Board 233: Creating the Capacity for CS Education Researchers to Produce Research That is High-quality and Equity-Focused

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Abstract

With respect to previous studies and the state of the quality of K-12 computing education research, there remains room to improve the quality and quantity of research being conducted as well as the identification of research gaps focused on ensuring all children's learning needs are considered. To mitigate this, our project was designed to answer three research questions: How comprehensive is K-12 CER when examined with a specific lens on how it explicitly addresses broadening participation in computing or equity goals? What are the barriers that prevent K-12 computing education researchers from conducting research across the four components of CAPE? How effective are new resources, materials and workshops specifically created to address the gaps in and barriers to producing high-quality, equity-focused K-12 CER?

Over the last two years, our project has been engaged in answering these research questions through 1) framing prior research against the CAPE framework to identify gaps in research, and identify barriers researchers face when conducting high-quality research in equitable K-12 computing education; 2) using resulting data as well as input from experts in the field and other standards bodies, develop recommendations and resources for expanding coverage of equitable K-12 computing education research using the CAPE framework; and 3) using recommendations and resources to design and pilot workshops for training researchers in equitable K-12 CER methods and practices. This poster describes some of the recommendations and resources we have created for expanding coverage of equitable K-12 computing education research.

1 Introduction

The United Nations champions ”inclusive and equitable quality education” for each student [1, p. 1]. As National Research Council emphasizes, equity is crucial to improving the ”...goals, structures, and practices that support learning and educational attainment for all students” (p. 277). This principle guides computing education policies, standards, curriculum, and teaching methods, driving initiatives like ”Computer Science for All” [3].

Equity-enabling education research is research that supports the needs for achieving equity in education, including providing

> ...the evidence needed for decision-makers and educators to advocate, support, and deliver computing education in K-12 classrooms that lead to equitable access, participation, and experiences (and therefore outcomes) among all students. Equity-enabling education research, by its very nature and necessity, must meet quality standards to provide meaningful evidence for particular contexts for which studies have been conducted [4].

Frameworks that center methodologically sound, equity-enabling research include funds of knowledge, asset-based approaches, intersectionality, and the CAPE framework González et al., Fletcher and Warner, Pearson et al..

Engineering culture often suffers from non-inclusivity, fueled by stereotypical views of engineers themselves, as Verdin et al. highlight. Similarly, in computing research, embedded assumptions about students' knowledge and backgrounds can prevent researchers from situating students' diverse lived experiences [9]. Recognizing and leveraging the unique knowledge each individual brings fosters a more inclusive research approach [2, 8].

Building on prior research, we recognized a need to strengthen K-12 computing education research (CER) and to ensure that the research holistically is reflective of the students we collectively teach. This includes increasing the volume and quality of studies, and pinpointing research gaps that ensure all students' learning needs are met. To address these issues, our National Science Foundation (NSF) project investigates three key questions:

> RQ1: How comprehensive is K-12 CER when examined with a specific lens on how it explicitly addresses broadening participation in computing or equity goals?
>
> RQ2: What are the barriers that prevent K-12 computing education researchers from conducting research across the four components of CAPE?
>
> RQ3: How effective are new resources, materials, and workshops specifically created to address the gaps in and barriers to producing high quality, equity-focused K-12 CER?

Over the last two years, our project has been engaged in answering these research questions through 1) framing prior research against the CAPE framework to identify gaps in research, and identify barriers researchers face when conducting high-quality research in equitable K-12 computing education; 2) using resulting data as well as input from experts in the field and other standards bodies, develop recommendations and resources for expanding coverage of equitable K-12 computing education research using the CAPE framework; and 3) using recommendations

