



Using Computational Thinking to Demystify Computer Science for Elementary Teachers

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ABSTRACT

The computer science education research community has thought deeply about how students learn computational thinking (CT) as it relates to other domains of computer science (CS; e.g. programming) and core content areas (STEM, humanities), but less work has examined the role of CT in pathways to computer science for K-5 teachers. This panel examines the experiences of practitioners – educators, administrators, and curriculum designers—who have both experienced and supported others in incorporating CT in elementary school settings as a pathway to or component of computer science education. All panelists have worked with teachers not previously trained to teach CS and have encountered the many opportunities and difficulties of bringing CS to in-service teachers. They will reflect on the multiple ways educators grapple with CT: as an entry point to computer science, as a way to enrich core disciplines, and as a way to support equitable practice – for example, several of the panelists have experiences leveraging CT and other domains of CS to support the expression and development of emergent bilingual students. The panel will explore ways in which CT and its associated language and strategies for problem solving may provide a particularly helpful onramp to CS generally, including integration with other disciplines and with language about academic skills more generally.

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1 SUMMARY

Goals of the panel The panel will compare and contrast three efforts to using CT as a strategy to help normalize computing education:

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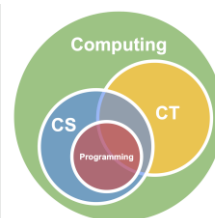
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- Help frame for the research community how teacher development in computing is approached at the elementary education level
- Provide multiple practitioner perspectives including curriculum developer, teacher, and the often overlooked role of principal
- Provide insight from multiple perspectives about the value and affordances of including CT in an elementary school education
- Share reflections from the field from three different geographical, demographic, and socioeconomic contexts in which CT and CS are being implemented
- Examine computing integration in multiple subjects, including English Language Arts, Math, Science, and for emerging bilingual students

Intended Audience K-12 CS education researchers, curriculum developers, educators, coaches, educational administrators, policymakers, funders

Relevance to the SIGCSE community This panel will present perspectives from the field about the role of CT in pathways to computer science for teachers, especially in settings focused on multilingual learners and other groups historically excluded from computing. We will examine the role of CT in making computing more accessible, and in creating a computing ‘through line’ via its integration into other disciplines for these students and their teachers. Panelists will present a discussion of how CT has made CS more accessible for elementary teachers.



The definitions of CT vary [1], though many refer to the definition first advanced by Cuny, Snyder, and Wing [2]. CT overlaps the discipline of CS, which includes “[t]he study of computers and algorithmic processes, including their principles, their hardware and software designs, their [implementation], and their impact on society” [3]. The diagram shown depicts CT as a subset of the general practices of computing and as a component of both CS and programming, but highlights how CT encompasses practices that lie outside of CS [4]. The CS education research community grapples with the pros and cons of CT in the elementary school setting. Some challenge

the universal value of teaching CT [5]. However, CT, when offered as a component of computer science education, can create equitable access to computing literacies [6,7]. While students from more economically vulnerable communities may be exposed to coding, they are rarely offered the context of CT as part of computational problem solving [8].

2 PANEL STRUCTURE

Panelists will present their work independently, then begin an interactive discussion with the audience and one another.

- Panelists will introduce themselves and briefly describe their projects. They will each share their working definition for CT, the pedagogical underpinnings of its inclusion in their work, the affordances and challenges they faced, and any outcomes or findings.
- Panelists will be asked to comment on their perceptions of the role of CT in teacher preparation and student learning, of CS as well as core subjects.
- Panelists will be asked to comment on the role of CT in creating a sense of belonging for marginalized students, including students with disabilities.
- The moderator will check with the audience to surface any participants' experiences in implementing or researching the role of CT in K-12 classrooms and observations they can share, and pose any questions for the panelists.
- After this interactive discussion, panelists will pose questions for one another and audience members.

3 POSITIONS STATEMENTS

Moderator: Diane Levitt (Sr. Director of K-12 Education, Cornell Tech) is the PI for the NSF-funded grant CTCS: Integrating Computational Thinking into ELA and Math, Building an Onramp to Computer Science in Grades K-5

Position Statement: The cognitive and capacity overload of teachers, and their understandable resistance to a new discipline as well as a new set of teaching responsibilities, is a major barrier to the wholesale adoption of CS in elementary schools. Introducing computing in a progression that begins with CT, concepts that can tie to existing practice and their core values, and then follows with programming and impacts of computing, is proving to be a successful strategy for our public school partners.

Panelist 1: Dylana Garfus-Knowles, SOCS for All (Oregon) is an English Language Learning teacher in the Pacific Northwest. She is currently a lead teacher and coach for the NSF grant-funded project SOCS for All 2.0. In this project she is training teachers about CT and how to integrate CT concepts into their lessons and teaching strategies.

Position Statement: As a lead teacher/coach for integrating CT across subject areas in elementary education, I believe learning CT concepts is key to problem solving and creating a space for the foundation of CS. Providing access to this teaching/learning for all students (especially for Black, Latinx, Native American, Pacific Islander, and female peoples) is ultimately the way to open doors to CS for our students and provide more opportunity for diversity in the field of CS in the future.

Panelist 2: Wyman Khuu (Sr. Director of Science, Technology & Engineering, KIPP NYC) is an instructional leader and STEM curriculum designer for a large urban charter school network that includes 8 elementary schools and 9 middle schools serving over 7,000 students where they have been integrating CT into interdisciplinary classes across their schools.

Position Statement: At KIPP NYC, we believe that all students must create, innovate, and wonder every day in order to become future problem solvers. I believe that there is a great opportunity to leverage CT instruction in elementary school to expand who ultimately has access and agency in leveraging technology to solve the problems of today and the future. With intentional integration of CT into interdisciplinary subjects through authentic learning experiences, we can create the next generation of diverse learners and problem solvers.

Panelist 3: Sara Siddappa (PS 89, Brooklyn) is the assistant principal of a dual language immersion program serving Spanish-speaking migrant children in Brooklyn.

Position Statement: As the instructional leader in an elementary school serving an emerging bilingual population, we place a high priority on explicit language instruction for our students. Our school is focused on providing students with the skills and knowledge that will mitigate some of the racism and anti-immigrant bias they face outside their school, neighborhood, and homes. We have seen the power of student engagement in CT and CS, and the excitement our teachers feel when they bring this powerful discipline into their classrooms. We believe the language of computational thinking helps build a context for computing that goes beyond programming, and we are working to bring it into every discipline, in both English and Spanish.

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