inclusive to all students, regardless of background or opinion
- Education as a tool to foster independent thinking
- Community based civic education
- Misconceptions about critical perspectives
- Cautious about being perceived as biased

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