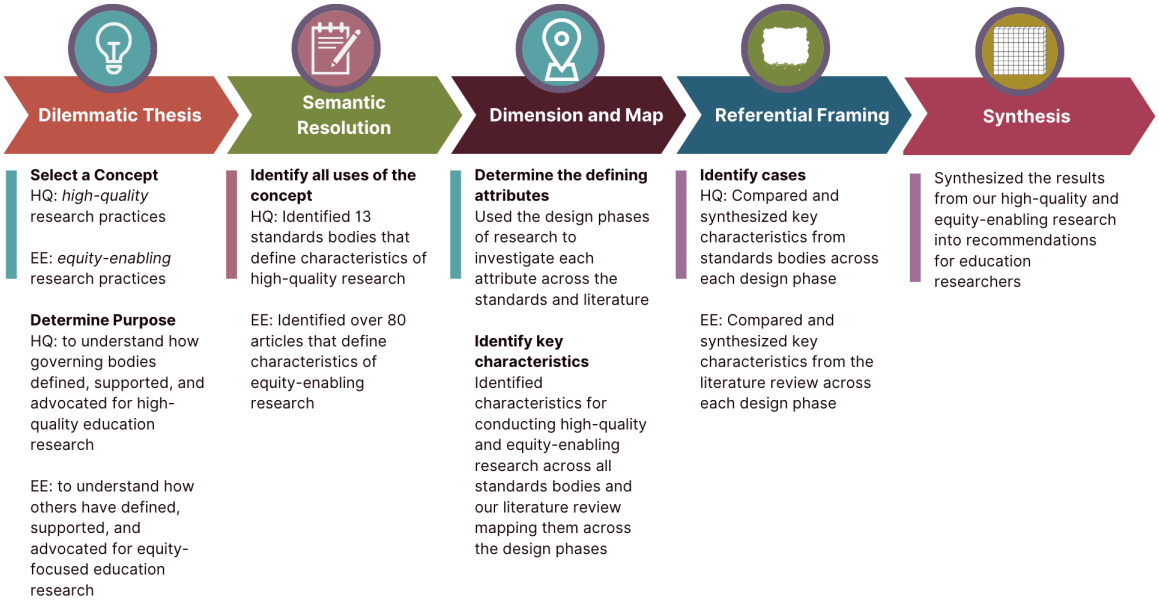

Figure 1: Using Petrina [10] and Walker et al. [11] to develop a process for this analysis.

and resources to design and pilot workshops for training researchers in equitable K-12 CER methods and practices. This poster describes some of the recommendations and resources we have created for expanding coverage of equitable K-12 computing education research.

2 Process

For this particular part of our project, we sought to define methodologically sound research that is also equity-enabling, then created a series of workshops to train other education researchers. Leveraging the ACM ITiCSE Working Group as a way to engage a wider range of researchers than our team would provide, our working group conducted a conceptual analysis of various research standards and practices.[1] Our working group goal was to gain a comprehensive understanding of how to conduct methodologically rigorous and equity-focused research, particularly in the context of the computing education research community. We combined the theoretical strengths of Petrina with the practical guidance of Walker et al. to perform a the analysis [10, 11]. Our framework involved exploring key elements like the dilemmatic thesis, semantic resolution, dimensioning and mapping, referential framing, and representational provision. Each element is visualized in Figure 1.

Upon completion of the Working Group Report [4], our NSF research team (the authors of this paper) conducted a series of workshops at academic conferences (2024 ACM SIGCSE Technical Symposium, 2024 NARST, and 2024 ASEE) and created a series of guidelines as a resource available online.

[1]Members of the working group included Monica McGill, IACE; Sarah Heckman, NCSU; Christos Chytas, Utrecht University; Michael Liut, University of Toronto; Vera Kazakova, Knox College; Ismaila Temitayo Sanusi, University of Eastern Finland; Selina Marianna Shah, Amrita Vishwa Vidyapeetham; and Claudia Szabo, University of Adelaide.

Identifying a Critical Framework

- ☐ Adopt a critical framework, i.e. critically and equitably contextualise the research
- ☐ Employ diversity dimensions that most equitably serve the research and the affected communities
  - ☐ Delineate asset-based diversity dimensions (e.g. race, ethnicity, gender, disability)
  - ☐ Consider discretising commonly used categories and metrics into smaller, more inclusive, and more descriptive categorisations and evaluations.
  - ☐ Identify similarities and differences within and across the studied/impacted groups.
  - ☐ Identify intersectionality and any complexities inherent to the overlapping contexts of the participants and their data.
- ☐ Identify and honour funds of knowledge from who has expertise in this context (area, community, socio-political climate, etc.), considering:
  - ☐ what is considered knowledge in this context?
  - ☐ what are the assets of the participants and their communities?
  - ☐ what are the equity-focused needs and the desired outcomes?
- ☐ Identify and use equity-centering metrics, tools, and procedures

Figure 2: Guidelines: Identifying a Critical Framework

3 Guidelines Summary

The working group defined ten major area which we explored: Engaging in Researcher Reflexivity, Adhering to Research Ethics, Framing the Research Problem and Questions, Identifying a Critical Framework, Conducting the Literature Review, Choosing Research Methods, Engaging with Participants, Crafting Instrumentation and Collecting Data, Analyzing and Interpreting Data, and Reporting on Research.

After analyzing 12 standards bodies from seven countries and several dozen research articles [12–23], the working group created guidelines for each of the major areas. For example, Figure 2 shows the resultant critical framework guidelines resulting from the analysis.

4 Reflection

Through our analysis, the working group merged valuable standards offering insights, guidance, and concrete examples for conducting education research. These standards address diverse aspects that can influence perceptions of methodological soundness and equity within research groups and communities, depending on their familiarity with specific standards. For instance, communities primarily familiar with the What Works Clearinghouse (WWC) standards might lack a nuanced understanding of ethical considerations in research [23]. Our working group aims to bridge this gap by providing comprehensive guidelines drawing upon best practices from various standards. This approach empowers researchers across diverse contexts to select the most relevant standards for their specific needs.

Unfortunately, our analysis revealed a consistent gap in how ethics are addressed across most standards. While some might implicitly allude to ethical considerations, even widely used standards in education, like [23], [20], and [21], offer minimal emphasis on the explicit implications of ethics for research practice. This is problematic and also highlights the importance of having a set of guidelines that combine traditionally elevated standards with research methods that enable equity.

5 Sharing Our Findings: Workshops and Online Resources

Our new guidelines are not limited to computing education, and in fact, can be leveraged across education research in general. We (members of the project team) have developed and held three workshops, engaging over 60 education researchers on how conduct computing education research that is needed to meet the needs of all learners. We have also created a set of online, publicly-available resources that are now available and can be shared widely, providing a solid resource that can be used now and in the future.

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