# EPK-2: Exploring Early Childhood Teachers' Abilities to Identify Computational Thinking Precursors to Strengthen Computer Science in Classrooms

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EPK-2 developed a yearlong professional learning program to facilitate PreK-2 teachers' understanding and implementation of CT learning practices in early elementary classrooms.

### Participants

25 PK-2nd grade teachers comprised of classroom teachers, specialists, and administrators; Teaching experience ranged from 1 to 31 years. CT experience ranged from 0 to 3 years.

### District partner

Public school system in Central Texas; 78% non-white; 70% economically disadvantaged; 10% ELL.

### Theoretical perspectives

Generative Learning (Ball, 2009, 2020).
Generative Professional Development (GPD) (Assaf et al., 2016).
Material Inquiry (Cabral & Justice, 2019).

### Methodology

Ethnographic; Mixed Methods.

### Structure

3 Phases with 2 cohorts of teacher participants.
Yearlong GPD: Summer Institute and yearlong support (meet ups, coaching, and conference).

### Data Collection

- Interviews with video recall at 3 time points.
- Observational videos and photographs.
- Participant-produced reflective artifacts.
- Lickert-style survey on CT dispositions at 3 time points.

### Data Analysis

Mixed methods: Descriptive and analytical statistics, and constant comparative analysis.

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## RESEARCH QUESTIONS

**1: What do teachers learn while participating in a year long Professional Development program focused on CT?**

**2: In what ways do teachers implement CT in their classrooms while participating in the program?**

**3: What mediated teachers' CT learning during the program?**

## GUIDING IDEAS & PROCESSES

### CT Frameworks

Concepts, Practices, & Perspectives (Brennan & Resnick, 2012)
Powerful Ideas & Design Process (Bers, 2021)

### What is Computational Thinking and why does it matter in early childhood classrooms?

CT is an emergent way of thinking catalyzed by programming computers to make artifacts that contribute to a learning community (Bers, 2021; Brennan & Resnick, 2012; Resnick, 2017).

CT is broadly relevant to human life today so learning pathways should be available across the entire K-12 spectrum, applicable across all content areas (Kafai & Proctor, 2022; Pinder, 2022).

### Computational Thinking explored as expressive and participatory.

The EPK-2 summer institute was designed as a Generative Professional Development (GPD) program focused on expressive STEM+CT experiences, framed by Material Inquiry pedagogy.

First, teachers learned to work with computational tools like ScratchJr. and KIBO alongside non-computational tools like circuits and recylced materials. Then, teachers designed and implemented CT learning activities in their classrooms.

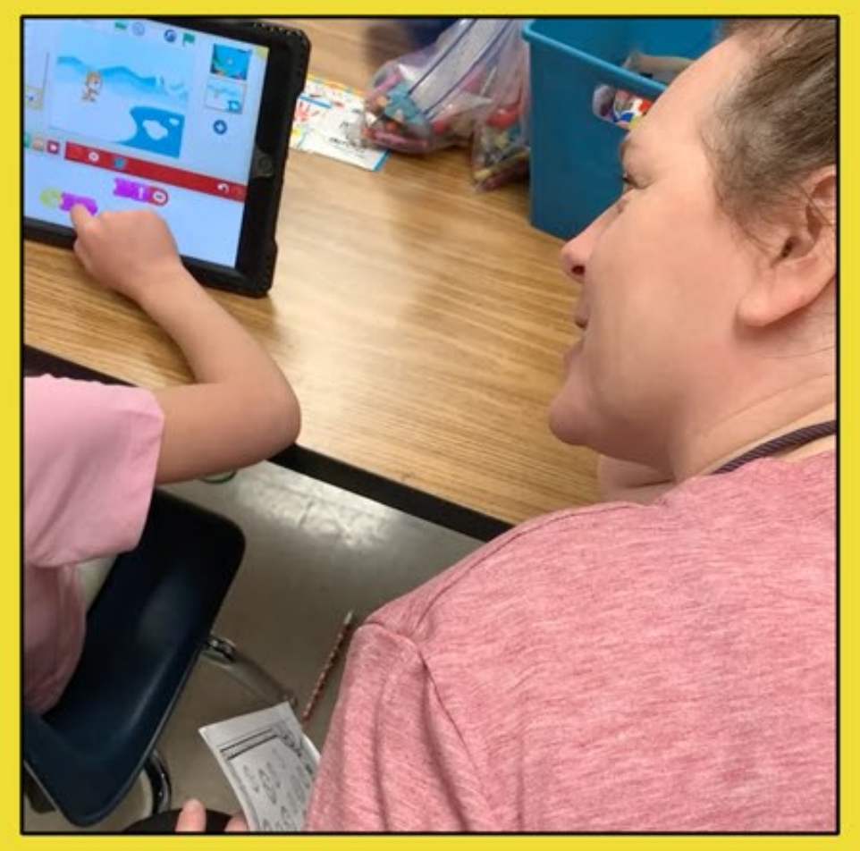
### Precursors of Computational Thinking

