Supporting Teacher Understanding of Computational Thinking Integration into Early Elementary Curricula

Heather Sherwood†
Education Development Center
HSherwood@edc.org

Alice Kaiser
Education Development Center
AKaiser@edc.org

Camille Ferguson
Education Development Center
CFerguson@edc.org

Anthony Negron
New York Hall of Science
anegron@nysci.org

Ray Ferrer
New York Hall of Science
rferrer@nysci.org

Don Labonte
Participate
don.labonte@participate.com

ABSTRACT

The recent emphasis on computational thinking (CT) integration across disciplines in elementary education nationwide is important to ensure that students are well-equipped to meet the demands of the data-driven workforce. However, this requirement poses major challenges to early elementary teachers who are faced with little direction in terms of how best to implement and assess their young student's application of these new practices.

This project engaged researchers, professional development (PD) providers, and K-2 teachers to develop and design a hybrid PD experience to support teachers in a process of learning about and identifying the use of CT skills and strategies in their students' work. The hybrid PD approach utilized a combination of instructional coaching, both face-to-face and through an online Community of Practice. Researchers used a mixed-methods design to measure teachers' change over time in their understanding of how to identify emergent computational thinking in their students' work process. Data collection methods included teacher focus groups and interviews, classroom observations, and teacher pre- and post-surveys.

Preliminary findings showed an increase in teachers' understanding of CT and confidence in engaging their students in CT-integrated lessons. Teachers reported that the combination of in-person PD and online Community of Practice helped them prepare to bring CT into their classroom and cited placing more of a distinct focus on teaching students the process of CT rather than just using CT vocabulary. Teachers also referenced success in evaluating their students' application of CT skills and concepts by using informal and formative assessment strategies that focus on evidence of student understanding rather than assessing CT vocabulary.

SIGCSE 2024, March 20–23, 2024, Portland, OR, USA

ACM ISBN 979-8-4007-0424-6/24/03.
https://doi.org/10.1145/3626253.3635540

ACM Reference format:
Heather Sherwood, Alice Kaiser, Camille Ferguson, Anthony Negron, Ray Ferrer, and Don Labonte. 2024. Supporting Teacher Understanding of Computational Thinking Integration into Early Elementary Curricula. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 2 (SIGSCE 2024), March 20-23, 2024, Portland, OR, USA.* ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3626253.3635540

1 INTRODUCTION

Computational thinking is new to grade K-2 classrooms, having only become a priority following the establishment of the national CS for All initiative in 2016 [1]. Since 2016, a range of new curricula, instructional tools and assessments have been developed to support this new emphasis on both computer science and CT, some of them specifically for early elementary grade teachers and students.

To address the need above, this project sought to produce and investigate a set of sustainable, scalable structures and resources to support high-quality teacher learning about how to recognize, interpret and support students' use of computational thinking to define and solve problems across multiple subject areas for early elementary learners.

2 RELATED WORK

This research builds in part on an inference that early grade computational thinking instruction is similar to early grade mathematics instruction in important ways, and that computational thinking PD should accordingly draw from exemplary models of ambitious early grade mathematics PD. Grade K-2 learners can use distinctive approaches to defining and modeling problems. Rehearsal of these varied approaches to problem-solving during the early grades lays the conceptual and practical groundwork for further disciplinary study in the later grades [2]. While research on early grade CT is not yet wide-ranging, it does suggest that K-2 teachers are facing challenges as they learn the principles of CT but are often not fully prepared to recognize, interpret, and respond to evidence of that type of thinking in their students' work [3; 4].

3 PROJECT DESIGN

This project engaged researchers, professional development providers, and early elementary teachers (K–2) in a collaborative

research and development process to design a scalable professional development (PD) experience for early elementary teachers. Teachers' learning was supported through instructional coaching, both face-to-face during a Summer Bootcamp and through an online community of practice platform. Providers made instructional resources available via this platform, which allowed teachers to extend their learning beyond the in-person PD.

