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Making Space for Critical Action: Re-visioning Computational Thinking

Preeti Raman, Toronto Metropolitan University, praman@torontomu.ca
Rubaina Khan, University of Toronto, rubaina.khan@mail.utoronto.ca
Meera Sharma, University of Toronto, mrinalini.sharma@mail.utoronto.ca
Renato Carvalho, University of Toronto, renato.carvalho@utoronto.ca
Chandan Dasgupta, University of Twente, c.dasgupta@utwente.nl
Aakriti Mahajan, University of Toronto, aakriti.mahajan@mail.utoronto.ca
James Slotta, University of Toronto, jim.slotta@utoronto.ca

Abstract: While school makerspaces promise to inspire and excite, the challenge of meaningfully integrating them into schools remains. Guided by a philosophy of praxis that stresses the need for education to interweave theory, action, and reflection to advance positive social change in our communities (Freire, 1970), this paper reports on the co-design of a school space called the Critical Action Learning Lab (CALL) for inclusive making to support computational thinking and critical action through curriculum-informed learning.

Introduction

Schools around the world are racing to invest in makerspaces as a way to support design thinking and 21st century competencies. However, they seldom promote the deep forms of learning envisioned by makerspace advocates (e.g., Halverson & Peppler, 2018), wherein students explore domain content while engaging in critical inquiry, collaboration, design and computation. In the developing South, schools are experiencing new forms of cultural imperialism as they attempt to emulate classic western designs, with an even poorer fit to their curriculum and cultures. The challenge remains, to democratize makerspaces and enable a generation of maker curricula by schools (Blikstein, 2018). One approach that has gathered attention is that of critical making, in which students are given voice and classrooms are democratized through empowering forms of design, storytelling and fabrication. Such activities can support students' development of identity, and serve as magnets into STEM and related disciplines for marginalized students.

This paper reports on our design of a Critical Action Learning Lab (CALL) for schools in Bengalaru, India, working in close collaboration with teachers and school leaders to create critical making lessons that fit within the school culture and curriculum. These lessons, in turn, help determine the form and function of an inclusive space in which students participate in making, unmaking, remaking and reimagining in various forms and materials – including historic and culturally relevant means – focusing on what is important to them. This paper will present the design process for the CALL space, curriculum, and teacher community, with a particular focus on the intersection of computational thinking with critical action curriculum design using the Critical Action Learning Exchange (CALE) framework(Carvalho et al., 2021).We adopt a critical framing of Computational Thinking, where learning occurs at the intersection of emerging understandings of how realities are shaped and what strategies/actions are needed to amplify the voices of the marginalized and oppressed (Kafai & Proctor, 2021). Engaging in design-based participatory research, we explored various affordances and functions of a Critical Action Learning Lab (CALL) for middle and high school students, focussing our inquiry on the following research questions: How can we design a culturally relevant making space for critical action learning? In what ways does computational thinking intersect with critical pedagogy and action regarding global issues within a local cultural context?

Background and theoretical framework

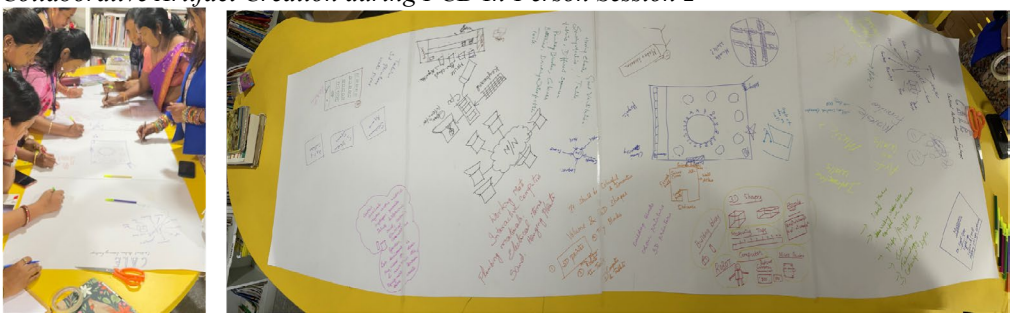
Computational Thinking (CT) is often understood as a particular form of problem solving and reasoning in which the learner addresses open-ended problems to formulate the problem in such a way that its solutions can be represented as algorithms that can be worked through by Computer Scientists (Slotta et al., 2020). CT develops competencies that will serve students in learning across disciplines and throughout their lives. For this project, we envisage that our teachers engage in computational thinking in pursuit of critical action. In our context, opportunities for such engagement are created while the teachers focus on collectively designing a school makerspace that is sensitive to the available school resources. The primary purpose of such a space was affording critical action through making.

Methods

Data for this paper includes pictures and drawings of the visualized space, audio and video transcription of the sessions, design artifacts created during the online and in-person sessions including curricula, and field notes. We engaged in both online and in-person PCD sessions with the teachers (Figure 1) to understand existing practices and spaces for learning within the teachers' cultural context. Following a few online sessions on Zoom, three researchers from our team visited the school to engage in four in-person co-design sessions over four days with educators.

Figure

Collaborative Artifact Creation during PCD In-Person Session 2



Initial analysis and findings

Our reflexive thematic analysis of data from audio and video recordings from the workshops involved pattern recognition within the data and the identification of themes through "careful listening/watching and re-listening of the data (Guest et al., 2021). We developed an apriori codebook based on research questions. The codes that are the focus of the first iteration are: "experiences that shape learning", "criticality in curriculum", "CT skills" and "recommendations for makerspaces". In subsequent iterations of coding, we allowed for additional codes to emerge. These include: "21st century competencies," "knowledge and skills" "culture and inclusivity" "STEM pathways" and "experiences in the space". Initial analysis suggests an alignment of certain CT processes with particular elements of critical action, which can help inform our understanding of how CT occurs within critical action learning.

Conclusion

In recent years, many learning scientists have called upon our community to re-vision school makerspaces: Blikstein (2018, 2020) calls for local generation of culturally-relevant maker curricula by schools; Kafai (2021) encourages us to find practices and possible trajectories of how students can deepen their CT skills. Through this work, we begin to tackle the complex challenge of designing a "making" space for critical action, aiming to empower students and teachers to engage in meaningful making and transformative action to drive positive change in their communities.

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