Precursors are non-computational thinking routines and practices that may become computational thinking with time, nurturing, and opportunities for exploring computational tools and materials.

The notion of precursors assumes that capacities for knowing and doing are rooted in social participation and therefore always already present in learners' lives.

For example, in the context of early childhood CT, teachers might learn to notice children's interests in pattern recognition or sequencing, among other participatory thinking routines, leading them to focus instruction on what needs to be in place (for themselves, their students, their classrooms and communities) for young learners to refine the social, cognitive, and affective tools needed to sustain and expand communities of *computational* participation.

## IMPLICATIONS & IMPACTS



Generative PD provided opportunities for sustained learning and implementation of CT. Teachers innovated, adapted, and problem solved based on their professional knowledge and knowledge gained from their students.

The focus on CT precursors positioned learning CT as an additive rather than as a deficit encounter with these unfamiliar computational tools and materials, inviting teachers to notice and name what students already know and do.

Teachers' knowledge of literacy and early childhod learning enabled them to identify and integrate CT in literacy and science based activities (Kotsopoulos et al., 2022; Love et al., 2021).

## What Teachers Learned

***About CT***

- •Teachers noticed and named CT concepts and practices in classrooms.
- •Teachers connected CT to curriculum in grade-appropriate ways, e.g., algorithm as sequence, debugging as revision, etc.
- •Teachers taught with diverse computational tools (Scratch, Scratch JR., Makey Makey, and KIBO).

***About Teaching & Learning***

- •Inquiry teaching became a driving force.
- •Teachers reconsidered their role as the CT expert in the classroom.
- •Teachers learned to support and inspire each other. They recognized their own tenacity for learning CT in a community of learners.

***Statistical Significance***

Teachers' CT beliefs and self-efficacy were measured with the TBaCCT (Rich et al., 2020) at 3 time points. Paired ttest means were significantly higher across all subscales, Coding, Teaching, Value, and CT, with good to excellent reliability and strong effect sizes.

## What Teachers Implemented

*Literacy*

- •Story responses based on read-alouds (ScratchJr.).
- •Phonics hide & seek sight words (ScratchJr.).
- •Storymaking retelling with recyled materials and code (Scratch, KIBO).
- •Teachers connected coding to print-based writing activites by asking students to make animations in addition to making pictures.

*Science*

- •Habitat descriptions of interdependence among organisms (ScratchJr.).
- •Lifecyle depictions of ladybugs & butterflies (Scratch).

## What Mediated Teachers' Learning

*Pedagogical Practices from the Summer Institute*

- •Noticing Routines: "What do you notice about my project?"
- •Community Expertise: Naming students as leaders and experts.

*Naming and Noticing CT Ideas & Perspectives*

"Bers' Powerful Ideas tethers gives me structure and purpose for how to think about what I'm introducing." (Pre-K teacher)

*Awareness of Student Learning*

Teachers learned from their students and shifted their instructional practices based on what their students were showing them about coding.

REFERENCES