The research questions that guided this work included: 1. What kind of PD and guidance do teachers need to identify and support emergent computational thinking development in young students' language and work process? and 2. What kind of PD and guidance do teachers need to identify emergent computational thinking development in young students' work products?

3.1 Methods

The research used a mixed-methods design to examine teachers' change over time in their understanding of how to identify emergent computational thinking in their students' work process. Researchers analyzed teacher interviews and focus groups, observations, and teacher pre- and post-surveys.

3.2 Participants

22 K-2nd grade teachers from seven New York City schools participated in the face-to-face Summer PD training and then engaged in the Community of Practice (CoP) using an online platform throughout the 2022-2023 school year. Nine teachers from three schools participated in additional research activities, including the teacher interviews and focus groups, teacher surveys, and classroom observations.

4 RESULTS

4.1 Supporting Teacher Understanding of CT Development

One goal of this project was to learn what kind of professional development and support teachers' need when learning how to engage early elementary learners in computational thinking. To understand this, the research team asked teachers to reflect on the different aspects of the professional development program they engaged in over the project period, including attending the in-person Summer PD, engaging in the CoP, self-directed use of the online platform and resources, and any additional outside resources they sought after to deepen their CT knowledge.

Preliminary data analysis of teacher surveys, interview and focus group data showed an increase in teachers' understanding of CT and confidence in engaging their students in CT-integrated lessons. Teachers described how the in-person PD helped them to focus on the process of using CT, instead of just teaching the vocabulary. In addition, teachers appreciated the hands-on nature of the Summer PD, which allowed for opportunities to watch the PD providers model lesson activities with children during work periods. Teachers emphasized how instrumental this live-action modeling proved to be in preparing to bring CT into their own classroom.

Teachers also stated that their primary goals for using the PD resources and CoP on the platform was to refresh their memory of CT concepts presented in the Summer PD and to look at other teachers' lesson plans for ideas. Additionally, teachers found value in being a part of the CoP and highlighted being able to share ideas with colleagues for feedback and maintain connections with colleagues outside of their school as two main benefits.

However, when asked about platform usage and their engagement in the CoP, teachers consistently stated that they did not visit the platform often, did not use resources on the platform in depth and did not use the platform for planning or communicating with teachers from their own school. They stated 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.

4.2 Supporting Teachers in Identify CT in Student Work Products

Another main goal of the project was to learn how teachers are identifying CT in young learners' work process. In order to evaluate student learning and specifically the CT strategies applied, teachers described using informal and formative assessment practices, such as observing students, listening to peer discussions, and asking students direct questions. When asked how teachers determined which strategies to employ when looking for evidence of students' application of CT in classwork, they cited drawing on activities and examples that they were modeled by PD providers during the Summer PD, drawing on their own Pedagogical Content Knowledge and prior experiences as a teacher.

Furthermore, teachers referenced looking for evidence of students using CT practices, such as breaking problems down, and by looking at the process of problem-solving students were engaging in, rather than listening for explicit CT vocabulary. Teachers added rationale to their decisions for focusing on the process instead of CT vocabulary by stating 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.

ACKNOWLEDGMENTS

This material is based upon work supported by the National Science Foundation under Grant No. 2101547. We are grateful to the district staff, school administrators, teachers, and students involved in this work, without whom this research would not be possible.

REFERENCES

[1] DeLyser, L. A., Wright, L., Wortel-London, S., & Bora, A. (2020). Evaluating a systems approach to district CS education implementation. In *Proceedings of the 51st ACM technical symposium on computer science education* (pp. 1120-1126).

[2] 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/.

[3] 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.

[4] Yan, W., Liu, R., Israel, M., Sherwood, H., Fancsali, C., & Pierce, M. (2020). School-wide integration of computational thinking into elementary schools: A cross-case study. In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education* (pp. 1325-1325).