Supporting Teacher Understanding of Computational Thinking as a Problem- Solving Strategy in Early Elementary Education

Paper presented as part of the panel, "Strategies for Broadening Teachers' Views of Early-grade Learners' Competencies Through Computational Thinking. Presented at the annual meeting of the American Educational Research Association, April 2024, Philadelphia, PA

Heather Sherwood, Education Development Center, Inc.; Julie Keane, Participate; Anthony Negron and Katie McMillan Culp, New York Hall of Science

Objectives

This paper describes findings from a collaborative research and development process that engaged researchers, professional development (PD) providers, and early elementary teachers (K–2) to design a scalable, hybrid PD experience to engage teachers in a process of learning about and supporting their students' emergent use of computational thinking (CT) strategies.

Theoretical Framework

Supporting CT skills among young learners who are marginalized can promote their ability to shape their own educational pathways and future related careers. However, research on early grade CT suggests that PD experiences that help teachers learn CT principles often do not fully prepare them to recognize, interpret, and respond to evidence of that type of thinking in their students' work (Rich, Yadav & Schwartz 2019). Prior program evaluations have shown that elementary grade teachers who have had initial PD and coaching in CT typically recognize the importance CT for their students, yet do not feel that they know how to identify CT in their students' talk or work, especially in ways that allow them to evaluate their students' learning and adapt their instruction appropriately (Grover et al, 2019; Sherwood, 2020).

Methods

This project's PD cycle engaged teachers through instructional coaching, both face-to-face and through an online community of practice. The research used a mixed-methods design to examine changes in teachers' perceptions of their students as problem-solvers, and their uses of specific instructional strategies to probe students' use of CT strategies. The project research questions were: (1) What kinds of PD and guidance do teachers need to develop the capacity to identify and support emergent computational thinking in young students' language and work process? and (2) What kinds of PD and guidance do teachers need to identify emergent computational thinking development in young students' work products?

Data Sources

We collected data from 20 teachers across six urban elementary schools that serve high proportions of students historically underrepresented in computer science (CS), including multilingual and inclusion classrooms. Our primary data sources included classroom observations, teacher interviews, focus groups, and teacher pre- and post-surveys.

Results

Data analysis showed an increase in teachers' knowledge of, and confidence in their ability to engage young learners in, equitable CT-focused lessons. Teachers identified live-action modeling of CT-focused instruction by the professional development providers during face-to-face instructional coaching as a highly effective strategy to prepare them to integrate CT into their own

lessons. Teachers also expressed that they found value in being a part of the online Community of Practice, because it allowed them to share ideas and learn from other teachers. However, teachers expressed in interviews that they did not regularly engage with others in the online platform. Teachers stated that their primary goals for using the platform were to refresh their memory of CT concepts presented in the Summer PD and to look at other teachers' lesson plans for ideas. Teachers reported that they would visit the platform when there was a specific purpose (such as sharing their lesson) or when they were prompted to by reminder emails from the PD team. In teacher post-surveys, more than half of teachers reported incorporating CT into their lessons at a greater frequency after participating in the PD cycle. Additionally, teachers expressed

that having a more significant focus on teaching students the process of using CT concepts and less emphasis on teaching CT vocabulary amplified their interpretation of students' capabilities to use CT as a problem-solving strategy. Interview data shows that teachers were able to identify CT strategies applied by listening to students' descriptions of their problem-solving processes through informal, formative assessment practices, which included observing students, listening to peer discussions, listening to student responses during whole-group share-outs, and asking students direct questions during work periods. In interviews, teachers explained that they would look for evidence of students using CT practices, such as breaking problems down, by looking at the process of problem-solving students were engaging in, rather than listening for CT academic vocabulary. Teachers' rationale for focusing on CT process rather than CT vocabulary was that it is challenging to focus on CT vocabulary with young learners, especially those that are Emergent Bilingual or English Language Learners, as they often have limited understanding of English and CT vocabulary can be too advanced or complicated for them.

Scientific or Scholarly Significance of the Study or Work

The project's research findings will add to the literature on CT in the early grades, and on teachers' trajectories of growth as they build their understanding of how their students explore and develop mastery of CT. The products of this study will identify the artifacts, facilitation approaches, and modes of interaction that effectively prepare K–2 teachers to learn about their students' emergent use of CT strategies.

References

Grover, S., Jackiw, N., & Lundh, P. (2019). Concepts before coding: Non- programming interactives to advance learning of introductory programming concepts in middle school. *Computer Science Education*, *29*(2-3), 106-135.

Rich, K .M., Yadav, A., & Schwarz, C. V. (2019). Computational thinking, mathematics, and science: Elementary teachers' perspectives on integration. *Journal of Technology and Teacher Education, 27*(2), 165–205. https://www.learntechlib.org/primary/p/207487/.

Sherwood, H. (2020). CSforALL community call: Integrating computational thinking across the elementary curriculum. Presentation to CSforAll.org Community Call, April 22, 2020.